Independent Third Party Assessment of Coca-Cola Facilities in India

Prepared for

The Meridian Institute
Colorado, USA

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The Energy and Resources Institute

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Steering Committee

Prof. Y K Alagh

Prof. Y K Alagh was a Member of Parliament, Rajya Sabha (India), from 1996-2000. He has been Minister of State (Independent Charge) for Power and Science and Technology, and earlier Planning and Programme Implementation, and Member, Planning Commission of India (in the rank of Minister of State). He is a Member of several national and international committees. Prof. Alagh holds a Doctoral Degree in Economics from the University of Pennsylvania and Master's Degree in the same subject from that University, and the University of Rajasthan. He has several books and over a hundred articles to his credit published both in India and abroad. He has been Chairman, Agricultural Prices Commission of India, Director, Sardar Patel Institute of Economics and Social Research, and Chairman of the Economics Group of Indian Institute of Management Calcutta.

Prof. K.J Nath

Prof. K J Nath was Director of the All India Institute of Hygiene and Public Health—a premier institute for public health issues based in Calcutta in India. Prof. Nath has worked for nearly 38 years in the field of environmental management and has carried out assignments for WHO, the World Bank, and UNICEF. He has completed a number of important research studies and project reports on solid waste management, sanitation, community water supply, wastewater and industrial effluent analysis and treatment, and resource recycling.

Dr A K Keshari

Dr Ashok K Keshari is an Associate Professor in the Civil Engineering Department of the Indian Institute of Technology, New Delhi. He was awarded the INAE Young Engineer Award 2000, at New Delhi. His areas of expertise include: groundwater flow and pollution modelling, remote sensing and GIS hydrology, optimization and FEM impact.

Mr Gourisankar Ghosh

Mr Ghosh was, till October 2006, the Executive Director of Water Supply and Sanitation Collaborative Council, Geneva. Prior to 2001, he was the Chief of Water Environment and Sanitation cluster in UNICEF, New York, for nearly a decade. He was the architect of the current UNICEF water policy. He was also the Chair of the UN ACC Sub-Committee on Water through 1998-2000 and developed the concept of the World Water Development Report. He was one of the two plenary speakers leading the theme of water and sanitation in the water session in the UN World Summit for Sustainable Development (WSSD) held in Johannesburg in August, 2002. A former member of the Indian Administrative Service, Mr Ghosh is a Geologist and Development Economist by academic training. He was also the Secretary, Health, as well as the Chairman of Gujarat Water Supply and Sewerage Board to

Government of Gujarat. He was the Founder Director of the Rajiv Gandhi National Drinking Water Mission, Government of India 1986-1991. Mr Ghosh is a Fellow of International Water Academy, Oslo; Indian Institute of Hydrology, Roorkee; Indian Earth Science Academy. He has several papers and a book to his credit. He was a recipient of the President of India Silver medal for meritorious service.

The roles of the Steering Committee were the following:

Finalizing the detailed scope of work Pending the primary survey and interviews for field data collection that would precede the meeting of the Steering Committee, following were some of the procedural issues that the Steering Committee focused on:

- Criteria for selecting the sample of facilities for detailed study
- Procedures on environmental monitoring and management
  - Effluents – treatment and disposal
  - Laboratory specifications
- Procedures on water monitoring and management
  - Raw water input quality
  - Process water input quality
  - Plant water balance
  - Laboratory specifications
- Procedures and methodology for examining community concerns
  - Community perception of groundwater drawdown in relation to extraction by the Coca-Cola facility
  - Other water resource management concerns – groundwater contamination by effluent
- Communication strategies
- Documentation and reporting systems

Periodic review of progress of assessment The Steering Committee periodically reviewed processes, work completed, and any trouble-shootings throughout the assessment process. The committee identified critical points and recommended possible solutions for refining the ongoing assessment. They finally endorsed the outcomes of the study including the recommendations. A total of four meetings of the Steering Committee were held.

Project team

The team would like to acknowledge the continuous guidance and support of Dr R K Pachauri, Director-General, TERI.

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List of symbols

Symbol	Definition
µ	Micron
Ag	Silver
Al	Aluminium
amsl	Above the mean sea level
As	Arsenic
Ba	Barium
BOD	Biochemical oxygen demand
BPM	Bottles per minute
Ca	Calcium
Cd	Cadmium
Cl	Chlorine
CN	Cyanide
COD	Chemical oxygen demand
CPM	Cans per minute
Cr	Chromium
Cu	Copper
cumecs	Cubic metres per second
DDD	Dichloro diphenyl dichloroethane
DDE	Dichloro diphenyl dichloroethylene
DDT	Dichloro diphenyl trichloroethane
E. Coli	Escherichia coli
F	Fluoride
Fe	Iron
ft	Feet
Ha	Hectare
HCH	Hexachlorocyclohexane
Hg	Mercury
HP	Horsepower
K	Potassium
kl	Kilolitres
kld	kilolitres per day
km	kilometres
LPM	Litres per minute
m amsl	Metres above the mean sea level
m bgl	metres below ground level
m3	Cubic metres
MCM	Million cubic metres
Mg	Magnesium
mm	Millimetres
Mn	Manganese
MPN	Most probable number
MT	Metric tonnes
MW	Megawatt
N	Nitrogen
Na	Sodium
NH_3	Ammonia
Ni	Nickle
NPK	Nitrogen, phosphorous, and potash
O & G	Oil and grease
ºC	Degree centigrade
P	Phosphorous

Pb	Lead
PPB	Parts per billion (equal to microgram per litre for water pollutants)
PPM	Parts per million (equal to milligram per litre for water pollutants)
Se	Selenium
TDS	Total dissolved solids
TKN	Total Kjeldahl nitrogen
TSS	Total suspended solids
V	Vanadium
Zn	Zinc

List of Abbreviations

Abbreviation	Definition
ACF	Activated carbon filters
AP	Andhra Pradesh
APHA	American Public Health Association
APPCB	Andhra Pradesh Pollution Control Board
APWALTA	Andhra Pradesh Water, Land and Trees Act
APWRDC	Andhra Pradesh Water Resources Development Corporation
AWLR	Automatic Water Level Recorder
BC	Backward Caste or Class
BDO	Block Development Officer
BIS	Bureau of Indian Standards
BIG	Bottling investment group
BW	Bore well
CAO	Chief agriculture officer
CBO	Community-based organization
CCI	Coca-Cola India
CEF	Community Engagement Framework
CGWA	Central Ground Water Authority
CGWB	Central Ground Water Board
CMA	Chennai Metropolitan Area
CMDA	Chennai Metropolitan Development Authority
COBO	Company-owned bottling operations
CPCB	Central Pollution Control Board
CSDs	Carbonated soft drinks
CSR	Corporate social responsibility
CtE	Consent to Establish
CtO	Consent to Operate
D1	Identifier used for defining location of village; defined as village located immediate downstream of the plant
D2	Identifier used for defining location of village; defined as village located extreme downstream of the plant (within 5 km radius around the plant)
DELC	Width of cells from top to bottom in MODFLOW
DELR	Width of cells from left to right in MODFLOW
DEM	Digital elevation map
ed.	Edition
EDD	Environmental due diligence
EIA	Environmental impact assessment

EMP	Environmental management plan
EOSH	Environmental and occupational safety and health
EPA	Environmental Protection Act
ETP	Effluent Treatment Plant
FAI	Fertilizer Association of India
FEZ	Free economic zone
FGDs	Focused group discussions
FOBO	Franchisee-owned bottling operation
GBSS	Gaon Bachao Sangharsh Samiti (a CBO in the study area)
GBSS	Gaon Bachao Sangharsh Samiti
GMS	Groundwater Modelling System
GMUS	Grameen Mahila Utthan Samiti
GT	Grand Trunk
GWD	Ground Water Department
HCCBPL	Hindustan Coca-Cola Beverages Private Limited
HRUs	Hydrologic Response Units
IBOUND	Identity of boundary condition in MODFLOW
ID	Irrigation department
IDR	Industries Development and Regulation
IMD	Indian Meteorological Department
IS	Indian Standard
ISO	International Organization for Standardization
KBPL	Kandhari Beverages Private Ltd
KMGSK	Krishak Mahila Griha Shilps Kendra (a CBO in the study area)
Ltd	Limited
LRQA	Llyod's Quality Register Quality Assurance
M1,2	Identifier used for defining location of village; defined as village located in the immediate vicinity of the plant
MKVDC	Maharashtra Krishna Valley Development Corporation
MODFLOW	MODular three-dimensional finite-difference ground-water FLOW model
MPCB	Maharashtra Pollution Control Board
MSWP	Maharashtra State Water Policy
MWRRAA	Maharashtra Water Resources Regulatory Authority Act
NABL	National Accreditation Board for Testing and Calibration Laboratories
NBSS & LUP	National Bureau of Soil Survey and Land Use Planning
NGO	Non-governmental organization
NOC	No objection certificate
NWP	National Water Policy
OHTs	Over-head tanks

PCB	Pollution Control Board
PET	Polyethylene terephthalate
PHE	Public Health and Engineering
PHED	Public Health and Engineering Department
PIL	Public Interest Litigation
PPCB	Punjab Pollution Control Board
PRA	Participatory rural appraisal
PRIA	Participatory Research in Asia
PSF	Pressure sand filters
PUDA	Punjab Urban Development Association
Pvt.	Private
PW	Process water
PWD	Public Works Department
RGBs	Refillable glass bottles
RIICO	Rajasthan State Industrial Development and Investment Corporation
RO	Reverse osmosis
RPCB	Rajasthan Pollution Control Board
RWS	Rural water supply
SC	Scheduled caste
SGWB	State Ground Water Board
SGWD	State Ground Water Department
SHGs	Self-help groups
SoI	Survey of India
SoW	Scope of work
SSI	Small-scale industry
SSSL	Sri Sarvaraya Sugars Ltd
ST	Scheduled tribe
STP	Sewage treatment plant
SW	Soft water
SWAT	Soil and water assessment tool
SWP	State Water Policy
TCCC	The Coca-Cola Company
TERI	The Energy and Resources Institute
TNPCB	Tamil Nadu Pollution Control Board
TPA	Third party assessment
TW	Tube Well
U1	Identifier used for defining location of village; defined as village located immediate upstream of the plant
U2	Identifier used for defining location of village; defined as village located extreme upstream of the plant (within 5 km radius around the plant)
UC	Utilization capacity

UFM	Ultrasonic flow monitor
UP	Uttar Pradesh
UPPCB	Uttar Pradesh Pollution Control Board
UPSWP	Uttar Pradesh State Water Policy
USEPA	United States Environment Protection Agency
UT	Union territory
UV	Ultraviolet
UWL	Unaccounted for water losses
WALTA	Water, Land and Trees Act
WHO	World Health Organization
WSSD	World Summit for Sustainable Development
WTP	Water treatment plant
WUAs	Water Users' Associations
WUR	Water utilization ratio

Glossary

Anganwadi
Anganwadi is a day-care center that takes care of children and provides better nutrition and education to pre-school children, free of cost. It is basically a nursery that prepares children to go to primary education centers.

Bajra
Bajra is a kind of millet.

Basti
Basti refers to a local neighborhood. In the context of this study it connotes the following: socially weaker sections (scheduled castes and scheduled tribes) live in separate settlement areas called bastis, located usually in the periphery of the village.

Bawi
Bawi is a local term used in Telugu language, which refers to an 'open/dug well'.

Bawdi
A bawdi is a local term used in Rajasthan state, which refers to traditional water harvesting structures.

Biswas
A biswa is a unit for measuring land; 80 biswas = 1 hectare.

Block
Administrative sub-divisions within a district in India.

CBO (community based organization)
CBO is made up of a group of local people who come together to accomplish a common goal or a set of goals. Organizations can range from profit-driven companies to non-profit organizations.

Cheruvu
Cheruvu is a Telugu word that means lake/pond. In the context of the study undertaken at the Sathupalle sub-watershed, it refers to an irrigation tank.

Dalit
Dalit is the latest and currently most politically correct of many terms used for the former 'untouchables' of India.

Dhanis
Dhanis are hamlets that lie in the midst of agricultural fields belonging to a village. The households in a dhani belong to the same caste.

District
A district is an administrative sub-division within a state in India.

Eri
Traditional water harvesting structures or surface-water tanks used mainly for irrigation purposes in the south of India.

FGD (focus group discussion)
A small group selected from a wider population, as by open discussion, for its members' opinions to a particular subject or area, used as a tool for data collection especially in social science research.

Gram panchayat
See panchayat

Guntha
Guntha is a local unit for measuring land; 40 gunthas = 1 acre.

Halka
Halka is a term used in the Hindi language, which means light.

Hapsaa
Hapsaa is a term used for handpumps locally near Pune.

Harijans
The term ‘harijans’ was coined by M K Gandhi, the Father of India, to refer to those people belonging to lower castes and who are considered as untouchables in the Indian caste system. Harijans, in literal sense, means ‘people of God’.

ISO standards
ISO (International Organization for Standardization) standards ISO is a NGO (non-governmental organization) that is the world's largest developer and publisher of International Standards. The ISO network comprises the national standards institutes of 157 countries, one member per country, with a Central Secretariat in Geneva, Switzerland, that coordinates the system. The member institutes of ISO are either a part of the governmental structure of their respective countries, or are mandated by their government, or have their roots in the private sector.

ISO 9001 quality standards
ISO 9001: 2000 provides a set of standardized requirements for a quality management system, regardless of what the user organization does, its size, or whether it is in the private, or public sector. While providing a systematic approach to managing an organization's processes so that its products satisfy customers' expectations, the ISO 9001 quality standards framework does not dictate how the standards should be met by any particular organization. An organization may choose to engage the services of an independent quality system certification body to obtain an ISO 9001:2000 certificate of conformity.

ISO 14001 environmental management standards
The set of ISO 14001 EMS (environmental management standards) provide a framework for an organization of any size or type to identify and control the environmental impact of its activities, products or services; to improve its environmental performance continually; and to implement a systematic approach to setting environmental objectives and targets, to achieving these and to demonstrating that they have been achieved. The ISO 14001 standards do not lay down levels of environmental performance and can to be implemented by a wide variety of organizations, whatever their current level of environmental maturity. However, a commitment to compliance with applicable environmental legislation and regulations is required, along with a commitment to continual improvement – for which the EMS provides the framework.

Jowar
Jowar is a kind of millet.

Kharif
Kharif is the first agricultural season of the year.

Kovil
Kovil refers to a temple in Tamil Nadu

Nagar panchayat
A nagar panchayat is the local self-government of a municipality area.

Nallah
Nallah refers to a stream, channel, ravine, a watercourse.

Neeti sangha
Neeti sangha means a WUA (water user association).

Open Caste
Open caste is a term that is used more commonly in the region to refer to general caste.

Panchayat or gram panchayat
Panchayats are the basic administrative unit of democracy in India. A gram panchayat is a body of elected representatives at the village level, the lowest rung of the three-tier local self-government system. Members of the gram panchayat are elected directly by the local community members for a term of five years.

PHED (Public Health and Engineering Department)
Public Health and Engineering Department is an independent department under the public health ministry of state governments and is mainly responsible for survey, investigation, preparation and execution of water supply schemes for towns and villages.

Pheeka
Pheeka is a term used in the Hindi language, which means tasteless.

Pradhan
Pradhan refers to the head of the panchayat samiti, the block-level local self-government.

Pulley patta
Pulley patta is a system of a chain of buckets slung round a vertical wheel, which is turned by a system of interlocking wheels normally powered manually or by oxen.

Rabi
Rabi is the second agricultural season of the year.

Revenue village
A revenue village is the smallest administrative unit, which has definite surveyed boundaries. The revenue village may comprise several hamlets but the entire village will be treated as one unit for presentation of the data.

Sarpanch
Sarpanch is the head of the gram panchayat.

Site
Study area, as defined in chapters 4A to 4F, within which the plant is located.

Stage of groundwater development
The stage of groundwater development is a ratio of annual ground water draft (use) and net annual ground water availability and is expressed in terms of percentage. Net annual ground water availability is estimated after deducting the natural discharge during non-monsoon months from the annual replenishable groundwater resource. The stage of ground water development has been categorized based on two criteria.
stage of ground water development, and
long-term (for a period of ten years) trend of pre and post monsoon water levels.

A 'significant long-term rate of water level decline' has been taken between 10 cm to 20 cm per year depending upon the local hydrogeological conditions. The criteria for categorization of Ground Water Development is

S.No	*Stage of Ground Water Development*	*Significant long-term decline*		*Categorization*
		Pre-monsoon	*Post-monsoon*	
1	≤ 70 percent	No	No	Safe
2	> 70 percent and ≤ 90 percent	No	No	Safe
		Yes/No	No/Yes	Semi-critical
3	> 90 percent and ≤ 100 percent	Yes/No	No/Yes	Semi-critical
		Yes	Yes	Critical
4	> 100 percent	Yes/No	No/Yes	Over-exploited
		Yes	Yes	Over-exploited

Swadeshi
Swadeshi is a term that means 'indigenous'. During the Indian independence movement the term gained prominent use, when it was used specifically as a mark to show attachment to anything Indian and oppose what was western.

Swajaldhara
Swajaldhara is a community-led participatory programme, which aims to provide drinking water facilities in rural areas with minimum provision of 40 lpcd.

TCCC (The Coca-Cola Company) Guidelines
TCCC guidelines are formulated as suggestions for bottling operations; the appropriateness of their implementation is to be decided upon by the concerned bottling operator. TCCC notes that these provide an approach to contingency planning and continuous improvement towards enhanced efficiency levels.

TCCC Requirements
It is mandatory for all bottling operations across the world (COBOs [Company-Owned Bottling Operations] and FOBOs [Franchisee-Owned Bottling Operation]) to comply with TCCC requirements; these include compliance with locally relevant rules and regulations, as well as requirements established by TCCC.

Thanni
Thanni is a term used in the Tamil language, which means water.

Uppu
Uppu is a term used in the Tamil language, which means salty.

Vihir
An infiltration well is locally known as vihir near Pune.

Zaid
Zaid is the third agricultural season of the year.

Executive summary of the study on independent third party assessment of Coca-Cola facilities in India

Introduction

In late 2004, the University of Michigan, Michigan, USA, initiated an enquiry into Coca-Cola's water management practices in India. The University of Michigan and Coca-Cola agreed that an independent assessment would provide the information needed for the University to move ahead with its enquiry. In this context, Coca-Cola and the University of Michigan agreed that TERI, a New Delhi based international research organization, would conduct the assessment guided by an independent Steering Committee to reinforce quality control. It is in this context, during 2006-07, TERI conducted an independent assessment of TCCC's (The Coca-Cola Company) water resource management policies and practices in India.

The assessment was undertaken at two levels.

1. *Level 1: An assessment of regulations and policies related to water resources management* This included an assessment of government regulations as well as TCCC requirements, guidelines, management systems, and compliance mechanisms relating to water resources management and environmental protection.
2. *Level 2: An assessment of select Coca-Cola plants* This included regional (ex situ) and in-plant (in situ) water quality assessment; in-plant water audit; and key stakeholder discussions within a defined area to assess the relevant issues associated with water stewardship. The select Coca-Cola facilities included both company-owned and franchisee plants.

The Third Party Assessment Report is divided into five chapters. The first chapter provides background, scope of work, and the structure of the report. Chapter 2 discusses the approach and methodology followed in conducting the assessments. Chapter 3 reviews the regulatory and governance issues related to water resource management in the country, with a focus on industrial use of water. Chapter 4 (A to F) provides the details of the six plant-specific in situ (plant level) and ex situ (regional) assessments. Chapter 5 puts forth recommendations.

Parties involved and their roles

The University of Michigan acted as a catalyst for initiating the assessment, and participated in initial discussions with TCCC. The University played a key role in determining the scope of assessment. Three primary parties were involved in defining the scope of work of the assessment and establishing protocols to ensure TERI's independence: TERI, TCCC, and the Meridian Institute.

TCCC and Coca-Cola India

TCCC and CCI (Coca-Cola India) negotiated the original scope of work; provided TERI with documented information related to TCCC's and CCI's water resource management practices; and facilitated TERI's access to bottling facilities.

Meridian Institute

The Meridian Institute played the role of a neutral third-party organization to ensure independence to TERI by acting as a neutral convener and facilitator for the parties.

TERI

TERI participated in the preparation of the scope of work within agreed broad parameters; was required to constitute a Steering Committee comprising external experts to oversee the research design and provide strategic direction to the assessment process, conduct the assessment; and prepare the report. The names of the Steering Committee members are provided in Chapter 1 of the report.

Selection of plants

The plant-level assessment focused on the following six Coca-Cola plants (four COBO [company owned bottling operation] and two FOBO [franchisee owned bottling operation]) in India.

- HCCBPL (Hindustan Coca-Cola Beverages Pvt. Ltd), Kaladera, district Jaipur, Rajasthan (COBO)
- Kandhari Beverages, Nabipur, district Fatehgarh Sahib, Punjab (FOBO)
- Sri Sarvaraya Sugars, Sathupalle, district Khammam, Andhra Pradesh (FOBO)
- HCCBPL, Pirangut, district Pune, Maharashtra (COBO)
- HCCBPL, Nemam, district Thiruvellore, Tamil Nadu (COBO)
- HCCBPL, Mehndiganj, district Varanasi, Uttar Pradesh (COBO).

The plants were selected using a process that included ranking regional and plant-level water-related indicators as well as several other key factors to capture the maximum variability of conditions across the plants. The additional key considerations included the following.

- The agro-ecological region in which the plant is located
- At least two plants that are subjects of controversy
- At least one plant that meets its raw water requirements from surface water
- At least one plant that is located in areas where the intensity of pesticide usage is high
- At least one franchisee plant

The assessment team drew upon analyses of secondary data; combined ranking of in situ and ex situ indicators; and guidance from the Steering Committee to help select the six plants for site-specific analyses.

Level I: Regulatory, governance, and policy assessment

The Level 1 regulatory and governance assessment was designed to review the following.

- Corporate level assessment including assessment of TCCC policies, procedures, management systems, and compliance mechanisms relating to environmental protection and water resource management that guide all CCI operations.
- Effluent treatment management policies and adherence to regulations and TCCC requirements or norms.
- Water availability and quality parameters taken into consideration for siting of Coca-Cola facilities in India.
- Assessment of steps taken to ameliorate negative water resource impacts, if any, of Coca-Cola operations in India.

To address the above, the regulatory and governance assessment comprised the following.

- Review of government policies and regulatory requirements including assessment of the compliance of the bottling plants to government regulatory requirements.
- TCCC requirements and guidelines for water usage, and wastewater water disposal including assessment of the compliance of the bottling plants to TCCC requirements and guidelines.
- Assessment of steps taken to ameliorate negative water resource impacts, if any, of Coca-Cola operations in India.

To conduct this portion of the assessment, TERI requested relevant documents and information from various government departments, TCCC, and CCI; reviewed the documents and prepared compliance

checklists; conducted field visits to the six selected Coca-Cola plants and to relevant government agencies to assess the specific requirements and the associated response at these plants. Reports from the selected plants relating to environmental audits, siting, pump-tests, detailed self-assessments, environmental audits, and impact assessments were not shared with TERI for legal and confidential reasons.

Level 1: Findings and conclusions

A) Government policy and regulatory requirements

The latest NWP (National Water Policy) to regulate water use was formulated and adopted in 2002. The policy

- demarcates water allocation priorities in the planning and operation of the systems in the following order: drinking water, irrigation, hydropower, ecology, agro-industries and non-agro-industries, navigation, and other uses. All the study states except Maharashtra accord greater priority to agriculture use of water over industrial use,
- advocates that exploitation of groundwater resources should be so regulated as not to exceed the recharging possibilities and development of efficient water pricing system for use of water.

In addition, there are two specific laws to regulate water use applicable to states under Indian Union. These are the Water (Prevention and Control of Pollution) Act, 1974 and Rules thereunder as amended in 1998 (referred to as Water Act hereafter) and the Water (Prevention and Control of Pollution) Cess Act, 1977 and Rules there under as amended in 1992 and 2003 (referred to as Water Cess Act hereafter).

The Water Act requires industries to obtain CtE (Consent to Establish) and CtO (Consent to Operate). Under the two consents, the conditions and limits are prescribed for pollution control and wastewater discharge both in terms of quantity and quality by the state pollution control boards. The compliance of six selected plants of TCCC with respect to conditions prescribed in CtE and CtO is provided in Table 1.

Table 1 Compliance with conditions in CtE (Consent to Establish) and CtO (Consent to Operate)

Issues covered in CtE and CtO	*Nabipur (franchisee)*		*Kaladera*		*Mehndiganj*		*Pirangut*		*Sathupalle (franchisee)*		*Nemam*	
	Mentioned in consent	*Compliance*	*Mentioned in consent*	*Compliance*	*Mentioned in consent*	*Compliance*	*Mentioned in consent*	*Compliance*	*Mentioned in consent*	*Compliance*	*Mentioned in consent*	*Compliance*
Limits for discharge of wastewater	√	√	√	√	√	√	√	√	√	√	√	√
Limits for water withdrawal	NA	NA	NA	NA	NA	NA	NA	NA	√	√	NA	NA
Mode of discharge of wastewater	√	√	√	√	√	√	√	√	√	√	√	√
Compliance with standards	√	√	√	√	√	√	√	√	√	√	√	√
Requirement of sampling and flow measurement of wastewater	√	√	NA	NA	√	√	NA	NA	NA	NA	NA	NA
Submitting test reports and environmental statements to pollution control board	√	√	√	√	√	√	√	√	√	√	√	√
Rainwater harvesting, water recycling, and conservation	√	√	√	√	√	√	√	√	NA	NA	√	√

Note: the compliance of all the plants is assessed based on the secondary data provided; results of compliance based on technical assessment that are at variance with the secondary data are presented in Level 2 assessments in sections below

NA: Not applicable (not mentioned as a condition in the consent)

Plants in compliance with government requirements

The assessment, based on secondary data provided by CCI, shows that all the plants except Mehndiganj adopted the land discharge of treated effluent method. The Mehndiganj plant discharges treated effluent into a drain leading to an inland water body. The

data shows that all the plants are in compliance with the standards prescribed by the pollution control boards.

Registration of bore wells in overexploited areas

Amongst the six states included in the assessment, four states namely, Rajasthan, Uttar Pradesh, Tamil Nadu, and Maharashtra, have formulated state water policies, while two states namely, Andhra Pradesh and Punjab, do not have state water policies. So far as state laws on water resource regulation and management are concerned, Andhra Pradesh, Maharashtra, and Tamil Nadu have enacted laws on groundwater use. Rajasthan and Uttar Pradesh are in the process of enacting these laws. As a requirement under the defined state laws on groundwater use, the groundwater extraction sources (bore wells) need to be registered with the groundwater board in notified overexploited areas. While Nabipur (Punjab) and Kaladera (Rajasthan) plant sites fall in overexploited areas, they are yet to be notified as such. As per the requirements of Andhra Pradesh Water, Land and Trees Act, 2002, the bore wells in the Sathupalle plant are registered with the gram panchayat (a local village level democratic administrative unit). Bore wells are not required to be registered at present in the remaining five plant sites.

B) TCCC requirements and guidelines

The assessment of TCCC water resource management practices was undertaken under following areas.

- Siting decision of a bottling plant.
- Water extraction,usage, and wastewater discharge.

Siting decision of a bottling plant

EDD (Environmental Due Diligence) conducted by TCCC, prior to selecting a site or acquiring an existing site for setting up a bottling operation, examines the sources of water availability, restriction with respect to wastewater discharge, and issues of contamination and pollution at the site. While TERI was informed that this requirement for conducting EDD existed, the actual EDD assessments of the six selected plants were not shared due to legal and confidential reasons. Hence, it is not possible to surmise the extent to which long-term water availability for bottling operations were considered while conducting EDDs, or indeed the wider regional impacts considered. A case in point here is the HCCBPL, Kaladera, which was established in 1999 in the Govindgarh block. This block was declared an overexploited block as per the assessment of January 1998 but was not notified as such. In response to queries from TERI, Coca-Cola representatives explained that the company's requirements do not explicitly necessitate the assessment of the effects of HCCBPL, Kaladera, bottling operations on groundwater in the region of operation but focused on ensuring a sustained supply of water for business operations.

Water extraction, usage, and wastewater discharge

Compliance status of water extraction and usage and wastewater discharge with respect to TCCC's requirements and guidelines are presented in Tables 2–4. The compliance status with respect to applicable regulatory requirements is presented in Table 1.

Table 2. Compliance with respect to TCCC (The Coca-Cola Company) requirements for water usage

Issues	*Nabipur (franchisee)*	*Kaladera*	*Mehndiganj*	*Pirangut*	*Sathupalle (franchisee)*	*Nemam*
Environmental Due Diligence conducted prior to siting of the plant	DNS	DNS	DNS	DNS	DNS	DNS
Documented water availability assessment	DNS	DNS	DNS	DNS	DNS	DNS
Initial and periodic water utilization assessment	√	√	√	√	√	√
Implement and maintain a process for water utilization	√	√	√	√	√	√
Establish a continuous improvement process for water utilization	√	√	√	√	√	√
Define water utilization objectives and goals in annual business plans	√	√	√	√	√	√

DNS: document not shared by TCCC for 'legal and confidential reasons'

Table 3. Compliance with respect to TCCC (The Coca-Cola Company) guidelines for water usage

Issues	*Nabipur (franchisee)*	*Kaladera*	*Mehndiganj*	*Pirangut*	*Sathupalle (franchisee)*	*Nemam*
Self-assessment – water utilization	DNS	DNS	DNS	DNS	DNS	DNS
Self-assessment – water supply	DNS	DNS	DNS	DNS	DNS	DNS
The data collected during self-assessments to be used to build a water conservation plan	DNS	DNS	DNS	DNS	DNS	DNS
The establishment of a cross-functional team for water resources management	√	√	√	√	√	√

DNS: document not shared by TCCC for 'legal and confidential reasons'

Table 4. Compliance with respect to TCCC (The Coca-Cola Company) wastewater requirements

Issues	*Nabipur (franchisee)*	*Kaladera*	*Mehndiganj*	*Pirangut*	*Sathupalle (franchisee)*	*Nemam*
Meet applicable regulatory requirements	√	√	√	√	√	√
Maintain an effluent quality that will have no adverse effects on fish or other aquatic biota in receiving waters	√	√	√	√	√	√
Maintain and operate treatment facilities in an efficient manner	√	√	√	√	√	√
Compliance with wastewater quality requirements developed by TCCC; plant to get its treated effluent analyzed annually by an accredited laboratory and send the results to the corporate office	√	√	√	√	√	√
A detailed drainage plan of all water and wastewater streams in the facility	√	√	√	√	√	√
Separate wastewater streams for process wastewater, sanitary wastewater, cooling water, and storm water	√	√	√	√	√	√
Prevent the pollution (of) from water and wastewater	√	√	√	√	√	√
Minimize the volume, strength, and hazardous nature of wastewater	√	√	√	√	√	√
Treatment of process water such that it is compliant with TCCC analytical standards; compliant with government effluent discharge standards; conducive to the long-term survival of fish in the treated effluent	√	√	√	√	√	√
Sanitary wastewater to be discharged to a sewer connected or a sewage treatment plant	√	√	√	√	√	√

Treatment of storm water according to government regulations if applicable; else prevent the pollution of water and wastewater streams due to the run-off	√	√	√	√	√	√
Non-contact cooling water may be discharged into the local environment unless otherwise dictated by local laws or regulations	NA	NA	NA	NA	NA	NA
If treated wastewater discharge is through infiltration, prior to infiltration the wastewater must meet TCCC requirements and local regulations	√	√	√	√	√	√
If treated wastewater is disposed through land application, then						
Groundwater must be monitored quarterly within the application area, as well as up- and down gradient of the application area	NMP	NMP	NA	NMP	NMP	NMP
The soil's carrying capacity should not be exceeded such that there is surface run-off	NMP	NMP	NMP	NMP	NMP	NMP

Note The compliance of all the plants is assessed based on the secondary data provided; results of compliance based on technical assessment that are at variance with the secondary data are presented in Level 2 assessments in sections below.

NMP: no monitoring by the plant

The assessment shows that bottling operations have moved towards the land application of treated wastewater. It is suggested that TCCC ensure that all plants fulfil the existing requirements specified and also develop and adopt criteria for the quality of treated wastewater applied on land within the plant premises.

C) Initiatives to ameliorate negative water resource impacts, if any, primarily through corporate social responsibility interventions

TCCC launched a groundwater risk assessment programme in 2004 and all company-owned and franchisee-owned operations in India participated in the assessment. The framework comprised a checklist-based data collation approach on six interrelated categories with respect to water: watershed; supply reliability; efficiency; supply economics; compliance; and social and competitive climate. The checklists serve as a starting point for further investigation and quantitative assessment for evaluating the diverse physical, business, political, and social risks related to water.

With respect to CSR (corporate social responsibility), the company's early activities were designed to build bridges with the local communities and earn goodwill. However, in 2005, TCCC began developing an increasingly structured and systematic 'community engagement framework' designed to enhance community participation and foster workable partnerships with governmental and non-governmental agencies for community development schemes. CCI has also developed its own plan of action until 2010 and has outlined specific roles and responsibilities for the Division (CCI), COBOs and FOBOs related to water management; these include

initiatives on conservation (such as rainwater harvesting), access (including providing drinking water to schools), and awareness (including workshops and demonstrations). The evolving citizenship framework for community engagement is in the form of voluntary guidelines whose implementation is the prerogative of the specific bottling operations. Water-based community initiatives in the six plants include the following.

- Community drinking water initiatives in HCCBPL, Kaladera; SSSL, Sathupalle; HCCBPL, Nemam; HCCBPL, Varanasi; HCCBPL, Pune
- Rainwater harvesting initiatives in all the plants; rainwater-harvesting initiatives for the community in HCCBPL, Kaladera; HCCBPL, Pune; HCCBPL, Varanasi; HCCBPL, Nemam
- Restoration of ancient water conservation structures (*tankas* and *bawris*) by HCCBPL, Kaladera

Level II: Plant-level assessment

The six plant-level assessments encompassed the following.

- *Agricultural practices* Study of agricultural practices in and around the plant area with regard to agricultural input relating to usage and quality of local area water.
- *Raw intake water* Study of sources, quantity, and quality of plant intake water based on primary monitoring and secondary information on selected sites.
- *Process water (treated water used inside for plant processes)* Study of process water quality based on primary monitoring.
- *Effluent discharge* Study of the nature, quantity, quality, sources, and point of discharge and adherence to discharge norms by primary monitoring as well as secondary data information.
- *Water balance* Establishment of water balance at the plant level based on primary survey and measurements.
- *Groundwater* Study of regional groundwater quality based on primary monitoring and groundwater level based on secondary information (study area: within 5 km radius from plant location).
- *Stakeholder perceptions* Stakeholder perceptions capture the views of different stakeholders on the issues of trends in water availability, quality, utilization, and access across the study villages.

Three rounds of water and wastewater sampling were undertaken at each plant site during the period January – June, 2007. Samples collected in each round include 5 – 11 regional groundwater samples, and 6 – 10 in-plant samples (plant intake raw water, process water, and wastewater). Sample details can be found in Chapter 4(A-F).

Level II Findings and conclusions

A) Agriculture and local context

Five of the six site areas are rural and heavily dependent on agriculture, with cropping intensity and water use on the rise. Paddy or rice is often the dominant crop with other water-intensive crops like groundnut (in Kaladera) also coming into play. With intensive agriculture and irrigation demands, there has been a considerable increase in the use of fertilizers in these areas. Nemam, near Chennai, has been urbanizing rapidly, with well over 81 percent of the population living in urban areas (Table 5). Less than 20 percent of the area was under agriculture and that percentage is in steep decline.

Table 5 Basic features of plant locations

Plant Site		*Kaladera*		*Mehndiganj*	*Pirangut*	*Khammam*	*Nemam*	*Nabipur*
Name of the Block (an administrative unit)		*Amer*	*Chomu*	*Arajiline*	*Mulsi*	*Sathupalle*	*Poonamallee*	*Sirhind*
Total Population (2001)		294 055	326 488	311 723	127 385	65 952	431 758	90 315
Urbanisation (%)		10	15	0	6	20	81*	40
Population growth (1991–01)		2.84	3.06	3.21	0.36	2.40		1.58
Total Geographical Area (Ha)		89 147	68 361	21 555	103 900	27 447	24 000	30 786
Cropping intensity	Average	1.65	1.69	1.34	1.11	1.14	1.99	1.82
	Trend	Constant	Constant	Slightly increasing	Constant	Increasing	Increasing	Decreasing
Irrigation Intensity	Average	1.39	1.41	1.35	1.3	1.12		1.82
	Trend	Constant	Constant	Increasing	Slightly increasing	Increasing		Decreasing
Source of Irrigation	Diesel	2333 (2001)	722 (2001)	406 (2005)	134 (2000)	38 (1994)	100 (2006)	5740 (2006)
	Electric	306 (2001)	687 (2001)	1950 (2005)	64 (2000)	389 (1994)	1600 (2006)	3276 (2006)
Gross IA/Gross SA	Average	0.64	0.7	0.75	0.03	0.55	N.A.	1.00
	Trend	Constant	Constant	Increasing	Constant	Increasing	-	Constant
Crops Produced	Rabi (November to March)	Wheat, barley, mustard, gram		Wheat, pulses	Wheat, jawar, pulses	Rice, jowar, maize, gram	Paddy, ragi, green gram	Wheat
	Khariff (July to October)	Bajra, groundnut, pulses		Rice, maize, sugarcane, pulses	Rice, sugarcane, pulses, groundnut	Rice, jowar, maize, gram		Paddy
	Zayed (April to June)	Vegetables, green fodder		Vegetables (brinjal, potatoes)				

* Between 1981 and 2001

B) Raw intake water

Five of the six plants source their raw water from deep groundwater aquifers. One plant (that is, Pirangut) sources its water from infiltration wells linked to surface water reservoirs. Figure 1 shows the quantum of raw water use across the six plants, as per the information provided by CCI.

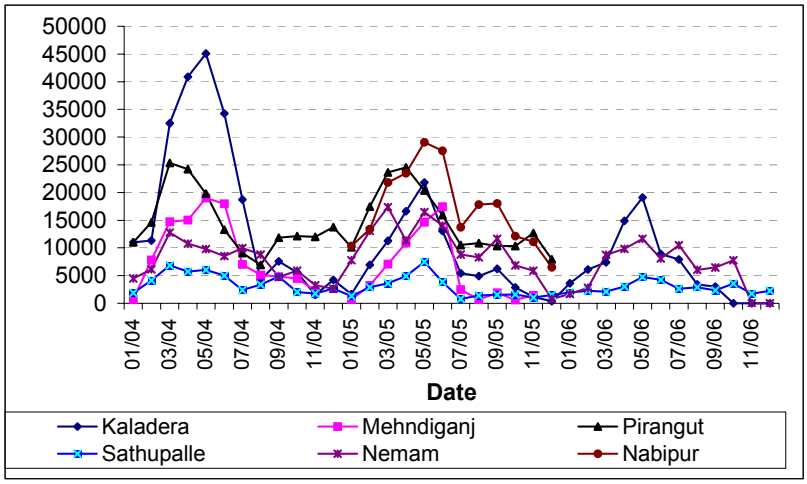


Figure 1. Raw water intake (kl/month) by plants

Note: Discontinuity in the graph in three cases, namely, Pirangut, Nabipur, and Mehndiganj, is due to gaps in data provided.

The water quality sample results obtained for the intake raw water of the six plants (in situ) were compared with the Indian Standard for drinking water (IS 10500: 1991, BIS). Intake raw water of four out of the six plants indicated exceedance of total alkalinity, compared to IS 10500. These were HCCBPL Kaladera, Mehndiganj, Nabipur, and Pirangut. Other parameters exceeding standards included barium at HCCBPL Nemam, Nabipur, and Sathupalle; nitrate, iron, and pH at Sathupalle; lead, aluminium, and turbidity in HCCBPL Pirangut; and fluoride and TDS (total dissolved solids) at HCCBPL Kaladera. Table 6 presents intake raw water quality results of parameters found to be exceeding the prescribed standards for all the six plants. Pesticides were not found to be present in intake raw water used by the plants.

Table 6. Plant Intake raw water quality results for parameters found to exceed the prescribed drinking water standard IS 10500

Test parameter	*BIS 10500: 1991*	*Kaladera*	*Mehndiganj*	*Nabipur (franchisee)*	*Nemam*	*Pirangut*	*Sathupalle (franchisee)*
Total alkalinity; mg/l	200						
Lead; mg/l	0.05; 0.01 (WHO)						
Fluoride; mg/l	1.0						
Total dissolved solids; mg/l	500						
Barium; mg/l	0.7						
Chloride; mg/l	250						
Nitrate; mg/l	45						
Iron; mg/l	0.3						
Turbidity; NTU	5						
Aluminium; mg/l	0.03						
pH	6.5 to 8.5						

Red: Large number of exceedances (detected in all rounds) (> 75 percent samples); Orange: Moderate number of exceedances (40 –75 percent samples); Yellow: One-time exceedance/marginal exceedance (< 40 percent samples); Green: No exceedance

Note: The intake raw water is treated by the plants (as processed water) before it goes into beverage production.

C) Process water

Plant process water quality was compared to the norms prescribed by national standards IS 10500: 1991, and IS 14543: 2001 (for packaged drinking water) as well as TCCC specifications for treated water.

Process water quality was not in exceedance of any of the monitored parameters at three of the six sites (HCCBPL Kaladera, Neman, and Pirangut). HCCBPL, Nabipur was found to be meeting norms for all parameters except nitrite compared to the norms specified under IS 14543:2004. The samples taken at HCCBPL Mehndiganj were also well below the specified standards; however, nitrite showed a one time marginal exceedance compared to the norms specified under IS 14543:2004. At the Sathupalle site pH, after a 0.22 micron filter, was found slightly in excess (towards acidic) of IS 10500, IS 14543 limits. Table 7 presents process water quality results of parameters found to be exceeding the prescribed standards for all the six plants.

None of the pesticides as per the scope of work were found to be present in process water used for beverage production by the plants.

Table 7. Process water quality results that exceed national standards IS 10500: 1991, and IS 14543: 2001

Test parameter	*IS 14543: 2001*	*Kaladera*	*Mehndiganj*	*Nabipur (franchisee)*	*Nemam*	*Pirangut*	*Sathupalle (franchisee)*
Nitrite; mg/l	0.02						
pH	6.5–8.5 (as per BIS 10500: 1991; 14543 : 2004)						

Red: Large number of exceedances (> 75 percent); Orange: Moderate number of exceedances (40–75 percent); Yellow: One-time exceedance/ marginal exceedance (< 40 percent); Green: No exceedance

Note: The pH of ultra-pure water in Sathupalle plant can drop a little below 6.5 as it may absorb carbon dioxide (CO_2) from the atmosphere during grab sample collection or pH measurement, but this does not mean that the water is now grossly contaminated; just a fraction of a ppm of CO_2 will cause the pH to fall. The pH values found in samples range between 6.0 – 6.3 which is possible for reason stated above (ref: American Society of Testing of Materials, ASTM-D 5464-93 (2001)).

C) Effluent discharge

The treated effluent discharge at four of the six plants (namely, HCCBPL Kaladera, Mehndiganj, Sathupalle, Nabipur), mostly met the effluent discharge requirements except for one-time exceedance of bioassay test at two sites (HCCBPL Kaladera and Nabipur) as per the appropriate regulatory standards by CPCB (Central Pollution Control Board), Ministry of Environment and Forests, Government of India, for disposal of treated wastewater on land for irrigation. The quality of the treated wastewater from the ETP (effluent treatment plant) at HCCBPL Nemam indicates exceedance of fluoride as per specified Tamil Nadu State Pollution Control Board limits. Similarly, the quality of the treated wastewater from the ETP at HCCBPL Pirangut facility indicates exceedance of chloride as per specified Maharashtra State Pollution Control Board limits.

On an overall basis, the quality of the treated wastewater indicates effective treatment for most of the parameters vis-à-vis prescribed pollution control board discharge standards.

As compared to TCCC's own treated wastewater quality standards, TKN (total Kjeldahl nitrogen) was found to exceed the limits in all the six plants. In addition to this, one time or marginal exceedances were found for TDS, total suspended solids, and anionic surfactants in HCCBPL Mehndiganj; biochemical oxygen demand, total suspended solids, and iron in HCCBPL Nabipur; and biochemical oxygen demand, iron, and cadmium in HCCBPL Pirangut. Table 8 presents treated effluent water quality results of parameters found to be

exceeding the prescribed standards for all the six plants. None of the pesticides as per the scope of work were found to be present in treated effluent water discharged from the plants.

Table 8. Treated effluent quality results (compared to existing PCB [Pollution Control Board] norms for discharge on land for irrigation and TCCC's [The Coca-Cola Company] requirements for discharge into natural waterbodies; in case of HCCBPL Mehniganj plant PCB norms for discharge into drain have been used)

Test parameter	*CBCP/ SPCB/TCCC*	*Kaladera*	*Mehndiganj*	*Nabipur (Franchisee)*	*Nemam*	*Pirangut*	*Sathupalle (Franchisee)*
Total dissolved solids; mg/l	<2000:TCCC requirement						
Bioassay test	90						
Anionic Surfactants; mg/l	<0.5:TCCC requirement						
Total kjeldahl nitrogen; mg/l	<5: TCCC requirement						
Cadmium; mg/l	<0.02: TCCC requirements						
Total suspended solid; mg/l	<50: TCCC requirement						
Biochemical oxygen demand; mg/l	< 50: TCCC requirement						
Fluoride; mg/l	2.0 (as per SPCB)						
Chloride; mg/l	600 (as per SPCB)						

Red: Large number of exceedances (detected in all rounds) (> 75 percent samples); Orange: Moderate number of exceedances (40–75 percent samples); Yellow: One-time exceedance/marginal exceedance (< 40 percent samples); Green: No exceedance

Note: TCCC requirements for treated effluent discharge to a natural waterbody applies to Mehndiganj plant only. Rest of the five plants discharge their treated effluent on land for which TCCC has yet to come out with specific individual standards. In absence of any specific individual standards for land application by TCCC, the quality of treated effluent for all the plants has been compared in the table above with the TCCC specific standards for discharge into natural waterbodies.

D) Water balance

The water audit that was carried as part of the assessment in all the six plants has included primary measurements of water intake, water used in process, and water discharge. The audit revealed that all the six plants are operating within the acceptable range of less than 10 percent of unaccounted for water losses. The components of the continuity equation (that is, inlet, outlet, and change in storages in the plant) are in conformation with each other at all of the six Coca-Cola plants studied.

Detailed water resource modelling and assessment conducted for Kaladera plant site shows that the annual groundwater extraction from the aquifer that feeds the HCCBPL, Kaladera, is overexploited, that is, 135 percent of the annual natural recharge rate. Agriculture (irrigation) accounts for more than 100 percent of the annual groundwater use. Albeit good recovery of the drawdown is expected in the aquifer zone, continuous daily extraction by the Coca-Cola

plant in the successive months of March, April, May, and June has added to the stress on the localized state of the aquifer, that is, in addition to irrigation withdrawals. The water level in Kaladera is declining due to a cumulative impact of below normal rainfall, droughts, and groundwater withdrawals by agriculture and industry. Thus, the water withdrawals by the HCCBPL, Kaladera, need to be viewed in the context of the already overexploited condition of the aquifer wherein the overall withdrawal is already over and above the total recharge.

E) Groundwater

The regional groundwater situation in the six plant locations shows that two plant locations, namely, Kaladera and Nabipur, fall in the groundwater overexploited zones, where regional groundwater use is more than the natural groundwater recharge. Three plant locations, namely, Mehndiganj, Pirangut, and Sathupalle fall in 'safe' groundwater zones. Nemam falls in 'critical'[1] groundwater zone.

Regional or ex situ groundwater quality was compared to the national standards IS 10500: 1991. The regional water quality assessment at all of the plant sites showed exceedances of parameters such as total alkalinity, coliforms, and lead. In addition to this, fluoride, TDS, barium, *Escherichia coli*, and iron were found to exceed the standards in five out of six plant sites. Other than the above parameters, few samples in one or two villages at each site were found to contain nitrate, nitrite, turbidity, pH, chloride, nickel, manganese, selenium, and aluminium exceeding the water quality standards. Three out of six sites (Kaladera, Nemam, Sathupalle) reported the presence of pesticides in one of the groundwater samples.

Regional water quality assessment of four out of six sites (Kaladera, Mehndiganj, Nemam, and Sathupalle) revealed that villages located in the immediate vicinity of the plant showed the excess presence of certain parameters. However, since this assessment here could not relate the regional groundwater quality to the operations of the Coca-Cola plant, there is a need to carry out a further detailed study to establish/rule out the reasons for such presence.

Table 9 presents regional groundwater quality results of parameters found to be exceeding the prescribed standards around all the six plants.

[1] Groundwater development categories are prescribed by the Central Ground Water Board, Ministry of Water Resources, Government of India. Category 'Safe' refers to groundwater situation in an area (defined as a district [an administrative sub-division of a state] or block [an administrative sub-division of a district]) where groundwater use is less than 70 percent of the groundwater availability (estimated from groundwater recharge); 'Critical' refers to a situation where use is between 90 and 100 percent of the availability and water tables are showing a long-term declining trend (a period of ten years); 'Over-exploited' refers to situation where groundwater use is more than 100 percent of the availability and water tables are showing a long-term (period of ten years) declining trend.

Table 9. Regional (ex situ) water quality results[2] (The table provides exceedence against standards and not an exposure assessment)

Test parameter	*BIS 10500: 1991*	*Kaladera*	*Mehndiganj*	*Nabipur*	*Nemam*	*Pirangut*	*Sathupalle*
Total alkalinity; mg/l	200	Khannipura, Disan, Kaladera, Durga ka Bas	All villages	All villages	Vellavedu, Korattur, Nochimedu	Coca-Cola & private infiltration well	Jagannathapuram, Sathupalle, Kakarlapalle, Bethupalle
Lead; mg/l	0.05; 0.01 (WHO)	Kaladera, Disan, Khannipura	All villages	All villages	Nemam, Korattur, Gudapakkam	All sources	All villages
Feacal coliform/100 ml	Absent	Durga ka Bas, Khannipura, Disan, Kaladera	All the villages	Kharodi	Vellavedu, Korattur, Gudapakkam	Urawade Reservoir	Jagannathapuram, Sathupalle, Bethupalle, Kakarlapalle,
Total coliform per 100ml	10	Khannipura, Kaladera, Disan, Durga ka Bas	All the villages	Kharodi	Nemam, Vellavedu, Korattur, Gudapakkam	Private Infiltration well & Urawade R.	Jagannathapuram, Sathupalle, Bethupalle Kakarlapalle,
Fluoride; mg/l	1.0	Khannipura, Disan, Kaladera, Durga ka Bas	Bhikharipur	Kharodi	Korattur, Nochimedu		Sathupalle, Kakarlapalle, Bethupalle
Total dissolved solids; mg/l	500	Khannipura, Disan, Durga ka Bas, Kaladera	Chhoti Khajuri, Mehndiganj, Kachnar, Bhikharipur	Nabipur, Kharodi Jalberi Galan	All villages		Sathupalle, Kakarlapalle, Bethupalle
Escherichia coli	Absent	Durga ka Bas	Khajuri, Mehndiganj, Kachnar Bhkharipur		Gudapakkam	Urawade Reservoir	Jagannathapuram, Kakarlapalle,Bethupalle
Barium; mg/l	0.7 (as per WHO)	Disan, Kaladera, Khannipura	Mehndiganj, Kachnar	All villages	All villages		All villages
Chloride; mg/l	250	Disan	Kachnar		Gudapakkam		Sathupalle
Nitrate; mg/l	45	Kaladera	Kachnar		Gudapakkam		Sathupalle, Kakarlapalle
Iron; mg/l	0.3	Khannipura, Disan, Kaladera, Durga Ka Bas	All villages		Nemam, Korattur, Nochimedu	Urawade Reservoir	Sathupalle, Kakarlapalle
Turbidity; NTU	5	Khannipura, Disan, Kaladera			Nochimedu	All sources	
Manganese; mg/l	0.1		Mehndiganj, Kachnar	Nabipur,Saidpura Kharodi	Nochimedu		
Calcium; mg/l	75		Kachnar, Karnadadi Bhikharipur,	Nabipur, Kharodi	Korattur, Nochimedu, Gudapakkam		Sathupalle, Bethupalle Kakarlapalle,
Selenium; mg/l	0.01			Jalberi Galan			
Aluminium; mg/l	0.03			Kharodi, Jalberi Galan	All villages		
Sulphate; mg/l	200				Korattur, Nochimedu		
Endosulfan-1; µg/l	0.1 (IS 14543-2004)				Gudapakkam		
Endosulfan-2; µg/l	0.1 (IS 14543-2004)				Gudapakkam		
Nickel; mg/l	0.07 As per WHO				Gudapakkam		Sathupalle, Kakarlapalle
pH	6.5 to 8.5						Sathupalle
Atrazine; µg/l	0.1 (IS 14543:2004						Bethupalle
Nitrite; mg/l	3	Disan, Kaladera					
2,4-DDE; µg/l	0.1	Durga ka Bas					
2,4-DDT; µg/l	0.1	Durga ka Bas					

Red: Extremely widespread (> 50percent samples + > 75 percent villages); Orange: Moderately widespread (> 50 percent samples + 40–75 percent villages; < 50 percent samples + > 75 percent villages); Yellow: Thinly widespread (one-time exceedance/ marginal exceedance); Green: No exceedance

[2] The intake raw water is treated by the plants (as processed water) before it goes into beverage production

F) Stakeholder perceptions

Stakeholder perceptions capture the views of different stakeholders on the issues of trends in water availability, quality, utilization, and access across the study villages. The section only records the views as presented by different stakeholders in the course of FGDs (focused group discussions) and key stakeholder interviews. It does not aim to make judgements nor draw conclusions based on these recorded perceptions.

In all but one of the six sites (that is, Nemam), there were consistent concerns expressed about water availability and quality. Depending upon the economic context, nature of the surrounding community, and the causes of the water quality and quantity problems identified by various stakeholders ranged from implications of intensive agriculture and irrigation; lack of rain and other weather patterns; draw down and wastewater practices of the local Coca-Cola facility; extraction by and effluent from other local industries; and combinations of the above.

Comparative analysis of stakeholder perceptions across six plant sites shows that the concerns expressed about groundwater availability, quality, wastewater discharge, and extractions by agriculture, industry, including Coca-Cola, are relatively higher for two out of six plant sites, namely, Kaladera and Mehndiganj, followed by Sathupalle, Nabipur, and Pirangut. In general, the community perceptions were found in conformity to the results obtained from the detailed technical assessment of groundwater resources.

The stakeholders also recorded concerns related to unregulated water extraction by Coca-Cola plants, especially in case of Kaladera. Community perceives that Coca-Cola has deep bore wells that continuously withdraw water from groundwater aquifers unlike bore wells used for irrigation that are relatively shallow and do not get regular supply of electricity. The study also consistently found quality problems with 'raw water' in the villages. The perception also indicated mixed views with regard to Coca-Cola's wastewater discharge and treated wastewater quality, especially in Mehndiganj followed by Sathupalle, Nabipur, and Pirangut.

Recommendations

General recommendations

Plant siting

- The company's assessment of water availability in the vicinity of a bottling operation should be from a perspective that is wider than business continuity. Operating in India for Coca-Cola could mean operating in many water-stressed localities. Even if each Coca-Cola facility can become water neutral, there will be other economic activities (that is, other industries and intensive agricultural production) that will characterize the regional context in which they would operate and which will generate other environmental and water stresses (for example, water drawdown and water contamination) that are beyond Coca-Cola's control. Therefore, while establishing a plant, water availability should be assessed from a long-term and ecosystem point of view, keeping in mind risks arising out of present and future (potential) competing demands in the area. Detailed investigations should be conducted prior to the siting of a bottling operation. The investigations, taking watershed as a unit of planning, should include comprehensive hydrological and groundwater modelling along with consultations with all the relevant stakeholders including government agencies like groundwater boards, water resources department, pollution control board, communities and so on.
- Siting policies need to recognize and respect the existing (formal and informal) riparian rights. For instance, the informal rights of the farmers to extract groundwater for irrigation need to be respected. This has also been acknowledged in the national and most state water policies that give precedence to domestic and agriculture demands vis-à-vis industrial demand for water. This aspect is relevant particularly in case of areas that are critical or overexploited (as per the norms defined by the Central Ground Water Board, Government of India) and/or have been experiencing irregular and low rainfall.
- TCCC and CCI should consider transitioning its current advisory committees on environment to include a broader focus on sustainable development. This should mirror a corporate evolution that allows it to integrate environment with social and economic development in its activities in a tangible, measurable, and accountable manner.

Water quality

- The plants generally meet the government regulatory standards but they need to also ensure full compliance with the existing wastewater requirements specified by TCCC. This compliance should be ensured at the earliest.

- It is also suggested that TCCC should also specifically develop and adopt criteria for the quality of treated wastewater applied on land within the plant premises. TCCC and CCI need to develop additional requirements (standards) covering treated wastewater quality. For instance, the presence of faecal coliform and several other physico-chemical pollutants in the treated wastewater in almost all the plants calls for an urgent and stringent definition (and implementation) of standards and practices as well as source identification. Absent or weak governmental regulations and norms should be countered by strong Company policies and self regulated norms. Apart from good stewardship, this is necessary to safeguard soil, groundwater, and water bodies in the vicinity of the plant operations from getting adversely impacted in the future and affecting business.
- Hydraulic loading rates as prescribed by the state pollution control boards for land application of treated effluent could not be verified at any of the sites as mentioned in the site-specific reports. Hence, the ETPs need to be redesigned/ modified and flow-measuring devices need to be installed both at the inlet and outlet of the ETP for all the plants.

Audits and reviews

- A system of annual social audits needs to be established to monitor in a transparent manner the corporate efforts for improving the quality of life in the areas surrounding the plant.
- Coca-Cola's senior executives should ensure that the company's business managers become responsible and accountable for corporate- and facility- water, environmental, and sustainable development goals as well as government and company compliance programmes. One possible mechanism to accomplish this could be to integrate these expectations into business managers' annual performance reviews.

Corporate social responsibility

- CSR initiatives need to be both sensitive to community needs and concerns. They also need to be able to better anticipate challenges that may arise in the future. In this context, a comprehensive, clear, and corporate policy on CSR needs to be enforced. This may require drawing upon a new framework for CSR in India to establish measurable benchmarks for facility, national, and perhaps global CSR. In conjunction with this, the company should establish a facility and national-level audit of these activities every three years and consider forming a special external advisory group to advise, assess, and review the programme and its components.

- CSR interventions designed for the benefit of the local communities must lead to the development of sustainable physical and social infrastructure. Stand-alone, periodic activities will make very little impact. For instance, the plant could focus on major long-terms programmes (in coordination with local governments) for provision of safe drinking water to rural communities. Similarly, the linkage of health and water could be addressed by focusing on the regional water quality results. In brief, the company should: (1) make its water programme more transparent to local communities and interested stakeholders, and accountable at the facility and country level; and (2) serve as an important catalyst for greater awareness and activities within the eco-region and watersheds within which it is operating. Appreciating the fact that wider regional issues cannot be the responsibility of a single company, TCCC may wish to consider catalysing public-private-community initiatives around such issues.
- The company needs to strengthen its reputation with local communities by taking local economic, social, and cultural norms and aspirations into account in its business, environment, and CSR programmes. Greater participation by facility managers in local community social networks, for example, might sensitise managers about special needs that could differ from one village to the next. Locating plant managers in communities where they speak the same language as the villages, for example, can enhance opportunities for communication and mutual understanding.

Water conservation

- The company should accord high priority to conservation of water and its enhancement in all its activities. It should ensure that all water conservation/enhancement measures are relevant to the perspectives and needs of the region in which they are located and that their effectiveness is sustainable over the life of the plant. There is a need to promote efficient use of water and conservation practices in joint collaboration with other stakeholders in the region such as irrigation and local government.
- In general, TCCC should try to be net water positive with respect to its own operations from a watershed perspective, especially in water stressed areas.
- It was obvious during the assessments across various plant sites that the state governments in India have not been able to value their water resources appropriately. The water use charges levied by various state governments render this important input into the production process virtually free. This fact too is resented by the communities that believe that the setting up of water intensive units, such as a Coca-Cola

plant, does not add value to the local area. TCCC should define a strategy wherein it is able to offset this anomaly through appropriate and commensurate interventions that should, ideally, result in a stream of benefit flows to the community.

Plant-specific recommendations

Kaladera

From the detailed assessment undertaken in the Kaladera watershed, it is obvious that the area is overexploited and it is highly unlikely that the water situation would improve to a level as to make its availability a non-issue. The reasons for this may be many and contributing factors may include, apart from the HCCBPL's operations, the existence of other industries, changes in cropping patterns, and rainfall. It was beyond the scope of this study to look at contributions, or indeed the chronology of establishment, of these other industries. Nor was it in the sprit of the assessment to attribute the issue to other stakeholders.

What emerges, however, is that the plant's operations in this area would continue to be one of the contributors to a worsening water situation and a source of stress to the communities around.

Water contingency measures as adopted by the plant seem to rely heavily on rainwater recharge structures, which in turn depend on rainfall in the region. Since the rainfall is scanty, the recharge achieved through such structures is unlikely to be meaningful.

In such a scenario, TCCC has to evaluate its options for HCCBPL, Kaladera, such as:

- Transport water from the nearest aquifer that may not be stressed (could be at quite a distance from the existing plant)
- Store water from low-stress seasons (may not exist!)
- Relocate the plant to a water-surplus area
- Shut down this facility

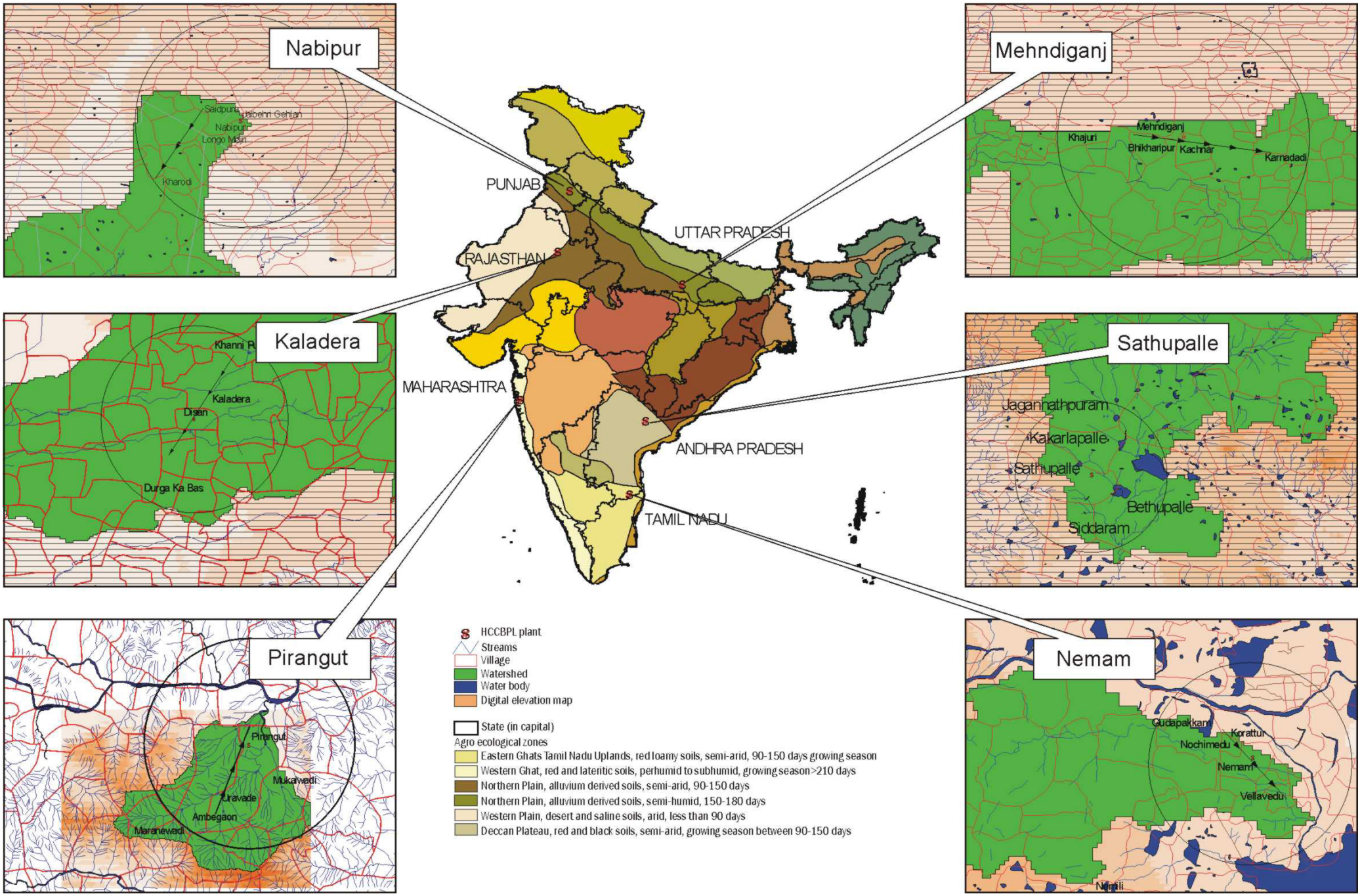
Mehndiganj and Nabipur

In addition to the general recommendations, there is a need to take note of the fact that while in Mehndiganj, the water tables have been depleting and the aquifer may move from a safe to semi-critical situation, in Nabipur, the state of the aquifer has already moved from critical to overexploited condition (refer Chapter 4B and 4C). In both the areas, water-intensive crops such as rice are predominantly

cultivated for a major part of the year and riparian rights need to be respected.

Since the movement towards water-stress situation is fairly recent, it may be prudent that the company focuses on proactively joining hands with farmers, local governments, and other stakeholders to develop and implement measures for improving the water scenario. Most state governments in India are today open to the public–private partnership model to implement infrastructure development projects. This model may be explored for options such as supplying piped drinking water to communities (the Pirangut example clearly demonstrates the impact such an initiative has on perceived stress release); setting up of water-harvesting structures; establishing sprinkler and drip irrigations systems; as also setting up social infrastructure such as educational or health institutions.

Independent third party assessment of Coca-Cola facilities in India



January 2008

Chapter 1 Background and Scope of Work

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CHAPTER 1 Background and scope of work

Background

In late 2004, the University of Michigan, Michigan, United States of America, initiated an enquiry into Coca-Cola's water management practices in India. The University of Michigan and Coca-Cola agreed that a set of independent assessments would provide the information needed for the University to move ahead with its enquiry. In this context Coca-Cola and the University of Michigan agreed that TERI, a New Delhi-based international research organization, would conduct the assessment guided by an independent Steering Committee to reinforce quality control. In addition, the parties agreed that this effort would be benefited if an organization played the role of a neutral convener and facilitator between the Coca-Cola Company and TERI. The parties agreed on the Meridian Institute, Colorado, United States of America, as the appropriate organization to fill that role.

Scope of work

The scope of work defined was to undertake an independent assessment of Coca-Cola (India)'s current water resources management practices. The assessment focused on two distinct levels:

- Level 1: *Corporate-level assessment*, including assessment of TCCC (The Coca-Cola Company) policies, procedures, management systems, and compliance mechanisms relating to environmental protection and water resource management, and questionnaire-based secondary data collection from sample Coca-Cola facilities in India consistent with Level 2;
- Level 2: *Plant-level on-site assessment* at a select number (six) of Coca-Cola facilities in India at an appropriate time after proper due diligence. This includes regional (ex-situ) and in-plant (in-situ) water quality assessment, in-plant water audit, primary monitoring, surveys, interviews of the key personnel from the facilities, and the community within the defined area and other stakeholders to assess the relevant issues associated with water stewardship.

Level 1: Corporate-level assessment

The preliminary step of the assessment was to gauge the procedures used by, and commitment of, Coca-Cola India to maintain sustainable water resource management practices in all plants (including franchisees) where its products are manufactured in India, and also to ensure the quality of intake water that is used for beverage production. This has been done through a review of TCCC corporate-level policies

and programmes.

In addition, both federal (national) and state level regulations and governance systems for water and wastewater management that influence operations of Coca-Cola in India were reviewed. Specifically, the focus of the assessment has been as follows.

- Review of corporate policies procedures, management systems, and compliance mechanisms relating to water resource management and treatment of intake water that guide all Coca-Cola India operations
    - Review of mission statements, internally developed codes of conduct, of principles and policies relevant to environmental performance as well as minimum stipulated regulatory (government) norms, which have a bearing on water management practices at Coca-Cola India
    - Understanding of externally developed, voluntary environmental charters, principles, or other initiatives to which the company subscribes or endorses and that have a bearing on the water management practices of Coca-Cola operations in India including federal and state laws
    - Evaluation of programmes and systems laid down to ensure compliance to regulatory norms as well as adherence to voluntarily subscribed or endorsed standards
        - Compliance tracking and reporting systems at the corporate level
        - Comparative assessment of differences, if any, in TCCC water management policies, practices, management systems, and compliance mechanisms between wholly-owned TCCC facilities and franchisees/contract packers (Any review of contractual provisions between TCCC and franchisees/co-packers will be limited to those relating to environmental concerns because such provisions relate to management practices and compliance mechanisms)
        - Systems and procedures initiated at the corporate level to share learning and good water management practices among its different facilities
- Review of effluent treatment management policies and adherence to norms
    - Review of TCCC policies relevant to environmental performance, and applicable Indian laws and regulations, which have a bearing on effluent management practices at Coca-Cola India
    - Any externally developed, voluntary environmental charters, principles, or other initiatives to which the company subscribes or endorses that have a bearing on the effluent management practices of Coca-Cola operation in India
    - Evaluation of programmes and systems laid down to ensure compliance to applicable regulatory norms as well as adherence to voluntarily subscribed/endorsed standards

    - Compliance tracking and reporting systems at the corporate level
    - Comparative assessment of differences, if any, in effluent management policies, practices, and compliance to company accepted standards between wholly-owned TCCC facilities and franchisees/contract packers
    - Systems and procedures initiated at the corporate level to share learning and good effluent management practices among its different facilities
- Assessment of water availability and quality parameters taken into consideration for siting of Coca-Cola facilities in India
    - Understanding of the kinds of studies or other analyses undertaken to support siting decisions
- Assessment of steps taken to ameliorate negative water resource impacts, if any, of Coca-Cola operations in India

Level 2: Plant-level on-site assessment

The scope encompasses an assessment of the following on all the selected sites:

- *Raw intake water* Study of sources, quantity and quality of intake water based on primary monitoring and secondary information
- *Process water* (treated water used inside the plant for beverage production) Study of process water quality based on primary monitoring and secondary information
- *Effluent discharge* Study of the nature, quantity, quality, sources and point of discharge and adherence to discharge norms based on primary monitoring and secondary information
- *Water balance* Establishment of water balance at the facility level based on primary monitoring and secondary information
- *Regional ground water* Study of groundwater quality based on primary monitoring and groundwater level based on secondary information with a suggested study area within a 10-km radius of the plant
- *Community concerns* Perception mapping exercise of community concerns with respect to environmental practices of the plant, in general, and water related issues, in particular
- *Agricultural practices* Study of agricultural practices in and around the plant area, with regard to agricultural input relating to usage and quality of local area water

The study comprised the evaluation of the raw intake water (groundwater or municipal supply, whichever is applicable), process water, and wastewater or effluent from the identified facilities for each listed parameter below using the following methodology.

Sample collection

Sample collection was undertaken with an aim to get adequate representation of the plant activities. Samples were collected as per the prescribed guidelines of APHA 20th edition 1998/BIS. Samples were

collected thrice consecutively for each month with location details as presented in the Table 1.1 below.

Table 1.1 Sampling protocol

Sample source	*Location of sampling*	*Quantity of sample*	*Type of sampling*	*Number of samples (from each location)*	*Protocol and guidelines for sampling and testing*
Raw intake water	Inlet(s) of waste treatment plant	5 litres	Composite	1	APHA 20th ed. 1998/ BIS 10500
	Outlet(s) of waste treatment plant	5 litres	Composite	1	APHA 20th ed. 1998/ BIS 10500
Groundwater samples	Borewell, open well, handpumps	2 litres	Grab	10 (max)	APHA 20th ed. 1998/ BIS 10500
Wastewater or effluent	Inlet(s) of effluent treatment plant	5 litres	Composite (1 hourly for 12 hours)	1	APHA 20th ed. 1998/ CPCB guidelines
	Outlet(s) of effluent treatment plant	5 litres	Composite (1 hourly for 12 hours)	1	APHA 20th ed. 1998/ CPCB guidelines
Wastewater or effluent	Outlet channel of effluent treatment plant up to 1 km away from plant boundary	5 litres	Composite (1 hourly for 12 hours)	1	APHA 20th ed. 1998/ CPCB guidelines
Process water	Plant processing sites	5 litres	Composite	10 (max)	APHA 20th ed. 1998/
Total number of samples	Monthly			25	
	Net	Each set of samples in duplicate for two different labs (25 x 2) = 50			
	Gross	For three months (seasonal) (50 x 3) = 150. For six plants = 150 X 6 = 900.			
Frequency of sampling: Each set of above sampling shall be undertaken consecutively for three months.					

Samples were collected in duplicate by TERI team and sent to two independent, accredited laboratories for analyses of the agreed parameters. This aspect is further described in Chapter 2 on 'Approach and Methodology'. TCCC representatives were allowed to take split samples at the time of the sampling event(s) if they so wished.

Transportation and preservation

All the samples were collected, preserved and transported as per the guidelines of APHA 20th edition 1998/BIS: 3025 so as to maintain the integrity and nature of samples intact.

Sample testing

All the collected samples were tested for the relevant parameters as per the recommended guidelines as mentioned below in Table 1.2:

Table 1.2 Test parameters (as per the original scope of work)

Source of samples	*Test parameters*	*Protocol and relevant guidelines*
1 Raw intake water 2 Process water	Physiochemical parameters: pH, Color, Odor, Taste, Alkalinity, TSS, TDS, Turbidity, Sulphate, Nitrate, F, Fe, Chloride, Ca, Mn, Cu, Hg, Cd, Se, As, Al, Pb Zn, Cr, CN, Mineral oil, Anionic surfactants (MBAS) Na, Nitrites, Ni, Mg, Ba, Ag Bacteriological Parameters: MPN Coliform, Faecal Coliform, Pesticides: Aldrin, Alachlor, Butachlor, HCH-Alpha, HCH-Beta, HCH-Gama(Lindane), HCH-Delta, Dieldrin, Endosulfan (Alpha, Beta, Sulphate), 2,4-DDD, 4,4-DDD, 2,4-DDE, 4,4-DDE, 2,4-DDT, 4,4-DDT, Atrazine, Chloropyriphos, Ethion, Isoproturon, Malaoxon, Malathion, Methyl-Parathion, Methyl-Paraxon, Monocrotophos, Phorate, Phorate Sulphoxide, Phorate Sulphone, 2,4-D.	BIS:10500 (Drinking water specification); BIS 14543 (packaged drinking water specification), BIS: 3025 (water and wastewater); USEPA; APHA 20th edition 1998
Groundwater	TDS, Cl^-, SO_4, F, Na, Mg, Nutrients: N, P, K Heavy metals: As, Hg, Cr^{+6}, Total Cr, Pb, Cd, Cu, Zn, Se, Ni, CN, Fe, Mn Pesticides: Aldrin, Alachlor, Butachlor, HCH-Alpha, HCH-Beta, HCH-Gama(Lindane), HCH-Delta, Dieldrin, Endosulfan (Alpha, Beta, Sulphate), 2,4-DDD, 4,4-DDD, 2,4-DDE, 4,4-DDE, 2,4-DDT, 4,4-DDT, Atrazine, Chloropyriphos, Ethion,	BIS:10500; BIS 3025; USEPA; APHA 20th edition 1998

Source of samples	*Test parameters*	*Protocol and relevant guidelines*
	Isoproturon, Malaoxon, Malathion, Methyl-Parathion, Methyl-Paraxon, Monocrotophos, Phorate, Phorate Sulphoxide, Phorate Sulphone, 2,4-D	
Wastewater or Effluent	pH, BOD, TSS, O&G, Nitrate-Nitrogen, phosphates, Color, Odor, COD, F, Sulphide, O&G, NH3, Kjeldahl-N, Total Residual Cl_2, Phenolic compounds, Mn, Fe, V. Heavy metals: As, Hg, Cr^{+6}, Total Cr, Pb, Cd, Cu, Zn, Se, Ni, CN, Bio-assay test Pesticides: Aldrin, Alachlor, Butachlor, HCH-Alpha, HCH-Beta, HCH-Gama(Lindane), HCH-Delta, Dieldrin, Endosulfan (Alpha, Beta, Sulphate), 2,4-DDD, 4,4-DDD, 2,4-DDE, 4,4-DDE, 2,4-DDT, 4,4-DDT, Atrazine, Chloropyriphos, Ethion, Isoproturon, Malaoxon, Malathion, Methyl-Parathion, Methyl-Paraxon, Monocrotophos, Phorate, Phorate Sulphoxide, Phorate Sulphone, 2,4-D.	APHA 20th edition 1998; BIS 3025, USEPA.

Note the additions in the number of parameters (i.e., in addition to SoW) have been highlighted in table 2.4, page 34, Chapter 2.

Laboratories for testing

Testing of the samples has been done through a NABL, ISO/IEC 17025, ISO-9001 certified lab capable of testing the aforementioned parameters to the applicable level of detection as required by the legal or other norms being evaluated.

Quantitative assessment and water balance

For assessment for water balance and quantum of water and wastewater generated, the following methodology was adopted.

- Assessment of ETP (effluent treatment plant) or WTP (water treatment plant) discharge and intake through the secondary records available with the plant and inputs from the questionnaire circulated to plant. However, the process water flow (closed conduit) was monitored by TERI team at all the selected sites.
- Assessment of water drawdown, or level, within the study area (5 km) through the available secondary information.
- Based on the secondary data and primary monitoring, water balance for the plant was established.

A comprehensive water balance was conducted for each plant site that includes measuring of flow rates in process units of the plant including raw water intake sources.

Community concerns study

The study reported community concerns (perceptions) relating to water resource management arising out of Coca-Cola plant operations in its neighbourhood.[1] The methodology included:

- Secondary data or information review pertaining to above issues in the last 5 years.
- Company records.
- Interviews with key company officials.
- Focus group discussions with key interest groups such as local government, NGO, community residing within study area etc.

Stakeholder perceptions capture the views of different stakeholders on the issues of trends in water availability, quality, utilization, and access across the study villages. The study only records the views as presented by different stakeholders in the course of FGDs (focus group discussions) and key stakeholder interviews. It does not make judgements nor draw conclusions based on these recorded perceptions.

Agricultural practices

This entails secondary data or information gathering to understand the agricultural practices prevalent in the study area in relation to the agricultural inputs to the groundwater (if any) and its subsequent usage. This includes evaluation of major agricultural practices in the region (cropping patterns, fertiliser inputs, irrigation technology, pesticide usage).

[1] In case the plant or facility takes water from a surface water source, the relevant watershed has been taken as a geographical unit of assessment. In case the source of raw water is groundwater, the aquifer extent map or related datasets available from the state groundwater board, have been taken as the unit of assessment. If datasets for delineating the relevant watershed or aquifer extent map are not available, a 5-km radius around the plant has been taken as the geographical unit of assessment.

Role of Steering Committee

An independent Steering Committee was constituted to oversee the entire study and provide strategic direction to the assessment process. The Steering Committee comprised of a broad-based group of experts having in-depth knowledge of the issues involved in the assessment programme. Care was taken to ensure that all members of the group do not already have a public position or relationships with any of the groups engaged currently or previously in active protesting or campaigning against TCCC with regard to any of the issues being considered in the assessment process. Following were the members of the Steering Committee:

Prof. Yoginder K Alagh
Prof. Y K Alagh was a Member of Parliament, Rajya Sabha (India), from 1996-2000. He has been Minister of State (Independent Charge) for Power and Science and Technology, and earlier Planning and Programme Implementation, and Member, Planning Commission of India (in the rank of Minister of State). He is a Member of several national and international committees. Prof. Alagh holds a Doctoral Degree in Economics from the University of Pennsylvania and Master's Degree in the same subject from that University, and the University of Rajasthan. He has several books and over a hundred articles to his credit published both in India and abroad. He has been Chairman, Agricultural Prices Commission of India, Director, Sardar Patel Institute of Economics and Social Research, and Chairman of the Economics Group of Indian Institute of Management Calcutta.

Prof. K J Nath
Prof. K J Nath was Director of the All India Institute of Hygiene and Public Health—a premier institute for public health issues based in Calcutta in India. Prof. Nath has worked for nearly 38 years in the field of environmental management and has carried out assignments for WHO, the World Bank, and UNICEF. He has completed a number of important research studies and project reports on solid waste management, sanitation, community water supply, wastewater and industrial effluent analysis and treatment, and resource recycling.

Dr Ashok K Keshari
Dr Ashok K Keshari is an Associate Professor in the Civil Engineering Department of the Indian Institute of Technology, New Delhi. He was awarded the INAE Young Engineer Award 2000, at New Delhi. His areas of expertise include: groundwater flow and pollution modelling, remote sensing and GIS hydrology, optimization and FEM impact.

Mr Gourisankar Ghosh
Mr Ghosh was, till October 2006, the Executive Director of Water Supply and Sanitation Collaborative Council, Geneva. Prior to 2001, he was the Chief of Water Environment and Sanitation cluster in UNICEF, New York, for nearly a decade. He was the architect of the

current UNICEF water policy. He was also the Chair of the UN ACC Sub-Committee on Water through 1998-2000 and developed the concept of the World Water Development Report. He was one of the two plenary speakers leading the theme of water and sanitation in the water session in the UN World Summit for Sustainable Development (WSSD) held in Johannesburg in August, 2002. A former member of the Indian Administrative Service, Mr Ghosh is a Geologist and Development Economist by academic training. He was also the Secretary, Health, as well as the Chairman of Gujarat Water Supply and Sewerage Board to Government of Gujarat. He was the Founder Director of the Rajiv Gandhi National Drinking Water Mission, Government of India 1986-1991. Mr Ghosh is a Fellow of International Water Academy, Oslo; Indian Institute of Hydrology, Roorkee; Indian Earth Science Academy. He has several papers and a book to his credit. He was a recipient of the President of India Silver medal for meritorious service.

The roles of the Steering Committee were the following:

Finalizing the detailed scope of work Pending the primary survey and interviews for field data collection that would precede the meeting of the Steering Committee, following were some of the procedural issues that the Steering Committee focused on:

- Criteria for selecting the sample of facilities for detailed study
- Procedures on environmental monitoring and management
  - Effluents – treatment and disposal
  - Laboratory specifications
- Procedures on water monitoring and management
  - Raw water input quality
  - Process water input quality
  - Plant water balance
  - Laboratory specifications
- Procedures and methodology for examining community concerns
  - Community perception of groundwater drawdown in relation to extraction by the Coca-Cola facility
  - Other water resource management concerns – groundwater contamination by effluent
- Communication strategies
- Documentation and reporting systems

Periodic review of progress of assessment The Steering Committee periodically reviewed processes, work completed, and any trouble-shootings throughout the assessment process. The committee identified critical points and recommended possible solutions for refining the ongoing assessment. They finally endorsed the outcomes of the study including the recommendations. A total of four meetings of the Steering Committee were held.

Organization of the report

The assessment comprises individual chapters. While this chapter provides the background and scope of work of the assessment, chapter 2 discusses the approach and methodology followed in conducting the assessments. Chapter 3 reviews the regulatory and governance issues related to water resource management in the country with a focus on industrial use of water. It also lays down the TCCC requirements and guidelines on water resources and environmental management that have a bearing on the establishment and operation of Coca-Cola plants in India. Chapter 4 (A to F) provides the executive summaries and the details of the six plant specific in-situ (plant level) and ex-situ (regional) assessments. Chapter 5 finally outlines a set of general as well as plant specific recommendations.

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CHAPTER 2 Approach and methodology

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CHAPTER 2 Approach and methodology

The approach and methodology followed during the course of the study has been broadly divided into six components. The components comprise the following.

- Selection of plants
- Regional and plant profiling
- Selection of study villages
- Documentation of stakeholders' perceptions
- Regulatory and governance assessment
- Technical assessment

Selection of plants

As mentioned in Chapter 1, detailed assessment of plant sites was undertaken for six plants. The approach for the selection of the plants comprised a combination of ranking regional and plant-level water-related indicators and considering the following factors to capture the maximum variability of conditions across the plants.

- The agro-ecological region in which the plant is located
- At least two plants that are subjects of controversy
- At least one plant which meets its raw water requirements from surface water
- At least one plant located in an area where pesticides are used intensively
- At least one franchisee plant

A three-pronged approach was used for the above, which are as follows.

- Analysis of secondary data
- Combined ranking of in-situ and ex-situ indicators
- Guidance from the Steering Committee

Analysis of secondary information

First, information was collected for all the Coca Cola plants (including the Franchisees) from CCI (Coca-Cola India) using a questionnaire (Annex 2.1). Second, available secondary data was collected at the district level and analysed. The information that was collected includes the following.

- Location of each plant with respect to
  - type of agro-ecological region
  - level of ground water exploitation in the region
- Controversy, if any, related to plant operations
- Source of raw water intake to the plant—ground water or surface water
- Plant level or in-situ indicators such as

  - daily raw water intake in 2005 as reported by the plant
  - effluent discharged in 2005 as reported by the plant
- District level ex-situ indicators such as
  - groundwater development (ratio of use by recharge) in 2004/05 based on the data published by the CGWB (Central Ground Water Board)
  - fertilizer consumption per net sown area in 2000/01 based on the published statistics by the Fertilizers Association of India

The information was collected from in and around 48 plants, based on published secondary data as well as data provided by CCI . Following this, a detailed analysis was made, the results of which are compiled and presented in Table 2.1 (page 2.32). Descriptions of the agro-ecological zones in India that have been used here can be found in NBSS & LUP (National Bureau of Soil Survey and Land Use Planning, 1999), also presented in Table 2.2 (page 2.34).

Combined ranking of in-situ and ex-situ indicators

The above-mentioned indicators were ranked based on their relative values as per the relative 'order of magnitude' for indicators against each of the 48 plants. The assigned individual ranks for four indicators (two, in- situ and two, ex-situ) were added against each plant and the sum total of rank value, also called the combined rank, was obtained. The rank values are also presented in Table 2.1.

Once ranks were assigned to each of the 48 plants, these ranks were used for selecting the plants after taking into consideration factors such as agro ecological region, controversy, source of water intake (ground or surface) for the plant, intensity of pesticide use, and ownership of plant (COBO [Company-owned bottling operations] or FOBO [Franchisee-owned bottling operations]) . Out of these factors, secondary data on pesticide consumption was not universally available for areas surrounding the plant locations. Hence, cotton or groundnut growing areas that required greater inputs of pesticides were taken as surrogate. The Plachimada plant in Kerala, though controversial, was not considered, as the plant was not operational during the course of the assessment.

Accordingly, the following six facilities, along with four standbys (as indicated in square brackets below), were identified for detailed in-situ plant level assessment. This included both COBOs and FOBOs. The identified plants, as highlighted in Table 2.1, include

- HCCBPL (Hindustan Coca-Cola Beverages Private Limited), Kaladera, district Jaipur, Rajasthan (COBO)

- Kandhari Beverages, Nabipur, district Fatehgarh Sahib, Punjab (FOBO) [HCCBPL, Dasna, district Ghaziabad, Uttar Pradesh (COBO) (standby)]
- Sri Sarvaraya Sugars, Sathupalle, district Khammam, Andhra Pradesh (FOBO) [HCCBPL, district Guntur, Andhra Pradesh (COBO) (standby)]
- HCCBPL, Pirangut, district Pune, Maharashtra (COBO) [HCCBPL, Bidadi, district Bangalore, Karnataka (COBO) (standby)]
- HCCBPL, Nemam, district Thiruvellure, Tamil Nadu (COBO) [Poornam Beverages, district Erode, Tamil Nadu (FOBO) (standby)]
- HCCBPL, Mehndiganj, district Varanasi, Uttar Pradesh (COBO).

Alternate sites were identified for possible selection in case of any limitation felt or faced by the TERI team in conducting the assessment on any of the sites on the shortlist. This could happen if, for instance, data was not available from state/district-level government bodies. Since data for the six selected plants was available, it was not necessary to consider the standby plants for the assessment. Further, standby plants were not identified against the plants under controversy, as it was felt necessary to include controversial plants in the assessment.

Following the selection of plant sites, local-level data was collected from each of these plants and its surrounding study region (explained in section on 'definition of the study area') to assess water management practices and policies of Coca-Cola plants in India, including the impact of its operations on local environment and stakeholders. The type of information collected and the process followed to collect the information is discussed in the following section.

Regional and plant profiling

This section describes the methodology for collection, collation, and analysis of regional- and plant-level information. The regional profiling was based on secondary data collected from district and block offices. The plant profiling was based on the plant-level data provided by CCI.

Regional (ex situ)

The main purpose of the secondary data collection was to construct the profile of the region, where the plant was located, by capturing changes in the following parameters over a period of time.

- Demography
- Economy
- Land use and cropping pattern
- Cropping and irrigation intensity
- Fertilizer use

Collection of secondary data from the region was done by using a questionnaire-based approach (see Annex 2.2). The questionnaire was sent to the district commissioner's office in each of the six districts where the selected plants were located. This was followed by a field visit to each district commissioner's office. One of the key purposes was also to inform the district commissioner about the study and identify the most appropriate local government departments and officials for collecting and compiling the necessary data. The following departments were visited in each of the districts to collect the information.

- Block Development Office
- State Government Offices
- State Ground Water Board
- State Pollution Control Board
- State Industrial Corporation
- Water Resources Department
- Department of Agriculture
- Non-governmental organizations
- Statistical and Planning Department
- Panchayat office
- Other related departments

Plant level (in situ)

The information collected from each of the selected plants can be broadly categorized under the following heads.

- Installed and utilization capacity
- Daily raw water intake
- Types of products produced and their total daily production
- Water utilization ratio
- Wastewater discharge— quality and quantity

A questionnaire was sent to CCI to arrange for the above-mentioned data sets from the six selected plants (Annex 2.1).

The ex-situ and in-situ information collected was analysed, the results of which are presented in the 'site' reports (Chapter 4A to F).

Defining the study area

According to the SoW (Scope of Work) the study area was to be confined within a radius of 10 km around the selected Coca-Cola plant. This issue was deliberated in detail during the initial planning stages of the project and in the first meeting of the Steering Committee. It was agreed that for efficient management of the assessment the following factors needed to be considered.

- Time constraints in undertaking social and technical field assessments
- Sub-watershed (typically covering an area of 50 [± 50 %]km²[1]), equivalent to a radius of approximately 5 km

It was agreed in consultation with the Steering Committee that a radius of 5 km around the Coca-Cola plant could be taken as an acceptable distance from the plant to measure any likely impact of the plant's operations in the area, including any expected zone of influence of tube wells operated by the plant. The likely impact of the Coca-Cola plant's operation in the defined area was studied in selected villages around the plant.

Identification of study villages within the defined area

The identification of study villages was based on two key parameters.

- Sub-watershed boundary within which the plant lies (5-km radius)
- Regional direction of groundwater flow to identify upstream and downstream villages in relation to the plant

Survey of India toposheets were digitized to generate a DEM (Digital Elevation Map) for each of the selected sites. The DEM was used to generate additional themes on flow direction and flow accumulation. These themes made it possible to define drainage networks, delineate watershed and sub-watershed boundaries, and extract watershed parameters. In addition, a village map and plant location were digitized and superimposed on the delineated watershed map.

Following the superimposition of watershed and village boundaries, including the location of the Coca-Cola plant, upstream and downstream linkages of villages were derived based on the direction of flow of water/ groundwater in the watershed. Determination of the direction of groundwater flow required analyses of additional data sets on hydrogeology and observation wells, including depth and geographical coordinates

[1] Development and demonstration of recommended methodology for delineation and codification of a watershed system of India, Watershed Atlas of India (1990), The Chief Soil Survey Officer, All India Soil and Land Use Survey, I.A.R.I Campus, New Delhi, India

of the wells, maintained by the groundwater departments. Observation of well data on water table levels or piezometric levels and mean sea-level data were used to generate the groundwater DEM. Groundwater DEM theme was used to generate additional themes on groundwater flow direction. Isotropic conditions have been assumed and hence only one hydraulic conductivity value has been taken. Heterogeneity has been taken based on the spatial distribution of hydraulic conductivity values obtained from secondary data sources. The variations of the depth of wells have been taken to ensure that they belong to the same aquifer system based on the lithology data of the area. Those wells that were not from the same aquifer have been discarded. Finally, villages within the same watershed located upstream and downstream (based on groundwater flows) of the Coca-Cola plant were selected.

Thus, the villages that were finally selected for detailed ex-situ assessment were based on the following classification system.

- Village in proximity to the plant or in which the plant was located (M)
- Village immediately upstream of the Coca-Cola plant (U1)
- Village immediately downstream of the Coca-Cola plant (D1)
- Village at the extreme upstream end of the Coca-Cola plant (U2)
- Village at the extreme downstream end of the Coca-Cola plant (D2)

In certain cases, the number of villages was less than five. This number was dependent on the number of villages located in the direction of groundwater flow within a radius of 5 km. Only in the case of Pirangut, Pune, where the Coca-Cola plant is dependent on a surface water reservoir, was the selection of villages done on the basis of the location of the reservoir.

Documentation of stakeholder perceptions

Stakeholder perceptions capture the views of different stakeholders on the issues of trends in water availability, quality, utilization, and access across the study villages. The section only records the views as presented by different stakeholders in the course of FGDs (focus group discussions) and key stakeholder interviews. Studies on qualitative research have discussed using the lens of the 'participants' of a study, as being one of the ways for giving a research account (Chreswell and Miller 2000)[2]. Underlying such an account is the

[2] Creswell, John W and Miller, Dana L. (2000). Determining validity in qualitative inquiry. *Theory into practice*, Vol. 39, No. 3, Getting good qualitative data to improve educational practice, pp. 124-130.

assumption that 'reality is socially constructed and it is what participants perceive it to be' (Chreswell and Miller 2000). In this light, the documentation of stakeholders' perceptions does not aim to make judgements, nor draw conclusions based on the recorded perceptions.

Perceptions from different stakeholders about water-related issues were recorded, with particular reference, to the following aspects.

- Causes and impact of change, if any
- Responses to changes by various stakeholder groups, if any
- Perceptions of the Coca-Cola plant operations and reasons for a particular stance of stakeholders, if any

Target groups

To capture perceptions comprehensively, several groups were identified as stakeholders for the study—women, farmers, panchayat members, weaker sections, CBOs (community-based organizations) and NGOs, key resource persons, government officials, as well as plant representatives.

Women

As women are primarily concerned with household tasks, many of which involve the use of water, they are the bearers and managers of water within the home and the farmstead. Any change in availability and/or quality of water for domestic use is most likely to impact women profoundly and therefore, most likely to be noticed by women.

Farmers

Farmers also usually have an intimate understanding of water availability and quality in the local area because of their dependence on water for agriculture. Their requirements include not only sufficient water quantity but also regularity of supply.

Panchayat members

Panchayats are the basic administrative unit of democracy in the country. As duly elected representatives of their villages, panchayat members have a comprehensive understanding about the whole village because of their position and access to information. Additionally, as representatives of the state at the lowest tier of governance, they are often the first point of contact for people experiencing problems within the village. This means that they are aware of problems in the village and the communities' perceptions of various issues. Panchayat members are also involved in implementing village-level schemes for augmenting or managing natural resources.

Hence, they were approached as one of the key stakeholders for capturing perceptions.

Weaker sections

Effort was made to identify and involve the socially or economically weaker sections, as their concerns are, at times, quite different from those belonging to the mainstream communities. This study sought to identify the kind of water supply they have, their water-use practices, the differences in access to water resource, and at the same time to capture their perceptions of changes in water resources in the area.

Community-based organizations/Non-governmental organizations

Often NGOs work closely with the local community and have insights regarding the local context. They are also likely to have an understanding of the vested interests and the power dynamics that drive local community life. Like panchayats, these groups are an invaluable source of information on the village, in general, and about the state of natural resources. Therefore, CBOs and NGOs that had local presence were interviewed as part of qualitative data gathering.

Additionally, some CBOs or NGOs, themselves, may have taken a strong position vis-à-vis the Coca-Cola plant or other industrial units, and also, may have been leaders in the community in this regard. In such cases, it was imperative to understand the reasons for their stance and their long-term objectives.

Local NGOs implementing Coca Cola's CSR (Corporate social responsibility) activities were also approached to get an understanding of the activities being undertaken.

Key resource persons

Key resource persons included people with known stances and local persons familiar with the area and the community concerns. It was important to consider and understand their viewpoint because of their familiarity with the area.

Government officials

Since officials at the district, block, and panchayat levels were either engaged with the provision of water resources or had an opinion on the issue, it was important to consider their views as well. The opinions of government officials are included in the discussions.

Plant representatives

The opinion of the plant representatives was sought on CSR activities and protests against the plant, if any. Their opinion is included in the discussions.

Methodology for capturing perceptions

Two tools were adopted for capturing stakeholders' perceptions, namely FGDs and semi-structured interviews that are discussed below.

Focus Group Discussion

FGDs with different stakeholders were used to capture the perceptions. FGDs generate rich qualitative data that are useful for understanding or exploring a range of opinions and views on a particular topic. Respondents are asked to draw on their experiences, feelings, and beliefs in order to qualify their responses (Gibbs 1997).

People's perceptions/experiences related to water or, specifically, to the Coca-Cola plant needed to be understood within a broader framework comprising historical experience, expectations, cultural beliefs and practices, and so on. In the study, FGDs were used as a 'self-contained' method rather than in combination with other methods like surveys that seek quantitative data[3].

At least one FGD was conducted with representatives of each of the target groups (farmers, women, weaker sections, and panchayats) in each selected village. In specific areas, a single panchayat represented two villages in the study area; in such cases, only one FGD was conducted.

The following guidelines were followed while setting up and conducting the FGDs (Table 2.3).

Table 2.3 Guidelines for setting-up and conducting the FGDs

Criteria	*Guidelines followed*
Identification/inviting of participants	Participants for each meeting were identified with the help of local leaders and government officers depending on their availability. This included the BDO (block development officer), the panchayat secretary of each village panchayat in the study area, or the sarpanch of each village panchayat in the study area. In addition, the assessment process ensured that information about the meetings (FGDs) was disseminated to a large section of the village community.

[3] *Sociological Abstracts* have quoted that the proportion of studies that rely solely on focus groups has been increasing in recent years.

Criteria	*Guidelines followed*
	Each stakeholder was approached with a letter explaining the objectives of the project; and the researcher's contact numbers were provided. Additionally, members of research teams spent one or two days getting acquainted with each study site. During that time they interacted with local village residents and informed them about scheduled meetings. After the time and venue for a meeting were fixed, two to three posters providing information about the meeting (objective, topic, time and date, and venue) were put up at prominent locations in the village to maintain transparency in the process.
Group composition	In general, each FGD was conducted with a homogenous group of people—women, farmers, and weaker sections. However, at several meetings people who did not belong to the target group also chose to join in. This was especially true in case of panchayat meetings where prominent or locally active members of the village participated as well.
Number of participants	While 8 to 12 participants are considered an ideal number for conducting an effective FGD, some FGDs often had more than 12, or as few as 6 participants. In an effort to be inclusive, no participant was turned away. The number of participants in a meeting also varied across the duration of the meetings, as people often joined in out of curiosity while others left halfway because of other pressing engagements or for personal reasons.
Location	Within and across study sites, meetings were held at locations identified by participants themselves or by people assisting the research team with arrangements. Locations chosen included anganwadi premises, panchayat office buildings, sarpanch's house, the courtyards of village residents, agricultural fields, and temple premises.
Records of FGDs and information about participants	FGDs were recorded in the following ways. ▪ Audio recording and, in few cases, video recording were made by informing and taking permission of the participants. ▪ Photographs were taken (with permission of participants) during the meeting. ▪ Field notes were taken by researchers. A record of participants was also maintained by requesting participants to sign an attendance sheet, whosoever agreed. To profile participants, forms, with a few basic questions, were filled out for each participant at the end of the meeting; those who might have left the meeting were not pursued.
Checklist for discussions	A specific checklist for each target group was used during each FGD. These questions were aimed at assessing the following. ▪ Current water availability and utilization ▪ Changes in water availability and quality since the inception of the Coca-Cola plant ▪ Stakeholders' perceptions of industrial consumption of water and its impact on the area and on their lives Additionally, a PRA (Participatory Rural Appraisal)[4] technique of rating was used to understand people's perceptions of levels of water stress.

[4] Chamber and Blackburn (1996) state that 'PRA can be described as a family of approaches, methods and behaviours that enable people to express and analyse the

Criteria	*Guidelines followed*
Role of facilitators	Each FGD was conducted by at least two facilitators working together in order to ▪ guide the discussion through key questions and follow up questions, ▪ record data through an audio recording system and for intensive note taking, and ▪ record participation through photographs and fill in attendance sheets and participant profiles
Maintaining transparency	As recommended by the Steering Committee, participants were informed about the scope and purpose of the study at the onset. The Steering Committee further emphasized that stakeholders be informed that the study focused on the impact of Coca-Cola operations on water resources. That was adhered to as part of the methodology.
Research ethics	Participants were free to join in or withdraw from meetings at any time. Permission was taken from the group before discussions were recorded or photographed or video recorded. Efforts were made to conduct meetings (including filling of participant profiles) within one-and-a-half hours, mindful of the fact that local people had other commitments. Efforts were made to make participants comfortable in their surroundings and to be culturally sensitive, especially with regard to women.

Semi-structured interviews with key individuals

In addition to FGDs, individual interviews were also conducted with people who were influential and/or likely to be well informed about the study area in terms of the local events and history, politics and power structures, and water-related issues. These interviews were conducted in order to develop an understanding of the local context.

The following criteria were used for selecting interviewees.

- The person was influential in the local community (for example, panchayat member, local college professor) in the area.
- The person worked or had worked closely with local communities or in the community (for example, school teacher, *Anganwadi* worker, NGO worker) and was likely to have knowledge about the social groups in the study area, and also the local conditions relating to water and stakeholder perceptions in this regard.
- The person had lived in the area for over 5 years and/or had an understanding of the local history and politics and power structures.

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realities of their lives and conditions, to plan themselves what action to take, and to monitor and evaluate the results' (p 1). For the study, a scaling technique was used where the members in each meeting were asked to rate the level of water stress the villages face on a scale of 5, where 1 indicated good condition and 5 indicated worst condition. The rating scale was decided by TERI.

Chambers R and Blackburn J.1996. *'The power of participation: PRA and policy',* Briefing Paper, Brighton: Institute of Development Studies. Policy Briefing 7. University of Sussex, Brighton, England.

- The person was known to have a strong opinion about the water conditions in the area or about the Coca-Cola plant.

The following guidelines were followed while setting up and conducting individual interviews (Table 2.4).

Table 2.4 Guidelines for setting up and conducting individual interviews

Criteria	*Guidelines followed*
Semi-structured	Interviews were semi-structured and were guided by a list of questions/issues that were to be discussed. Facilitators also provided an opportunity to participants to discuss issues, which were not included in the questionnaire, but were on their minds.
Documentation	Interviews were documented through hand-written notes and through audio recordings and video recording (of few) with prior permission. One or two photographs were taken during or after the interview.
Research ethics	Interviewees were informed about the project and the research team's work in the study area. The interviewees were free to terminate the discussion at any time. Permission was taken to record the interview.

The combination of FGDs along with key person interviews was useful, as the former enabled capturing the breadth of issues, while the latter were instrumental for covering the depth of issues. Morgan (1996) has discussed that the FGDs can be combined with individual interviews in a complimentary fashion to provide more robust qualitative information[5].

Documentation

The discussions in each selected site were processed and documented in the following ways.

Audio recordings

Audio recording of each FGD and individual interview was done.

Preparation of notes

A set of notes for each FGD and interview was developed based on hand-written field notes and audio-recordings.

Regulatory and governance assessment

The regulatory and governance assessment involved the following, with respect to water usage and wastewater disposal.

- A review of state policies and regulatory requirements

[5] Morgan, David L. (1996). Focus groups. *Annual Review of Sociology*, Vol 22, pp129-152.

- A review of the requirements and guidelines of TCCC (The Coca-Cola Company) at the corporate level
- Compliance to regulatory and TCCC requirements, and guidelines at the plant level
- CSR initiatives

The assessment comprised a three-pronged approach. First, relevant documents were identified and efforts were directed towards procuring the same from government departments and CCI. This was followed by an initial review of the documents obtained from the CCI and requests for additional information to fill the gaps. In specific cases, the relevant documents were not shared due to legal and confidentiality issues as indicated by TCCC.

Second, the documents were reviewed, and compliance checklists were prepared. Compliance checklists were drawn for each plant after a review of the following.

- State policies and regulations regarding issues of industrial use of water

TCCC requirements and guidelines on water resource management, wastewater treatment, and disposal.
Third, field visits were undertaken to assess the level of compliance of plants. Visits were made to both the plant and offices of the relevant government agencies. Government offices visited included the following.[6]

- District Commissioner's/Collector's office
- State pollution control boards
- State industrial development corporations
- Irrigation departments
- State groundwater departments
- CGWA (Central Ground Water Authority) and CGWB (Central Ground Water Board)
- District industries centres

Officials from relevant government agencies were apprised about the project. Enquiries were also made regarding regulatory requirements with respect to industrial water use vis-à-vis the establishment of water-intensive industries in respective states and their manufacturing operations.

At the plants, compliance to both regulatory requirements and requirements of the Coca-Cola Company with regard to water resource management and wastewater disposal were assessed. The assessment included review of documents received from CCI, meetings with the plant officials, and data verification. The focus of assessment was primarily on the following.

[6] Some government offices listed, for example irrigation departments, were site-specific.

- Terms and conditions in the consent to establish and operate, issued by the state pollution control board, and any other agreements with or licences from state and local governing bodies
- TCCC requirements and guidelines on water and wastewater management (refer to Chapter 3)
- Plant's water-based CSR initiatives

Technical assessment

The technical assessment comprised both regional (ex-situ) and in-plant (in-situ) water quality assessment, and in-plant water audit for all the selected sites. In addition, based on the recommendations of the Steering Committee, a detailed water modelling exercise for Kaladera, Rajasthan was conducted.

In situ (plant-level) water audit

A water audit is defined as the process of accounting for water inflows and outflows as well as changes in water storage such as changes in the water levels in water storage tanks within the plant. The 'continuity equation' or the 'law of conservation of mass' defines the governing equation for the audit. This involves a detailed analysis of water use at a given site for certain duration and includes all sources of water intake, storages, changes in storage, and various uses in functional process units and operations of the plant.

Figure 2.1 is the schematic representation of the steps followed during a plant-level water audit. These are further explained below.

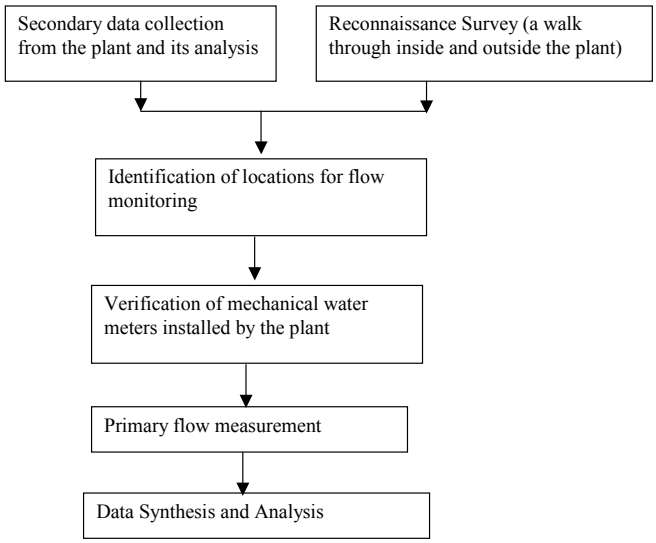


Figure 2.1 Schematic representation of the steps followed during a plant-level water audit

Secondary data collection and analysis

Prior to the plant visit, secondary information about the plant was obtained from CCI. This data essentially covered aspects related to layout of the plant, various unit processes and operations, location of water pumps, pump discharges, pipe networks, sources of water intake, water use and supply, including information on flows, water storages, process flow diagrams, and wastewater discharges. A reconnaissance survey was planned, based on the analysis of the available secondary information obtained from the plant.

Reconnaissance survey

The survey began with a walk-through of the entire plant. Technical details related to the capacity of units (such as details of bore wells, capacity of pumps); layout of pipeline networks; processes such as water and wastewater treatment; points of water use and discharge; and wastewater treatment processes and disposal schemes, including use of treated wastewater, were examined. During the walk-through, the available instrumentation, including level gauges, mechanical meters, and rotameters were identified, and their working conditions were checked.

Based on the secondary data collection and the walk-through of the plant, locations for primary flow monitoring were identified. The need and feasibility of installing ultrasonic flow meters at different locations were also examined.

Verification of installed water meters

It was observed during the walk-through exercise that the plants had installed mechanical meters to observe and record the flows in few process units or operations. The readings of these water meters were verified at all the locations with the use of an independent ultrasonic flow meter (carried for the purpose of examination of flows during the audit). Besides verification of the flow meters that had been installed, the functional condition of level gauges on selected storage tanks were also checked. During the first round of the audit exercise for some plants, level gauges on selected storage tanks were found to be non-functional or leading to high least count errors. In such cases, to avoid the error in overall tank balancing, the audit team used its own plumb-bob[7] measurement in the successive rounds of monitoring.

Flow measurement

[7] A mechanical devise (a weight) with a measuring tape used for gauging the vertical height of a liquid, such as water, stored in a tank

The flow measurement exercise involved installation of ultrasonic flow meters as well as recording of the readings of validated mechanical meters and tank water level gauges, following specifications and methods mentioned in IS: 2373 – 1981 (Reaffirmed 1997) Clause 5.3.3.
Flow measurement was conducted for accounting:

- Water supply from raw water intake sources, which in all cases were bore wells
- Pipe layout networks feeding into different storages, units, and operations
- Various storages in the plant
- Water supply of treated process and soft water[8]
- Effluent and treated effluent in the ETP (effluent treatment plant)

Flow measurement was done using state-of-the-art water flow meters as shown in figure 2.2. The characteristics of the meter are as follows.

- TransPort®PT878, portable meter
- Ultrasonic liquid flow meter
- Highly versatile, transit-time system
- Flow transducers and clamping fixtures to measure water velocity in the pipe
- Pipe wall thickness gauge transducer to measure the thickness of pipes

Based on the measured velocity and thickness values, the flow in the pipe at various points is estimated.

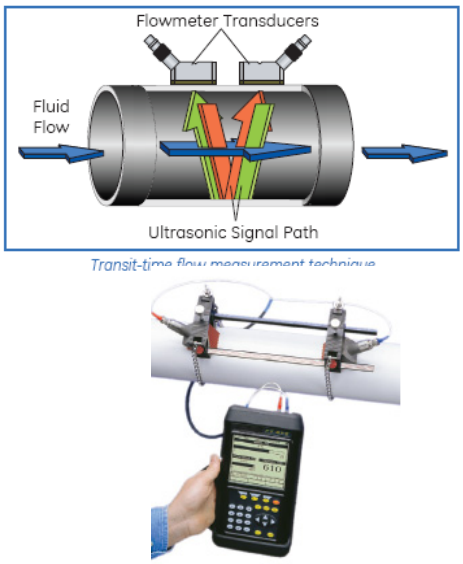


Figure 2.2 Flow measuring instrument

[8] 'Soft water' is a term used to describe water that contain few or no calcium or magnesium ion, used in boiler units as unchlorinated soft water or bottle washing after chlorination; 'process water' describes water that is used in preparation of the beverage after water treatment.

Data synthesis and analysis

Following the steps described previously and after flow measurement observations, flow readings were compiled and analysed in view of the objectives of the study. These included the following.

- Mass balancing of the raw water tank in order to establish conformity (or balance) between inflows and outflows of water, and change in raw water storage during the given period of study (equation of continuity)
- Analysis of the system of water supply from the raw water tank to water treatment plants (for processed/treated water, soft water); storages for treated water; and supply of treated water. This also included estimation of outflows from the above systems to establish net (final) storage inside the system at the end of the monitoring period; and information on the product (beverage) manufactured (in kilolitres).
- Effluent at the inlet and outlet of the ETP
- Estimation of the plant's water consumption per product unit

Water-quality assessment

The assessment included analyses of water quality at the intake, for raw and process water separately, and exit (effluent after treatment) from the plant (in situ), as well as the quality of water in the region outside the plant (ex situ). The evaluation sought to understand and assess the presence, if any, of pesticides, and to gauge other water quality parameters in intake water, process water, and the effluent generated. The study also involved assessment of the regional groundwater quality that has a bearing on the quality of plant raw water intake.

Ex-situ assessment

The ex-situ assessment was undertaken to gain an insight into the quality of water that is sourced and consumed by the plant and the impact, if any, of the effluent discharged after processing from the ETP of the plant. The water quality in the study villages was monitored to assess this (both upstream and downstream of the Coca-Cola plant, following the approach discussed in the section on 'Defining the study area').

Criteria for sampling

A reconnaissance survey was conducted in the chosen villages to identify the locations for water sampling. Two to three locations were identified in each village. A detailed process for selection

of the sampling location was undertaken in keeping with the following criteria.

- Primary use, such as drinking water source, irrigation source, and so on
- Kind of source, such as a hand pump or bore well
- Stakeholders' perceptions of the water quality in the village and, in particular, the source

Sampling protocol

The sampling locations were surveyed and specific information with regard to water use, availability, depth of the well, and so on, about the sources was gathered from local community representatives and owners of the hand pumps or the bore wells.

Sample collection

Grab samples of groundwater were collected from the locations mentioned earlier, as per the prescribed guidelines, that is, 'Standard methods for the examination of water and wastewater' by APHA (American Public Health Association) 1998 20th edition (Section 1060—Collection and preservation of samples) and IS: 3025 (part 1, Sampling)-1987 (reaffirmed 2003) of the BIS (Bureau of Indian Standards). Each source, namely, the hand pump or the bore well, was pumped sufficiently to remove the water within the pipeline or casing, and water was then collected so as to have a representative sample from the source. The samples, with the desired preservatives for different physiochemical and bacteriological parameters, were then transported to respective laboratories for testing.

Sampling for bacteriological parameters

Samples were collected in aseptic conditions, by sterilizing the source either by flaming it or swabbing it with ethyl alcohol. All samples for bacteriological tests were collected in a pre-sterilized bottle, and were then transported for testing to the respective laboratories within the prescribed time duration at desired temperature (APHA 1998). (9060: Collection, preservation, and storage); IS 1622: 2003(Methods of sampling and microbiological examination of water), and IS 3025 (part 1, sampling)-1987(reaffirmed 2003)]

Duplicate samples were collected from each location or source by the TERI team and sent to two independent, accredited laboratories for analysis of the parameters, as per the SoW.

Onsite tests

Water quality parameters namely pH, residual chlorine, and temperature were field-tested at the time of sampling.

The following procedure was used for sampling the water quality.

- Identifying the location, allotting the sample code, and marking of each container with the respective code
- Recording site details and source information in the field data sheet for the groundwater source
- Collecting grab sample (one time sample) in appropriate containers/bottles
- Field testing the quality of site water and recording data in respective field data sheets
- Packing and sealing samples, along with ice or gel packs with records of the sample in the chain of custody document
- Transporting the samples

Sample testing

The collected samples were tested for the relevant parameters, as per the recommended guidelines mentioned in Table 2.3. The samples were tested in an NABL (National Accreditation Board for Testing and Calibration Laboratories), ISO/IEC 17025, ISO-9001 certified laboratory, capable of assessing the aforementioned parameters to the applicable level of detection, as required by law or other norms being evaluated.

Various governmental, private, as well as national and international laboratories were contacted in consideration for testing the samples. Each of the labs were compared in terms of their relevance, capabilities, and turnaround time for results in keeping with the requirements of the scope of work and the lab selection criteria (that is, NABL and ISO certified). Based on the above criteria and in consultation with the Steering Committee, following two laboratories were finally selected for sample analysis.

- ALS (Australian Laboratory Services), Hong Kong, and
- Shriram Institute for Industrial Research, Delhi, India

To assess the compliance with regulatory norms, results were compared to the relevant national standard for drinking water (BIS 10500: 1991) and international guidelines (WHO [World Health Organization] guidelines for drinking water).

In situ assessment

The in-situ samples were collected from each plant. The sampling locations varied, based on the process and production in different plants. However, typically, the following sampling locations were selected for water quality monitoring.

- Raw water— Raw water inlet and raw water storage tank outlet
- Process water —This included
  - WTP (water treatment plant) outlet after micron filters (going as an inlet to beverage production)
  - Soft water treatment outlet (going as an inlet to bottle or crate washing, PET [polyethylene terephthalate] rinsing)
  - RGB (recycled glass bottle)/PET line paramix (inlet just before final bottle filling)
- Wastewater— inlet and outlet of the ETP

Samples were also collected from the STP (sewage treatment plant).

Sample collection

Sequential (time) composite samples were collected by using continuous, constant sample pumping or by mixing an equal volume of water collected at a regular interval of time. For all the selected locations, composite sampling was carried out with hourly sampling frequency for a duration covering the entire plant operation cycle. For this, two teams operated in shifts of 12 hours each during the day and at night.

Samples were collected as per the 'Standard methods for the examination of water and wastewater' (APHA 1998) 20th ed. 1998 (Section 1060: Collection and preservation of samples) and IS: 3025 (part 1, Sampling)-1987 (reaffirmed 2003) {Methods for sampling and test (physical and chemical) for water and wastewater}. Basic information on raw water, wastewater, and process water was recorded in field data forms. The sample bottles were marked or labelled, coded, and duly signed. Relevant field tests, namely, pH, residual chlorine, and temperature were carried out and recorded for each composite sample from the different in-situ sources.

The following procedure was undertaken for sampling the water quality.

- Identifying sampling points, assigning codes, and sticking or marking duly signed labels or stickers on each sampling bottle
- Recording the source details and basic information in field data sheet— in the case of automatic samplers, relevant information such as sampling frequency, duration, and

volume of the sample was fed into the instrument (discussed in section below) for collecting samples.
- Collecting hourly water samples for a duration spanning the entire plant operation cycle
- Field testing the quality of on-site water and recording relevant information on raw water, wastewater, and process water in field data sheets.
- Packing and sealing samples, along with ice or gel packs with a record of the sample in the chain of custody document.
- Transporting the samples to the laboratories

Sampling for bacteriological parameters

Samples were collected in aseptic conditions. Before collection of water, the source was sterilized either by flaming it or swabbing it through ethyl alcohol. All samples for bacteriological tests were collected in presterilized bottles. These samples were then transported for testing to the respective laboratories, at the desired temperature, and within the prescribed time duration. [Reference: APHA 20th ed. 1998 (9060: Collection, preservation & storage); IS 1622: 2003(Methods of sampling and microbiological examination of water) and IS 3025 (part 1, sampling)-1987(reaffirmed 2003)]

Sampling instruments/equipments used

Global Water WS700 automatic samplers were used for collecting wastewater from ETPs and STPs. The WS700 composite water sampler is a state-of-the-art water sampler, which can be used to take individual time-weighted composite samples or full-bottle discrete grab samples in a 2-gallon sample bottle. The water sample interval control allows setting the time between individual composite samples and enabling the external trigger mode for flow proportional sampling. A start delay timer allows starting multiple composite or discrete water samplers in the field at the same time. Alternatively, it can delay drawing a water sample after a triggering the event so that the water sample can better represent the water source. An automatic 15-second backflush cycle clears any debris from the strainer and empties the water from the hose so that the next composite sample is not contaminated.

Sample testing

The collected samples were tested for the relevant parameters, as per the recommended guidelines, as mentioned in Table 2.5 (page 2.35). The samples were tested in an NABL, ISO/IEC 17025, ISO-9001 certified laboratory capable of assessing these parameters to the applicable level of detection, as required by law or other norms being evaluated. The parameters that were

consistently found to be present in the samples have been discussed in Chapter 4.

The results observed have been compared for compliance to the relevant guidelines, limits, or requirements, which are as follows.

- For raw water— relevant national standard for drinking water (BIS 10500: 1991) and international guidelines (WHO guidelines for drinking water)
- For process water— relevant national standards
  - BIS 10500: 1991 (drinking water specification)
  - IS 14543: 2004 (packaged drinking water specification)
  - International guideline (WHO guidelines for drinking water)
  - TCCC's internal specification for treated water
- For wastewater discharge— relevant local regulation by state pollution control boards, CPCB (Central Pollution Control Board) guidelines, and TCCC internal quality guidelines

Data reporting

The results of each parameter obtained from the labs were compared with the national and international guideline values or limits. A set of controlled samples (that is, synthesized coded samples or samples of known quality used for comparison of lab performance) was also sent to the two labs along with the usual batch of samples. The criteria for reporting the results of the parameters, in consultation with the Steering Committee, are as follows.

- Parameters that exceeded the limits as compared to the relevant standards/guidelines.
- Parameters whose values were found to be exceeding the limits consistently in at least two of the three rounds monitored.
- Parameters whose values were reported to be in exceedance simultaneously by both the laboratories.
- Wherever there was a deviation from the (c) above, the lab that showed higher levels of confidence in its analysis (that is, results of the control samples in agreement with the experimental results as reported by the lab) was given a priority.

In addition to the above, the water quality was also classified parameter-wise, based on the following criteria.
For ex-situ samples, the parameters were classified as

- Extremely widespread, that is, parameters that exceeded the relevant standard/guideline (IS 10500 or WHO guideline) in more than 50 percent of the cases (all samples for the same parameter taken together) as well as in more than 75 percent of the villages monitored

- Moderately widespread, that is, parameters that exceeded in either
  - more than 50 percent of the samples and in 40 percent to 75 percent of the villages, or
  - less than 50 percent of the samples and more than 75 percent of the villages.
- Thinly widespread— those parameters that showed either one time exceedance or marginal exceedance than the desired limits

For In-situ (in-plant) samples, the parameters were classified as showing

- Large exceedance— parameters that exceeded in more than 75 percent of the samples
- Moderate exceedance— parameters that exceeded in 40 percent to 75 percent of the samples
- One-time exceedance— parameters that either exceeded once or showed marginal exceedance than the desired limits

Transportation and preservation

To keep the integrity and nature of samples intact, all the samples were collected, preserved, and transported as per the guidelines of 'Standard methods for the examination of water and wastewater' (APHA 1998) (Section 1060: Collection and preservation of samples) and IS: 3025 (part 1, Sampling)-1987 (reaffirmed 2003) {Methods for sampling and test (physical and chemical) for water and wastewater}. All the samples were transported within the desired time duration under ice-cooled conditions and with appropriate sealing and preservatives.

Detailed water balance for Kaladera, Rajasthan

On the request of the Steering Committee, and as a departure from the original SoW as described in Chapter 1, detailed regional water modelling was undertaken at the Kaladera site. The modelling helped in understanding the water availability, sectoral drawals particularly agriculture, and impact, if any, of drawal by the plant at the margin. The approach followed here used an integrated modelling technique where the land phase of the hydrological cycle and groundwater simulation was carried out in an integrated manner.

The land phase of the hydrological cycle was simulated using SWAT (Soil and Water Assessment Tool) model (Neitsch, Arnold, Kiniry, *et al.* 2001). Groundwater model MODFLOW [MODular three-dimensional finite-difference ground-water FLOW model] (McDonald and Harbaugh 1988) was used for simulating groundwater flows. Both these models are dynamic and distributed models that are physically based and time

continuous. SWAT has been tested and used successfully for ungauged river basins mainly due to its spatially explicit parameterization capability (Arnold, Srinivasan, Muttiah, *et al.*1998). Also the model has been applied successfully in India as well as world-wide using the scale of datasets as have been used in this study (Gosain, Rao, Srnivasan, *et al.* 2005; Karim, Abbaspour, Yang, *et al.* 2006). Both SWAT and MODFLOW were linked to each other in the project in a dynamic manner such that the outputs of SWAT were used as inputs to MODFLOW. This aspect has been further discussed in the section 'Data preparation for application of the integrated model'.

Data preparation for application of the integrated model

The watershed was delineated using the approach discussed in the section 'Defining the study area'. The sub-basin was taken as the first level of watershed subdivision, defined by surface topography as well as grid cell boundaries. The land area in the sub-basins, by the use of land and soil map (developed from satellite imagery and soil map prepared by NBSS & LUP), is divided into HRUs (Hydrologic response units). The local HRU water balance was presented by three storage volumes— soil profile, shallow aquifer, and deep aquifer. Soil water processes include infiltration, evaporation, plant uptake, lateral flow, and percolation to lower layers. Percolation from the bottom of the soil profile recharges the aquifer (groundwater recharge). The Penman-Monteith method was used to estimate the potential evapotranspiration. Actual evapotranspiration was computed for soil and plants separately using the approach mentioned in (Neitsch, Arnold, Kiniry, *et al.* 2001). Inputs for simulating land phase of the hydrological cycle were, hence, categorized into spatial and non-spatial data. Non-spatial data includes data on weather, crop, irrigation, and groundwater. Spatial data sets pertain to watershed characteristics, land use or land cover, soil type, and drainage network.

In MODFLOW, a finite difference model, grid cells were used to define the spatial extent of watershed and sub-basins. A grid cell, formed by two sets of parallel lines that are orthogonal, was linked to the size of the grid cell used within the sub-basins of the SWAT model. In the centre of each cell is the node—the point at which the model calculates hydraulic head (water levels above the mean sea level). Horizontal grid dimensions are specified in variables DELR (width of cells from left to right) and DELC (width of cells from top to bottom). Data requirements in MODFLOW include defining initial and boundary conditions, aquifer properties, and grid descriptors such as bottom and top elevations, recharge, discharge (wells), porosity, hydraulic conductivity, and anisotropy.

The grid size of each model cell was taken as 200 m × 200 m. Recharge to the model cell was specified as recharge intensity, a SWAT output, having the dimensions of velocity. The model calculated the recharge flux by multiplying the intensity with the grid cell area. The well package simulated pumping wells, using rates specified for each stress (time) period of the simulation. The elevation of the top and bottom layer was required for estimating aquifer (layer) transmissivity. Top layer elevation was taken as an input from DEM model output of SWAT, and bottom elevation was estimated from the available strata charts for the region. Initial conditions were determined by stating the starting heads derived from the DEM of water table elevations, which were obtained from observation wells in the region.

Defining boundary conditions required defining model geometry, and boundary array, in absence of which the model does not execute or carry out simulation. In MODFLOW, three types of grid cells are used to describe boundaries in a layer— inactive (no flow) cells, time variable specified heads, and constant head cells. Inactive cells are those in which no flow – in or out of the cell – occurs during the entire time of simulation. They are designated as number '0' (IBOUND = 0). Time variable specified heads, or active cells, are designated as '1' in IBOUND. Constant head cells are used to describe model boundaries with known heads, such as aquifer contacts, with major surface water that are hydraulically connected to each other. These are designated as '(–) 1' in the IBOUND array. In case of Kaladera, watershed IBOUND of '1' and time variable specified heads have been used. The procedure followed for determining IBOUND used the fence diagram plotted in GMS (Groundwater Modelling System) Version 6.0 with the help of available lithologs and strata charts, together with watershed and sub-basin boundaries from SWAT, as well as, distribution of active cells and IBOUNDS in MODFLOW. This combination of SWAT, strata chart in GMS, and MODFLOW established an accurate representation of the integrated watershed and aquifer systems in the region of study. Sources of the data sets for the integrated modules are presented in Table 2.6

Table 2.6 Various sources of information for the required data sets

Subject area	*Data basis*	*Source and map scale*
Basic data	Administrative boundaries, stream networks	SoI (Survey of India); 1: 50 000
Climatic data	Mean monthly and daily precipitation, daily maximum and minimum temperature, solar radiation, wind speed, potential evaporation	IMD (Indian Meteorological Department)
Soil (physical data)	Soil characteristics (percentage of silt, sand, clay, rocks), field capacity, wilting point, hydraulic conductivity, depth to water table, properties for different soil layers varying with depth	NBSS & LUP (National Bureau of Soil Survey and Land use planning); 1:250 000
Land use data	Ground cover	SoI, satellite images,
Hydrogeological and groundwater fluctuation	Groundwater-bearing lithologic units, transmissivity, hydraulic conductivity, groundwater levels, fluctuations, water use	Central Ground Water Board, state groundwater boards, strata charts
Topography data	Elevation contours	SoI; 1: 50 000
Crop data	Crop yields and types of crops; gross and net cropped areas	Fertilizer Statistics, Fertilizer Association of India

Calibration and validation of the model

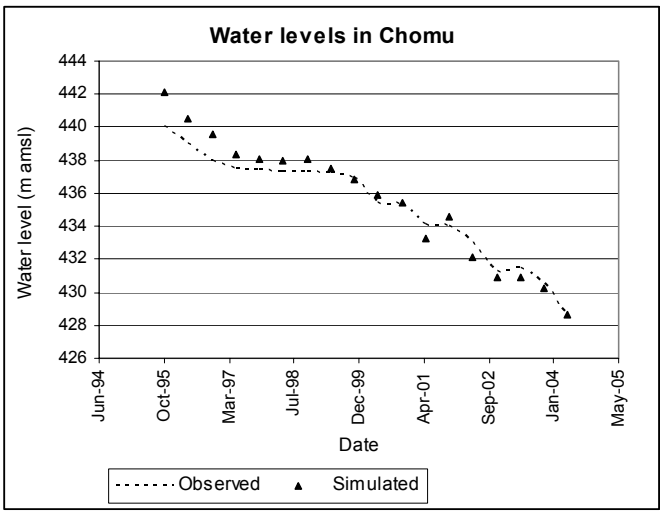
Calibration and validation of the integrated model was done with the help of the observed data on groundwater tables obtained for a time period between 1996 and 2004 from the State and Central Groundwater Boards. No data was available on surface water flows.

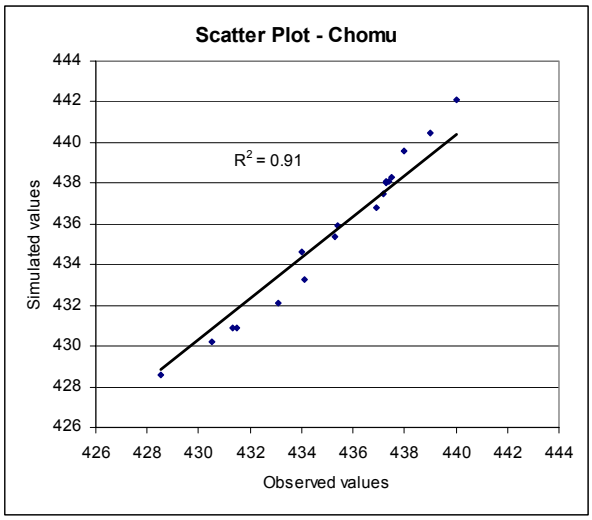
Calibration of groundwater flow in aquifers requires accurate estimations on groundwater heads for calculating groundwater flow direction and hydraulic gradient. The calibration parameters of the integrated model are recharge, aquifer thickness, aquifer hydraulic conductivity, and specific yield, in addition to water use. Thus, the overall calibration procedure in groundwater model involves adjusting the specific yield or storativity, recharge (output of SWAT), and outflows from groundwater, such that the resulting net recharge (inflows minus outflows from aquifer) produced water levels match the observed values. Observation data available on water levels for observation stations is compared with simulated water levels during the calibration periods. A set of two observation wells, namely, Puron ki Dhani and Chomu, were used for model calibration.

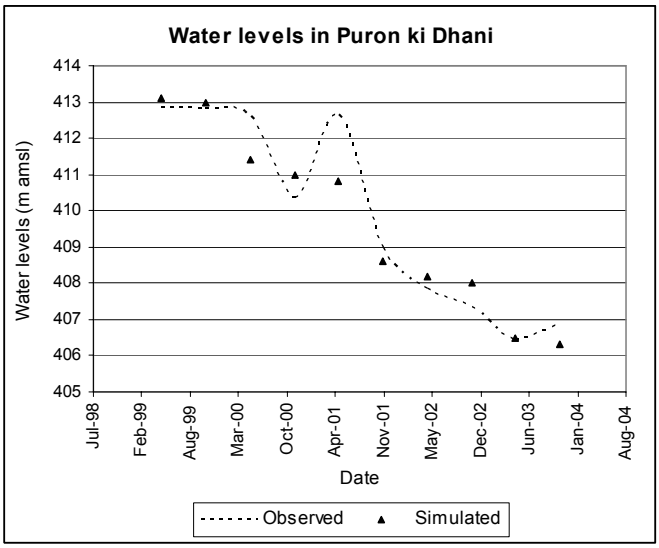
Validation of the model was attempted by comparing the results of the model with an independent data set (without further adjustment) obtained from the CGWB. Additional wells and observation data were used for validation. The integrated model results were authenticated by comparing the simulated data with the observed data for validation wells during the validation period. Two independent wells, Kaladera and N Purohitan, were used for validation of the model. In addition, the pre-monsoon period in the year 2004 was used for model validation, since water table data for the block area – that is, Govindgarh block, which is a part of the watershed (refer to Chapter 4A for details) – was available from the CGWB (CGWB 2004). Hence, regional validation of the integrated model was possible.

For evaluating the model performance during the calibration and validation periods, the R^2 criteria was used. R^2 values above 0.6 are generally acceptable, while values near unity indicate a close relationship between predicted and measured yields.

Figure 2.3 shows the simulation results and scatter plots for comparison of simulated and observed values for calibration wells. Figure 2.4 shows the simulation results and scatter plots for the comparison of simulated and observed values for validation wells as well as for the validation period (pre-monsoon 2004).







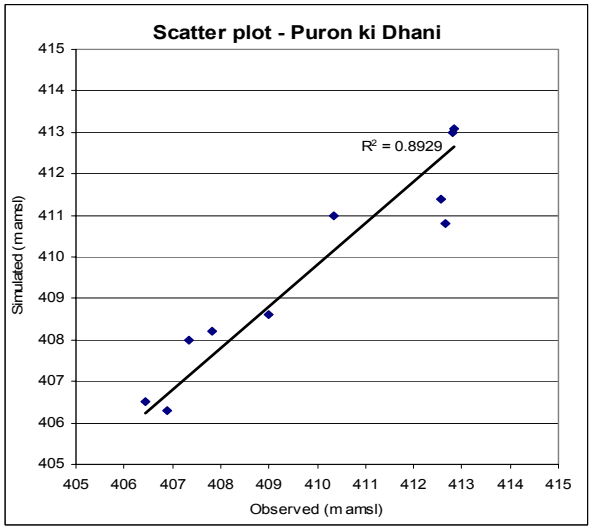


Figure 2.3 Water tables and scatter plots of simulated and observed heads for the calibration wells

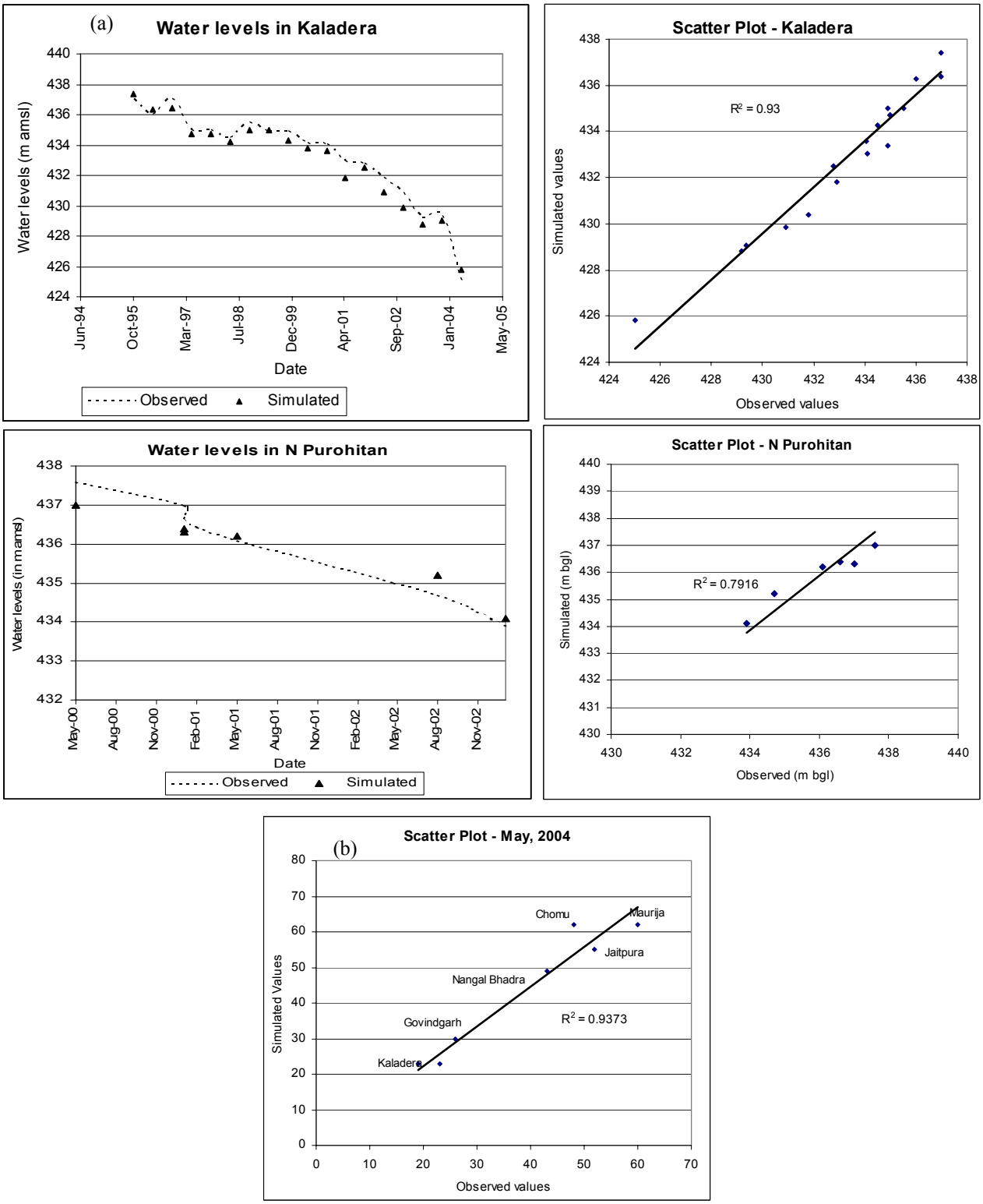


Figure 2.4 (a) Water table and scatter plots of simulated and observed heads for the validation wells **(b)** Scatter plot for the validation period (m bgl) for May 2004

Overall analysis of the groundwater simulation results, obtained for various groundwater observation wells in the calibration wells, showed model performance parameters R^2 values more

than 0.8. This suggested that simulation results obtained for calibration wells of the study were satisfactory and acceptable for further examination in the validation wells and the validation phase.

The simulation results obtained for groundwater recharge for the validation wells and period of May 2004 for all the wells showed R^2 values of more than 0.75, going up to 0.93. These were comparable to the values obtained for the calibration period. This suggested that the simulation during the validation period was satisfactory and stable.

Assessment of localized impact of HCCBPL, Kaladera

The Steering Committee further recommended the study of the impact of plant extractions on the local extent of the aquifer. In order to capture the localized impact, the study focused on groundwater withdrawal by the plant vis-à-vis irrigation pump sets. For that purpose, the model discussed earlier was used again on a smaller grid size of 20 m × 20 m to capture the localized impact (defined as the impact on local aquifer, with its extent spreading radially 1.5–2.0 km of the plant location). The impact was measured using the groundwater extraction data for the four HCCBPL bore wells provided by the plant. Besides this, the discharge data for irrigation pump sets was measured. The measured value for irrigation pump sets and the daily discharge data sets provided by the plant for each bore well were taken as inputs in the validated regional groundwater flow model. Further, a query related to drawdowns was introduced into the watershed model for delineating the localized impact of HCCBPL, Kaladera, if any. The size of the grid cells had to be refined to 20 m × 20 m in order to capture the drawdown curves. The starting heads were derived from the regional model for the transient time period coinciding with the HCCBPL, Kaladera, plant operations. The local model grid was linked with the regional model. Figure 2.5 depicts the linkage of the localized model (that had a 20 m × 20 m grid cell) to the regional model (that had a 200 m × 200 m grid cell).

Results of the regional and localized impact models have been discussed in Chapter 4A.

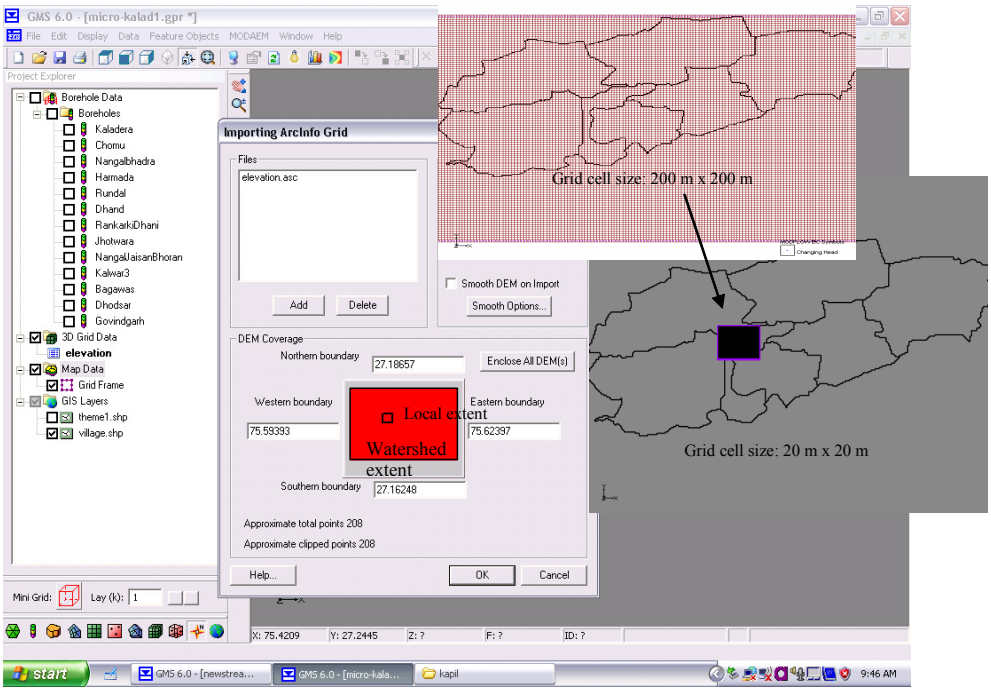


Figure 2.5 Extent of the localized model

Table 2.1 Detailed analysis of information collected from in and around 48 plants – for the purpose of selecting plants

Identification number	*District*	*State*	*Plant type (COBO=1, FOBO=2)*	*Agro ecological zone*	*In-situ indicators*				*Ex-situ indicators*				*Total rank*	*Combined rank*	*Is the plant under controversy?*
					Daily raw water intake in 2004/05		*Daily effluent discharged in 2004/05*		*Fertilizer consumption per net sown area in 2000/01*		*Groundwater development in 2005*				
			Code	Code	m^3/day	Rank	m^3/day	Rank	Ratio	Rank	%	Rank	Rank	Rank	
FIR/NAB/01/02/1310-01	Fatehgarh	Punjab	2	10	537	6	337	8	0.4106	6	161	4	24	1	No
FIR/DAS/01/01/2509-01	Ghaziabad	Uttar Pradesh	1	12	1433	1	829	1	0.3009	13	72	16	31	2	No
FIR/LUD/01/02/1310-01	Ludhiana	Punjab	2	12	386	16	261	13	0.4162	4	144	7.5	40.5	3	No
FIR/BAY/01/02/1310-01	Bareilly	Uttar Pradesh	2	10	830	3	325	9	0.2355	19	87	11.5	42.5	4	No
FIR/HAT/01/02/1310-01	Hathras	Uttar Pradesh	2	12	503	7	410	4	0.1963	23	97	9	43	5	No
FIR/SAH/01/02/1310-01	Sahibabad/Ghaziabad	Uttar Pradesh	2	12	436	11	350	7	0.3009	12	72	15	45	6	No
FIR/BID/01/01/2509-03	Bangalore	Karnataka	1	1	541	5	362	6	0.1091	34	171	2.5	47.5	7	No
FIR/FAI/01/02/1310-01	Faizabad	Uttar Pradesh	2	10	750	4	500	3	0.1569	26	67	22.5	55.5	8	No
FIR/DAN/01/02/1310-01	Hooghly	West Bengal	2	14	450	10	260	14	0.4853	3	39	30	57	9	No
FIR/GUR/01/02/1310-01	Gurgaon	Haryana	2	12	380	17	285	11	0.1686	25	145	6	59	10	No
FIR/NEM/01/01/2509-03	Thiruvellore	Tamil Nadu	1	1	337	18	256	15	0.2388	18	95	10	61	11	No
FIR/AMR/01/02/1310-01	Amritsar	Punjab	2	12	225	26	144	26	0.3851	7	152	5	64	12	No
FIR/KHE/01/01/2509-02	Kheda	Gujarat	1	6	408	13	366	5	0.1705	24	67	22.5	64.5	13	No
FIR/NAJ/01/01/2509-01	Bijnor	Uttar Pradesh	1	10	331	19	226	16.5	0.1999	22	80	13	70.5	14.5	No
FIR/AME/01/01/2509-03	Medak	Andhra Pradesh	1	16	420	12	210	19	0.1442	28	87	11.5	70.5	14.5	No
FIR/VEM/01/02/1310-01	East Godavari	Andhra Pradesh	2	3	326	20	226	16.5	0.3836	8	31	34	78.5	16	No
FIR/BAR/01/02/1310-01	Barabanki	Uttar Pradesh	2	10	292	22	220	18	0.2765	15	60	24	79	17	No
FIR/PUN/01/01/2509-02	Pune	Maharashtra	1	17	479	9	205	20	0.1172	32	70	19	80	18	No
FIR/WAD/01/01/2509-02	Thane	Maharashtra	1	5	1027	2	543	2	0.0742	38	21	40	82	19	No
FIR/LUA/01/02/1310-01	Ludhiana	Punjab	2	12	122	40	92	36	0.4162	5	144	7.5	88.5	20	No
FIR/NAG/01/02/1310-01	Nagpur	Maharashtra	2	7	400	14	320	10	0.0811	37	43	28	89	21	No
FIR/VAR/01/01/2509-01	Varanasi	Uttar Pradesh	1	12	169	33	103	33	0.3439	10	73	14	90	22	Yes
FIR/MOU/01/01/2509-03	Hyderabad	Andhra Pradesh	1	16	480	8	68	38	0.3010	11	31	34	91	23	No
FIR/KAL/01/01/2509-01	Jaipur	Rajasthan	1	12	253	25	176	24	0.0636	42	187	1	92	24	Yes
FIR/TAR/01/02/1310-01	Kolkata	West Bengal	2	14	193	31	120	29.5	0.2736	16	71	17	93.5	25	No
FIR/KES/01/02/1310-01	East Godavari	Andhra Pradesh	2	3	220	29	140	27	0.3836	9	31	34	99	26	No
FIR/HOS1/01/02/1610-02	Bangalore	Karnataka	2	1	320	21	25	45	0.1091	33	171	2.5	101.5	27	No
FIR/SAT/01/02/1310-01	Khammam	Andhra Pradesh	2	16	221	28	98	34	0.5848	2	21	38	102	28	No
FIR/VIJ/01/01/2509-03	Guntur	Andhra Pradesh	1	16	253	24	186	22	0.2860	14	10	46	106	29	No

Identification number	*District*	*State*	*Plant type (COBO=1, FOBO=2)*	*Agro ecological zone*	*In-situ indicators*				*Ex-situ indicators*				*Total rank*	*Combined rank*	*Is the plant under controversy?*
					Daily raw water intake in 2004/05		*Daily effluent discharged in 2004/05*		*Fertilizer consumption per net sown area in 2000/01*		*Groundwater development in 2005*				
			Code	Code	m^3/day	Rank	m^3/day	Rank	Ratio	Rank	%	Rank	Rank	Rank	
FIR/PAT/01/01/2509-01	Patliputra, Patna	Bihar	1	10	168	34	129	28	0.2024	21	52	25	108	30	No
FIR/BAD/01/02/1310-01	Solan	Himachal Pradesh	2	9	400	15	280	12	0.0645	41	15	43	111	31	No
FIR/BHO/01/01/2509-02	Raigarh	Madhya Pradesh	1	4	225	27	180	23	0.0731	39	25	37	126	32	No
FIR/JAM/01/01/2509-01	Gangyal	Jammu and Kashmir	1	9	202	30	151	25	0.0917	35	18	41	131	33	No
FIR/KHU/01/01/2509-02	Khurda	Orissa	1	3	289	23	200	21	0.0549	43	14	44.5	131.5	34	No
FIR/NAS/01/01/2509-02	Nasik	Maharashtra	1	17	92	43	60	39	0.1561	27	50	26	135	35	No
FIR/DAG/01/02/1310-01	Howrah	West Bengal	2	14	24	48	0	48	0.8291	1	21	39	136	36	No
FIR/VIZ/01/01/2509-03	Visakhapatnam	Andhra Pradesh	1	3	179	32	76	37	0.0841	36	34	32	137	37	No
FIR/KUS/01/02/1310-01	Pune	Maharashtra	2	17	100	42	18	46	0.1172	31	70	19	138	38	No
FIR/PAL/01/01/2509-03	Palakkad	Kerala	1	5	57	45	44	40	0.1319	29	44	27	141	39	Yes
FIR/SIL/01/01/2509-01	Jalpaiguri, Siliguri	West Bengal	1	14	157	35	32	44	0.2418	17	4	47	143	40	No
FIR/UNN/01/02/1310-01	Unnao	Uttar Pradesh	2	12	150	36	120	29.5	0.1295	30	69	48	143.5	41	No
FIR/BIL/01/02/1310-01	Bilaspur	Chattisgarh	2	4	120	41	96	35	0.0674	40	34	31	147	42	No
FIR/GOA/01/01/2509-02	Salcete	Goa	1	5	138	38	115	31	0.0000	48	26	36	153	43	No
FIR/JOR/01/01/2509-01	Jorhat	Assam	1	14	146	37	108	32	0.0282	45	14	44.5	158.5	44	No
FIR/JAB/01/02/1310-01	Jabalpur	Madhya Pradesh	2	7	52	46	40	41	0.0530	44	42	29	160	45	No
FIR/PER/01/02/1310-01	Erode	Tamil Nadu	2	1	50	47	12	47	0.2176	20	70	48	162	46	No
FIR/JAS/01/01/2509-01	Saraikela Kharswa	Jharkhand	1	3	137	39	36	43	0.0085	46	17	42	170	47	No
FIR/GUW/01/01/2509-01	Ribhoi	Meghalaya	1	15	65	44	36	42	0.0016	47	1	48	181	48	No

Note The shaded rows indicate the selected plants for the study

Table 2.2 Agro-ecological regions and their descriptions

Code	*Descriptions of agro-ecological regions*
1	Eastern Ghats Tamil Nadu Uplands, Red Loamy Soils, Semi Arid 90-150 days
2	Eastern Coastal plain, Alluvium,Sub humid with growing 90-210 days
2	Eastern Coastal plain, Alluvium,Sub humid with growing 90-210 days
2	Eastern Coastal plain, Alluvium,Sub humid with growing 90-210 days
3	Eastern Plateau red and lateritic soils, Sub-humid and growing150-180 days
4	Eastern Plateau red and lateritic soils, Sub-humid and growing150-180 days
5	Western Ghat, Red and Lateritic Soils, Perhumid to subhumid, grow > 210 day
6	Central Highlands, medium to dark black soils, semi-arid and 90-150 days
7	Central Highlands, Red and Black Soils, Sub-humid with 150-210 days
8	Western Himalays, Shallow skeletol soils, Arid with less than 90 days
9	Western Himalayas, Brown Soils and Podzolic Soils, Sub-humid, 180-210 days
10	Northern Plain, Alluvium Derived Soils, Sub-humid, 150-180 days
11	Western Plain, Desert and Saline Soils, Arid, less than 90 days
12	Northern Plain, Alluvium Derived Soils, Semi-Arid, 90-150 days
13	Eastern Plain, Alluvium Derived soils, subhumid with 180-210 days
14	Eastern Plain, Red and Yellow soils, Perhumid-Subhumid, with > 210 days
14	Eastern Plain, Red and Yellow soils, Perhumid-Subhumid, with > 210 days
15	North Eastern Hills, Red and Lateritic soils, Perhumid and greater 210 days
16	Decaan Plateau, Red and Black Soils, Arid and growing period less than 90 days
16	Decan Plateau, Red and Black Soils and Semi Arid with between 90-150 days
17	Decan Plateau, Black Soils and Semi-Arid with growing period between 90-150 days

Table 2.5 Test parameters (revised)

Source of samples	*Test Parameters*	*Protocol or relevant guidelines*
1 Raw water and 2 Process water	Physiochemical parameters— pH, Color, Odor, Taste, Alkalinity, TSS, TDS, Turbidity, Sulphate, Nitrate, F, Fe, Chloride, Ca, Mn, Cu, Hg, Cd, Se, As, Al, Pb Zn, Cr, CN, Mineral oil, Anionic surfactants (MBAS) Na, Nitrites, Ni, Mg, Ba, Ag Pesticides— Aldrin, Alachlor, Butachlor, HCH-Alpha, HCH-Beta, HCH-Gama(Lindane), HCH-Delta, Dieldrin, Endosulfan (Alpha, Beta, Sulphate), 2,4-DDD, 4,4-DDD, 2,4-DDE, 4,4-DDE, 2,4-DDT, 4,4-DDT, Atrazine, Chloropyriphos, Ethion, Isoproturon, Malaoxon, Malathion, Methyl-Parathion, Methyl-Paraxon, Monocrotophos, Phorate, Phorate Sulphoxide, Phorate Sulphone, 2,4-D. Bacteriological parameters— MPN Coliform, Faecal Coliform, Other Microbiological parameters— *E. Coli* (Protozoan Cysts): Giardia Lamblia & Entamoeba hystolitica.	BIS:10500 (Drinking water specification); BIS 14543 (Packaged drinking water specification), BIS: 3025 (water and wastewater); USEPA (US Environment Protection Agency); APHA 20th edition 1998
Wastewater or Effluent	Physiochemical parameters— pH, BOD, TDS, TSS, O&G, Nitrate-Nitrogen, phosphates, Chlorides, Anionic surfactants (MBAS), Alkalinity, Turbidity, Sulphate, Ca, Color, Odor, COD, F, Sulphide, NH_3, Kjeldahl-N, Total Residual Cl_2, Phenolic compounds, Mn, Fe, V. Bacteriological parameters— MPN Coliform, Faecal Coliform Heavy metals— As, Hg, Hexavalent Cr, Total Cr, Pb, Cd, Cu, Zn, Se, Ni, CN, Bio-assay test Pesticides— Aldrin, Alachlor, Butachlor, HCH-Alpha, HCH-Beta, HCH-Gama(Lindane), HCH-Delta, Dieldrin, Endosulfan (Alpha, Beta, Sulphate), 2,4-DDD, 4,4-DDD, 2,4-DDE, 4,4-DDE, 2,4-DDT, 4,4-DDT, Atrazine, Chloropyriphos, Ethion, Isoproturon,	APHA 20th edition 1998; BIS 3025, USEPA.

	Malaoxon, Malathion, Methyl-Parathion, Methyl-Paraxon, Monocrotophos, Phorate Sulphoxide, Phorate Sulphone, 2,4-D.	
Ground water	Physiochemical parameters— pH, Color, Odor, Taste, Alkalinity, TSS, TDS, Turbidity, Sulphate, Nitrate, F, Chloride, Ca, Mineral oil, Anionic surfactants (MBAS) Na, Nitrites, Mg, Ba, Nutrients— N, P, K Heavy metals— As, Hg, Hexavalent Cr, Total Cr, Pb, Cd, Cu, Zn, Se, Ni, CN, Fe, Mn, Al, Ag Bacteriological parameters— MPN Coliform, Faecal Coliform Pesticides— Aldrin, Alachlor, Butachlor, HCH-Alpha, HCH-Beta, HCH-Gama(Lindane), HCH-Delta, Dieldrin, Endosulfan (Alpha, Beta, Sulphate), 2,4-DDD, 4,4-DDD, 2,4-DDE, 4,4-DDE, 2,4-DDT, 4,4-DDT, Atrazine, Chloropyriphos, Ethion, Isoproturon, Malaoxon, Malathion, Methyl-Parathion, Methyl-Paraxon, Monocrotophos, Phorate, Phorate Sulphoxide, Phorate Sulphone, 2,4-D	BIS:10500; BIS 3025; USEPA; APHA 20th edition 1998

Note The parameters highlighted in blue are those that were recommended by the Steering Committee in addition to the scope of work.

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CHAPTER 3 Regulatory and governance framework

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CHAPTER 3 Regulatory and governance framework

This chapter provides a background of the government regulatory and TCCC (The Coca-Cola Company) corporate policy governing the usage of water for industrial purposes in India. In view of this, the chapter gives the regulatory and corporate context within which the Coca-Cola bottling plants operate in India. It also provides an overview of TCCC policy on CSR (corporate social responsibility) and concerns with respect to water therein.

Laws and regulations on industrial use of water: an overview

Water in the regulatory framework in India

This section provides an overview of the policies and laws prevalent in India with respect to water drawal, usage, and wastewater disposal, specifically by industrial units. In this context, the Constitution of India empowers the states to enact laws for the regulation and development of all water resources within their territories.[1] The issues related to inter- state surface waters fall under the jurisdiction of the Union government.[2] Industrial usage of water has three components: drawal, usage, and wastewater disposal. Table 3.1 summarizes the regulatory framework with respect to water in India, relevant for water-intensive industries.

Table 3.1 Applicable regulatory framework for water-using industries

Component of regulation	*Applicable regulatory framework for water-using industries*
Ownership of water	Government of India Act: The Easement Act 1882—private rights to groundwater since it is viewed as an attachment to land; surface water is state property
Drawal of water	State subject: few states have enacted and implemented water resources legislation
Usage of water	Government of India Act: Water (Prevention and Control of Pollution) Cess Act, 1977, amended in 1992 and 2003, and Rules thereof provide for the collection of a cess on water consumed by industry
Wastewater disposal	Government of India Act: Water (Prevention and Control of Pollution) Act, 1974, amended in 1998, and Rules thereof provide norms for wastewater disposal and prevention and control of water pollution

[1]Entry 17, List II (State List) of the Constitution: 'Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provisions of entry 56 of List I.'
[2] Entry 56, List II (Union List) of the Constitution: 'Regulations and development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest.'

In addition to the above, the NWP (National Water Policy), 2002, provides policy directions for judicious water use. This section focuses on the NWP and laws pertaining to the drawal and disposal of water by water-intensive industries.

The National Water Policy: providing direction

India first adopted a NWP in 1987; a new NWP was formulated in 2002. A major thrust under NWP, 2002, is the need for water resources planning; it advocates that water resources should be brought within the category of utilizable resources to the maximum possible extent. The policy promotes both non-conventional methods as well as traditional water conservation practices, like rainwater harvesting and rooftop rainwater harvesting, to increase the amount of water resources that can be utilized. It also says that water should be made available to water-deficit areas by transferring it from other areas, including transferring from one river basin to another, based on a national perspective, after taking into account the requirements of the areas or basins. It espouses the need for utmost efficiency in water utilization and public awareness on the importance of water conservation.

NWP, 2002, demarcates water allocation priorities in the planning and operation of systems in the following order: drinking water; irrigation; hydropower, ecology; agro-industries and non-agricultural industries; navigation; and other uses. The priorities can be modified or added to, if warranted by area- or region-specific considerations, although the drinking water needs of human beings and animals should be given the topmost priority. For instance, while most states accord greater priority to agriculture relative to industry in their water policies, Maharashtra prioritizes the water needs of industry ahead of agricultural requirements.

With respect to groundwater, NWP provides for a periodic reassessment of the groundwater potential on a scientific basis, taking into consideration the quality of the water available and economic viability of its extraction; it advocates that exploitation of groundwater resources should be so regulated as not to exceed the recharging possibilities, as also to ensure social equity. The policy requires the detrimental environmental consequences of the overexploitation of groundwater to be effectively prevented by the central and state governments, and groundwater recharge projects to be developed and implemented for improving both the quality and availability of groundwater resources. The NWP also stresses the importance of integrated and coordinated development of surface water and groundwater resources; their conjunctive use should form an integral part of the project implementation.

In addition to the above, the NWP also emphasizes on: (i) the need for an efficient pricing system for water and the development of a targeted and transparent subsidy structure for water rates for the disadvantaged and poorer sections of society; (ii) the development of a participatory approach to water resource management with a view to eventually transfer the management of such facilities to user groups and local bodies; (iii) private sector participation in the water sector; (iv) the necessity of undertaking a phased programme for improvement in water quality according to the 'polluter pays' principle, where applicable; (v) the need to base economic activities on the water zoning of the country; (vi) the promotion of water conservation consciousness in the country; and (vi) prioritizing the needs of drought-prone areas while planning water resource development projects.

While the NWP provides directions with respect to some dimensions of water resource management in the country, its success will depend, as stated by it, on the evolution and maintenance of a national consensus and commitment to its underlying principles and objectives. The NWP, therefore, recommends that the states should formulate their own state water policies, tailored to their specific conditions, with an operational action plan to be followed in a time-bound manner. Amongst the states assessed in the study, Rajasthan, Uttar Pradesh, Tamil Nadu, and Maharashtra have formulated state policies on water while Andhra Pradesh and Punjab[3] do not have state water policies.

Water laws in India

Several states in India have exercised their Constitutional rights to enact laws on water resource regulation and management, although the scopes of the regulations differ. Amongst the states included in this assessment, Tamil Nadu and Maharashtra have enacted laws on groundwater use; Rajasthan and Uttar Pradesh are in the process of enacting laws on groundwater; and Andhra Pradesh has enacted a comprehensive law on groundwater and surface water.[4]

Mounting concerns over depreciating groundwater levels prompted the central government to pass a Model Ground Water Bill in 1970, which contained a broad framework of groundwater regulations as a suggestion to the states. Amended in 1992, 1996,

[3] Reports suggest that a draft water policy was circulated in Punjab in 2004, based on the National Water Policy 2002. Details available at <http://www.countercurrents.org/en-dutt120207.htm>, last accessed on 21 July 2007.
[4] Andhra Pradesh Water, Land and Tress Act, 2002; Maharashtra Groundwater (Regulation for Drinking Water Purposes) Act, 1993; Tamil Nadu Groundwater (Development and Management) Act, 2003; Draft Rajasthan Groundwater (Rational Use and Management) Act, 2005, pending in the State Assembly; a draft bill has been prepared in Uttar Pradesh. Details available at <http://cgwb.gov.in/gw_profiles/st_up.htm>, last accessed on 27 June 2007.

and 2005 by the Ministry of Water Resources, the Model Bill provides for the establishment of a state or union territory groundwater authority in the concerned state and lays down its powers, including the power to notify areas to regulate and control the development and management of groundwater. With respect to notified areas, the Model Bill calls for the registration of existing wells[5] and the necessity of seeking permission to dig new wells from the groundwater authority established under the law. Permission to dig new wells in notified areas may be granted subject to specific conditions; for example, the mandatory provision of artificial recharge structures.

However, the Model Bill does not comment on the implications of such registration in terms of a groundwater withdrawal limit and monitoring of groundwater withdrawals from the wells. Also, the Model Bill does not comment on the allocation priorities of groundwater between different sectors during times of water scarcity, the imposition of user charges on groundwater extraction by industries or other agents, or the formation of public–private partnerships or water users' associations to regulate locale-specific groundwater usage. In addition to the above, there does not appear to be any provision for ensuring a groundwater withdrawal limit.

The two water-centric laws applicable in most states in the Indian Union, the Water (Prevention and Control of Pollution) Act, 1974, and the Water (Prevention and Control of Pollution) Cess Act, 1977, are primarily concerned with the prevention and control of water pollution. While the former establishes an institutional structure for preventing and abating water pollution, the latter provides for the levy and collection of cess or fees on water-consuming industries and local authorities. Importantly, the scope of the Water Cess Act is to levy differential water-usage rates, depending on the purpose groundwater extraction serves, to ensure that records are maintained of the extent of groundwater withdrawals. The laws are discussed in subsequent sections.[6]

The Water (Prevention and Control of Pollution) Act, 1974, as amended in 1978 and 1988

The PCBs (pollution control boards) constituted under the Water (Prevention and Control of Pollution) Act, 1974, undertake the functions relating to pollution prevention and control, and maintaining or restoring the wholesomeness of water. Industries covered under the provisions of this Act are required to obtain a CtE (Consent to Establish); the CtE is a one-time consent, required for the establishment of a new unit or before carrying out

[5] Model groundwater bill sourced from http://www.ielrc.org/content/e0506.pdf, last accessed on 6 June 2007.
[6] As per Schedule I of the EIA (Environment Impact Assessment) notification, 1994, the soft drink industry was not required to get an EIA conducted to obtain environmental clearance for the project, therefore, the EIA notification of 1994 is not being discussed

any expansion or modernization in an existing unit. The CtE specifies the requirements and conditions to be incorporated, primarily with respect to effluent disposal, while setting up the industry. Respective state PCBs frame the conditions of CtE, tailored to the existing environmental conditions and the operational characteristics of the industrial unit.

It is mandatory for units established under the CtE to obtain a CtO (Consent to Operate) before commencing commercial production under the provisions of the Water (Prevention and control of Pollution) Act, 1974, and Air (Prevention and control of Pollution) Act, 1981. TCCC plants are covered under the Water Act and hence required to obtain both the CtE and the CtO. The CtO is granted once the industrial unit has met the requirements specified within. It lays down conditions pertaining to pollution control and effluent disposal, to be followed during the operation of the facility. The requirements of both the CtE and the CtO are formulated by the respective state PCBs and, therefore, may differ from state to state, and depend on the ecological sensitivity of the location. Table 3.2 lists the water-related subjects covered by the two consents with respect to the Coca-Cola plants in the six states under assessment.

Table 3.2 Coverage of the Consent to Establish and Consent toOperate

Issues covered in CtE and CtO	*Nabipur (franchisee)*	*Kaladera*	*Mehndiganj*	*Pirangut*	*Sathupalle (franchisee)*	*Neemam*
	Mentioned in consent	*Mentioned in consent*	*Mentioned in consent*	*Mentioned in consent*	*Mentioned in consent*	*Mentioned in consent*
Limits for discharge of wastewater	√	√	√	√	√	√
Limits for water withdrawal	NA	NA	NA	NA	√	NA
Mode of discharge of wastewater	√	√	√	√	√	√
Compliance with standards	√	√	√	√	√	√
Requirement of sampling and flow measurement of wastewater	√	NA	√	NA	NA	NA
Submitting test reports and environmental statements to PCB	√	√	√	√	√	√
Rainwater harvesting, water recycling, and conservation	√	√	√	√	NA	√

CtE – Consent to Establish; CtO – Consent to Operate; PCB – pollution control board

Unlike the CtE, CtO is granted for a specific period, the validity of which is determined by individual states; an industrial establishment needs to apply for its renewal at the PCB to sustain operations. However, there does not appear to be any provision, as of now, that directly links the renewal of the CtO, or even the terms and conditions contained in the CtO, to the quantum of water usage by industrial units. Further, PCBs categorize

industries as green, orange or red, depending on the impacts of their operations on the receiving environment. Green industrial units are 'non-polluting units' or those that generally do not require pollution control devices; orange category units are classified as polluting industries or those with the potential to cause pollution; and highly polluting industries are categorized as red. However, in the state of Punjab (a state included in the assessment in this study), industries are classified under only two categories—green and red. Industrial units under orange and red categories are monitored with respect to their compliance with the requirements stated in the CtE and CtO issued by the state PCB; these units are required to set up pollution abatement devices like ETPs (effluent treatment plants).

The Water (Prevention and Control of Pollution) Cess Act, 1977, as amended in 1991

The Water (Prevention and Control of Pollution) Cess Act, 1977, (hereinafter called the Water Cess Act) provides for the levy and collection of a cess on water consumed by industries and local authorities, with a view to augment the resources of the CPCB (Central Pollution Control Board) and the SPCBs (state pollution control boards), constituted under the Water (Prevention and Control of Pollution) Act, 1974, to prevent and control water pollution and to encourage conservation of water.

Industries and local bodies have to affix meters for the use of water and file cess returns by the fifth day of every month, in specified forms, to the SPCBs. Water cess is charged at rates notified by the central government; these were last amended in 2003.

Column 3 in Table 3.3 provides the water cess rates applicable to the Coca-Cola plants under assessment in the study[11]. In this context, since the levying of water cess necessarily requires the documentation of groundwater extraction by industrial units, the Water Cess Act provides a legal framework for quantifying water extraction by industrial units in India.

[11] Rates verified from site visits to the plants and the concerned SPCBs (state pollution control boards); it remains to be verified why the plants pay the rates under column 3, since non-compliance was not reported by any of the SPCBs in the regions of the six plants in this assessment.

Table 3.3 Water cess rates applicable to the Coca-Cola plants in the assessment[12]

Purpose for which water is consumed (1)	Maximum rate of cess under Sub-section (2) of Section 3[13] (2)	Maximum rate under Sub-section (2A) of Section3[14] (3)
Industrial cooling, spraying in mine pits or boiler feeds	5 paise/kl	10 paise/kl
Domestic purposes	2 paise/kl	3 paise/kl
Processing whereby water gets polluted and the pollutants are (i) easily biodegradable or (ii) non-toxic or (iii) both non-toxic and easily biodegradable	10 paise/kl	20 paise/kl
Processing whereby water gets polluted and the pollutants are (i) not easily biodegradable or (ii) toxic or (iii) both toxic and not easily biodegradable	15 paise/kl	30 paise/kl

Under the 2003 amended Water Cess Act, the central government has been empowered by notification to exempt any industry consuming water below 10 KLD (kilolitres per day) from the payment of water cess. However, no provision exists for a progressively higher cess rate based on quantum of groundwater extraction above the quantity specified in the notification. Also, no provision exists for the cess rate to be based on the status of groundwater availability in an area.[15]

The Environmental (Protection) Act, 1986

The Environment (Protection) Act, 1986 (hereinafter called EPA 1986), enacted in India to implement the commitments made at the Stockholm Conference, is an overarching legislation that relates to the protection and prevention of hazards to human beings, other living creatures, plants, and property. In the context of water, it provides a framework for the coordination of central

[12] S.O.499 (E), [6/5/2003]—rate of cess notified under the Water (Prevention and Control of Pollution) Cess (Amendment) Act, 1977 (36 of 1977).
[13] Under this section of the Water Cess Act, cess shall be payable by
(a) every person carrying on any industry; and (b) every local authority,
and shall be calculated on the basis of water consumed by such person or local authority for any of the purposes specified in column 1 at rates specified in column 2.
[14] This section states that any person carrying on any industry or any local authority consuming water for domestic purpose liable to pay cess fails to comply with any of the provisions of Section 25 of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974) or any of the standards laid down by the central government under the EPA (Environmental Protection Act) 1986, cess shall be and payable at such rate specified in column 3.
[15] Recent statements from the Ministry of Water Resources indicate that upward revisions of the water cess rates are being considered; however, no time frame has been mentioned (*The Economic Times* 2007).

and state authorities established under the Water (Prevention and Control) Act, 1974.

Environmental protection rules framed under EPA 1986 (Sections 6 and 25) lay down the procedures for setting standards of emission or discharge of environmental pollutants, and prescribe the parameters under which the central government can issue orders of prohibition and restrictions on the location and operation of industries in different areas[16]. In addition to the above, an industry, operation or process requiring a CtE and a CtO under the Water (Prevention and Control of Pollution) Act, 1974, or under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981, or both, or authorization under the Hazardous Wastes (Management and Handling) Rules, 1989, is required to submit an annual environmental audit report for the financial year ending on 31 March.[17]

All the six Coca-Cola plants under assessment are required to submit their annual environmental report to their respective SPCBs, as required by the EPA.

The assessment and administration of groundwater extraction and use

This section provides a brief on the CGWB (Central Ground Water Board) and the CGWA (Central Ground Water Authority), both of which are associated with the extraction and use of groundwater resources in India; they function under the administrative control of the Ministry of Water Resources. It also touches upon the move to institutionalize the development of groundwater resources in all the states in the Indian Union.

Central Ground Water Board

The CGWB, established in 1972, is vested with the mandate to develop and disseminate technologies for scientific and sustainable development, and management of India's groundwater resources. For this, it undertakes groundwater monitoring, exploration, assessment, and measures for groundwater augmentation. The CGWB performs its function through its technical wings, regional offices, state unit offices, and divisional offices. In the course of discussions between TERI and CGWB officials, the following were highlighted in the context of the role played by the CGWB for the development and management of groundwater in the states of the Indian Union.

[16] The factors to be considered while prohibiting or restricting industrial location, operations or processes include (i) the net adverse environmental impact likely to be caused by an industry, process or operation; (ii) proximity to human settlements; (iii) any other factor as may be considered by the central government to be relevant to the protection of the environment in an area.

[17] This has to be submitted in the prescribed form to the concerned state pollution control board on or before 30 September every year.

- CGWB investigations provide a scientific base for the preparation of groundwater development schemes by the state governments.
- Areas affected by groundwater depletion, sea water ingress, and groundwater pollution are accorded priority, and special studies are undertaken to assess the magnitude of the problem and suggest remedial measures.
- A committee is constituted with representatives of the CWGB and concerned state government for the locale-specific estimation of water level.

Central Ground Water Authority

The Ministry of Environment and Forests, Government of India, constituted the CGWA in 1997, under the directions of the Supreme Court[18] to accord priority to groundwater management in the country. Since water is a state subject in India, the CGWA was established under the EPA1986[19], discussed previously, initially for one year and then subsequently it was declared a permanent body;[20] it is also empowered to take penal measures that protect and improve the groundwater situation in the country.[21] The CGWA takes into consideration results obtained from investigations carried out by the CGWB for groundwater regulation and control. In terms of composition, the CGWA is headed by the chairman, CGWB, and comprises four members from the CGWB and several members from different administrative departments of the Government of India; however, it does not feature any representation from the state governments.

The CGWA has categorized areas in India as safe, semi-critical, critical, and overexploited with respect to groundwater development: to date, a total of 839 areas have been assessed as overexploited and 226 areas have been assessed as critical in the country. However, out of the above, only 43 critical and

[18] The Supreme Court directive to constitute the CGWA (Central Ground Water Authority) was in response to a PIL (Public Interest Litigation) filed, voicing concern at the alarming depletion of groundwater in the state of Delhi.
[19] Under Sub-section (3) of Section 3 of the EPA (Environmental Protection Act) 1986, the central government may, if it considers it necessary or expedient to do so for the purpose of this Act, by order published in the Official Gazette, constitute an authority or authorities by such name or names, as may be specified in the order, for the purpose of exercising and performing such of the powers and functions (including the power to issue directions under Section (5) of the central government under this Act and for taking measures with respect to such of the matters referred to in Sub-section (2) as may be mentioned in the order and subject to the supervision and control of the central government and the provisions of such order, such authority or authorities may exercise and powers or perform the functions or take the measures so mentioned in the order as if such authority or authorities had been empowered by this Act to exercise those powers or perform those functions or take such measures
[20] Gazette notification of the Ministry of Environment and Forests, New Delhi, pertaining to the establishment of the CGWA, dated 14 January 1997 (as amended on 13 January 1998, 5 January 1999, and 6 November 2000) S.O.38 (E); No. S.O. 40 (E); and No. S.O (1024) E.
[21] EPA (Environmental Protection Act) Section 15. penalty for contravention of the provisions of the Act and the Rules, orders and directions, and Section 16: offences by companies.

overexploited areas[22] have been notified till date for the regulation of groundwater development, while registration of existing groundwater structures have been mandated in another 65 areas.[23] As per discussions between TERI and the CGWA, the registration of existing groundwater structures in a critical or overexploited area serves as a prelude to the regulation of groundwater development in the notified areas. The construction of new groundwater structures is prohibited in the areas notified for regulation, the exception being drinking water supply structures constructed by the government agencies; the concerned district magistrates have been directed under Section 5 of the EPA 1986 to regulate groundwater development in these notified areas.

It was understood from TERI's discussions with the CGWA officials that a list of these critical and overexploited areas has been circulated to the Ministry of Environment and Forests and the SPCBs; the latter is required to refer applications for the establishment of new industries or projects in these areas to the CGWA for getting clearance. However, there does not appear to be any mandate for the CGWA to decrease or stop groundwater withdrawal by industrial units in areas that have been declared as critical or overexploited subsequent to their establishment.

Groundwater assessment and administration in states

In the last few years, some states in India have moved towards instutionalizing water resource regulation and management with the establishment of water regulators through enabling legislations. Maharashtra enacted the Maharashtra Water Resources Regulatory Authority Act in 2005 and established the MWRRA (Maharashtra Water Resources Regulatory Authority), and some states (for example, states of Gujarat and Karnataka) are in the process of setting up regulatory institutions for water with a variety of powers and functions ascribed to them. Many states also have a state groundwater department, either under the PHE (public health and environment) department or the PWD (public works department); these departments are primarily concerned with the monitoring and assessment of groundwater levels in the respective states, albeit at more disaggregated geographical levels than the CGWB. They are also associated with the CGWA and the CGWB, primarily as sources of information on the status of groundwater development in various areas in their respective states.[24]

[22] Details available at <http://cgwb.gov.in/GroundWater/authority_area.htm>, last accessed on 21 June 2007.
[23] Details available at <http://cgwb.gov.in/GroundWater/authority_area_regulation.htm>, last accessed on 2 July 2007.
[24] As per discussions between TERI, CGWA (Central Ground Water Agency), and CGWB (Central Ground Water Board) officials.

The Coca-Cola Company's corporate policy on water usage

This section provides an overview of the water resource management practices of Coca-Cola. It draws exclusively on information shared by TCCC and CCI. As a background to the overview, it notes the reported organizational structure of TCCC, and highlights the administrative framework within the organization with respect to water resource management.

The organizational structure of Coca-Cola

'The Coca Cola System', as reported, comprises TCCC, franchise bottlers, and TCCC-owned bottlers. In 2005, the 'system' was divided into two independent operational segments, the division operating system and the bottling system, headed by a common administrative chief. The division operating system is responsible for laying the overall administrative framework in terms of company policies, compliance requirements, monitoring systems, and manufacturing the concentrates, beverage bases, and syrups. There are six groups[27] that administer over several divisions, with each division being responsible for operations in one or more countries. As conveyed by Coca-Cola, the bottling system, termed the BIG (bottling investment group), was established as a separate entity with its own president to consolidate company-owned bottling operations around the world.[28] COBOs (company-owned bottling operations) in countries report to BIG: COBOs are grouped under specific regions, and the director of each region reports to the president of BIG. FOBOs (franchise-owned bottling operations) are independently managed; Cola-Cola informed TERI that all franchisees have to ensure compliance with legal and TCCC requirements on environmental management standards.

The two Coca-Cola entities in India are CCI (Coca-Cola India) and the HCCBPL (Hindustan Coca-Cola Beverages Pvt. Ltd) company. The separation of divisional and bottling responsibilities was brought about in India in August 2005, when the HCCBPL started functioning as an independent company with its own administrative structure. The HCCBPL is responsible for all COBOs in India while CCI oversees operations in six countries: India, Sri Lanka, Maldives, Bangladesh, Nepal, and Bhutan.

Administering water resources management in the Coca-Cola System

Figure 3.1 explains the responsibilities with respect to water resource management at different levels of operation in Coca-Cola; the explanation is in the context of India, given based on the information made available to TERI by Coca-Cola. With respect to

[27] The six groups are Africa, Eurasia, European Union, Latin America, North America, and the Pacific.
[28] Currently, in 14 countries.

the above, there are two components to water resource management within TCCC: requirements and guidelines. As reported by Coca-Cola, it is mandatory for all bottling operations around the world to comply with the requirements; compliance of bottling units with the requirements is monitored by TCCC through an independent third party audit programme. Guidelines are formulated as suggestions; the appropriateness of their implementation at a facility is to be decided upon by the concerned operator; TCCC notes that these provide an approach to contingency planning and continuous improvement towards enhanced efficiency in water use, and minimum impact on water resources.

Water resource management in The Coca-Cola Company

Water resource management practices in the bottling operations of TCCC are assessed primarily from four perspectives: the water context in the siting decision of a bottling plant; water drawal and usage; wastewater disposal; and tracking compliance with legal and company requirements with respect to water resources. This section provides an overview of Coca-Cola's corporate practices with respect to each of the above.

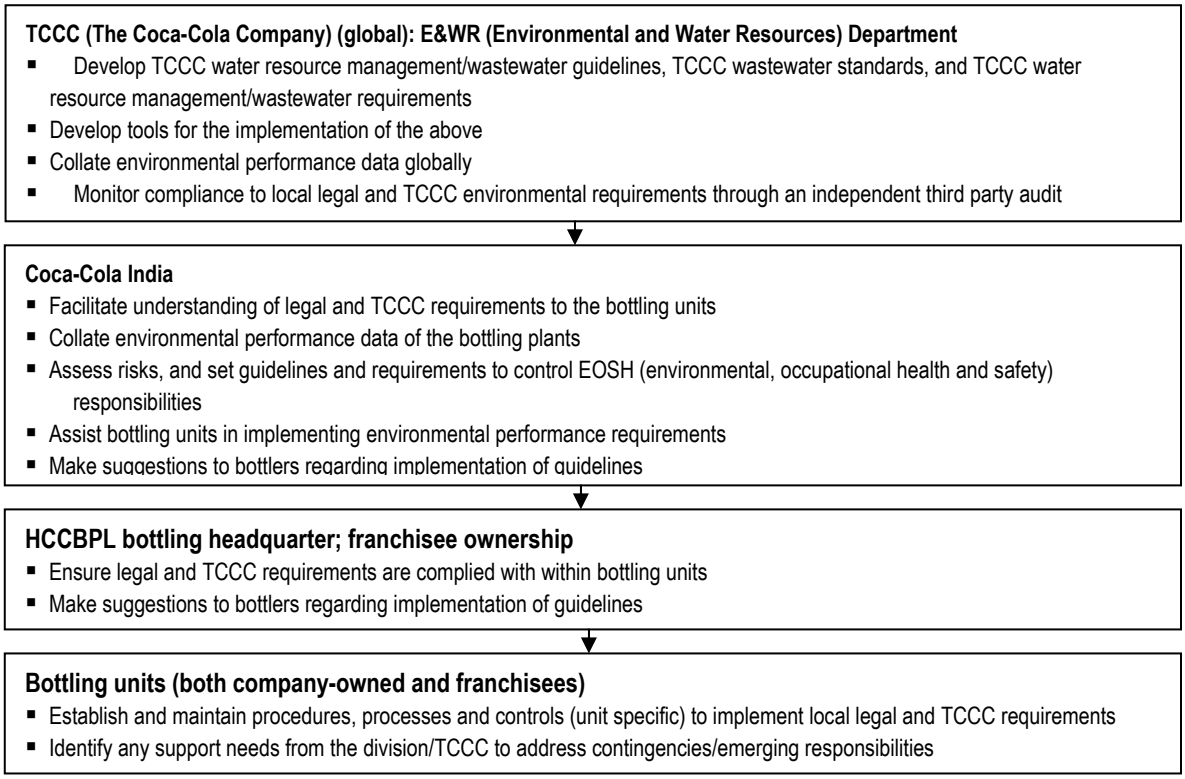


Figure 3.1 Water resource management: administrative responsibilities

Water in the siting decision of a plant

As per TCCC requirements, an EDD[29] (environmental due diligence), has to be conducted prior to selecting the site of a bottling plant or acquiring existing bottling operations. The requirements for the implementation of the EDD process, shared by the company, include the following water-related exercises: an evaluation of the water supply (current and future); and reviews and assessments of property, government or historical records and permits pertaining to environmental issues, particularly soil or water contamination. The documents received from Coca-Cola state that the evaluation of current and future water supply should include issues of access, availability, quality, social and community perceptions, and NGO (Non-governmental organization) activism relating to water in the area.

The EDD can be extended up to three phases (Table 3.4). The second and third phases would be required only if the Phase 1 exercise shows that the property or the adjoining vicinity may be 'environmentally contaminated', primarily due to the presence of hazardous substances or waste at the site or in the vicinity of the assessed property. According to the company, these phases should be conducted with the advice of the company's environment and water resource department, and the legal division.

Table 3.4 The Coca-Cola Company's corporate policy: phases in an environmental, occupational safety and health due diligence assessment

Phases	*Contours of assessment*	*Profile of assessors*
Phase 1	A non-invasive evaluation of EOSH status, issues, and risks; includes an evaluation of the current and future water supply, reviews and assessments pertaining to water contamination	Qualified company associates or external consultants
Phase 2	A more comprehensive evaluation that systematically samples, tests, and analyses environmental media or workplace conditions to determine whether potential risks and/or liabilities identified in a Phase 1 assessment actually exist	Qualified external consultants only

[29] As noted by Coca-Cola, an EDD ((environmental due diligence)) is part of the EOSH (environmental, occupational safety and health) exercise to be conducted by all TCCC (The Coca-Cola Company) operations worldwide in the context of purchasing, selling or leasing real estate; acquiring or divesting entities that own or lease real estate; and investing in entities, which will result in TCCC control or majority ownership of the entity. While the 'OSH' portion of an assessment is reportedly not required for transactions involving only undeveloped land (such as 'greenfields'), an EDD has to necessarily be conducted.

Phases	*Contours of assessment*	*Profile of assessors*
Phase 3	A further detailed, invasive investigation to determine more completely the extent of identified EOSH issues, risks, and liabilities, and the viability of proposed solutions. Typically, a Phase 3 environmental assessment would be completed whenever the Phase 2 results do not allow an accurate estimation of the financial or legal liability from existing environmental contamination on the site, or the measures that may be required under applicable law to resolve the identified issues.	Qualified external consultants only

EOSH – environmental, occupational safety and health
Source The Coca-Cola Company

The set of TCCC requirements for conducting an EDD assessment are in line with the ASTM (American Society for Testing of Materials) 1527-05 and 1528-05 standards of the US; these lay down the standard practices for Phase 1 of an environmental site assessment process exercise during property transactions.

In all cases, the source water for bottling operations is either surface water or groundwater. As reported by the company, in the case of surface water, gauging water availability is the responsibility of the agency or organization providing water to the plant as per an agreement drawn, and water availability in the area is not gauged by Coca-Cola. In the case of a bottling operation served by a groundwater source located within the plant premises, the EDD conducted prior to the plant's establishment assesses the water resource status.[32]

While requirements for establishing new facilities have been shared with TERI by CCI, the company has not shared the assessment on water availability with respect to the siting of individual plants, specifically the six plants under the purview of the TERI study. As communicated by TCCC, the company was unable to share the documents, as they contained sensitive information of both business and legal nature. Also, since the due diligence requirements document shared by Coca-Cola with TERI was issued on 29 November 2004 and amended on 16 June 2006, these would not have been applicable in their current form to the establishment of the six plants in the study.

Water usage: requirements and guidelines for bottling operations

As noted before, water usage practices in bottling operations fall under two categories: requirements and guidelines. In this context, the water resource management practices shared by Coca-Cola with TERI are relatively new, having been issued by the

[32] In India, this reportedly also takes into consideration block-level reports of the Central Ground Water Board.

company on 31 July 2004; a revision was conducted on 29 February 2005.[33] This section provides an overview of both Coca-Cola requirements and guidelines on water usage.

Water usage requirements

TCCC water resource management requirements, stated by the company to be applicable to all operations worldwide, are as follows.

- Develop and execute a programme to ensure continuity and quality of water supply through a documented water supply or availability assessment
- Conduct initial and periodic water utilization assessments to understand water usage in the plant and identify opportunities to utilize water more efficiently
- Implement and maintain a process to measure water utilization; establish a continuous improvement process for water utilization; and define water utilization objectives and goals in annual business plans
- Develop and execute internal and external water contingency plans as part of business continuity plans

TERI notes that the water resource management requirements shared by Coca-Cola emphasize on: (i) ensuring the continuity of water supplies to avert business risks due to water supply distortions; (ii) and maximizing efficiency levels in water use.

Water usage guidelines

The TCCC water resource management guidelines,[34] shared with TERI, suggest that source water should be monitored on a routine basis with focus on the context of quantity and quality and a source protection plan. The guidelines are as follows.

- A self-assessment of work practices and performance related to water utilization[35] in bottling operations. The survey follows the water resource management process, from acquisition of water to final release, highlighting opportunities for reduction and reuse. It provides information on current phase of water availability for the plant area; total cost per cubic metre of water for the plant; and water usage ratio for the plant

- A review of the reliability and vulnerability of the source of water for bottling operations. A tool for water supply assessment helps forecast and evaluate long-term availability of the plant's water sources. For this, a questionnaire can be prepared, consisting of three sections that address source water quantity and quality; watershed information; system operation and maintenance programme

[33] Dates stated in the documents received.
[34] Documents on water resource management guidelines of Coca-Cola, shared with TERI, were issued on 31 July 2002; they were revised on 20 June 2004.

To ensure a sustainable and consistent source of water for the bottling plants, TCCC guidelines, shared with TERI, recommend evaluating the need to support local water resource management initiatives; developing a source protection strategy; assessing risks of potential disruption in water quality and availability from municipal water sources, if applicable; and building a professional relationship with the water supplier so that plants are informed in advance about any potential threat to the quality of water supplies. The guidelines also advocate that the quality of water should meet WHO (World Health Organization) guidelines and local regulations for drinking water. An effective pre-treatment process can be used for this purpose, if necessary. The focus of the water supply assessment is clearly on securing a reliable water source from a business continuity point of view. While the formats of the self-assessment questionnaires have been shared with TERI, responses to the questions by the six bottling operations being studied were unavailable to the study team.

The guidelines further suggest adopting either a quantitative approach, depending on access to water availability data, or a qualitative approach based on information obtained from the water supply assessment tool, to define the phase of water availability in a given area. The company's definition of specific phases of water availability and methods of arriving at this definition are presented in Table 3.5.

Table 3.5 Defining water availability in a given area

Water availability phase	*Defining the water availability phase: quantitative method*	*Defining the water availability phase: qualitative method*	*TCCC practices during each phase of water availability*
Scarcity	Annual fresh water per capita < 1000 m^3	Permanent disruption of economic development due to lack of water	'Strategies in place to address the issue' not specified
Allocation	Annual fresh water per capita from 1000 to 2000 m^3	Water use permits, intermittent or localized water shortages	Water availability becomes a part of TCCC infrastructure planning
Noise	Annual fresh water per capita from 2000 m^3 to 5000 m^3	Water availability is not an issue yet, but being debated in the media, government, and business communications	Discussions begin on the issue of water availability for future development
Abundance	Annual fresh water per capita > 5000 m^3	Water availability is not an issue	No cause for concern

TCCC – The Coca-Cola Company
Source CCI

As per the documents received from TCCC, the company advocates that the data collected during self-assessments be used to build a water conservation plan for the facility. The primary focus areas of the water conservation plan should be on opportunities to reduce consumption and reuse water inside the plant. Guidelines are provided by TCCC on possible ways of achieving this. The guidelines suggest that the water conservation plan should adopt water usage ratio (monthly, volume weighted annual average) and total cost of water per cubic metre as baseline performance measures; other suggested indicators include litres of water saved, litres of wastewater minimized, savings in the total cost of water, and litres of water reused per month. The water conservation plan should be reviewed monthly or quarterly, and renewed annually as part of the business planning process of the bottling operation.

In addition to the above, Coca-Cola has also shared with TERI guidelines on the use of recycled water. According to these, reclaimed water can be put to non-product reuse only if it meets the criteria for raw water; and treatment operations are adjusted to address changes in raw water feed. The guidelines also mention that non-product reuse of reclaimed water should only be undertaken if the bottling operation has processes installed for the following: filter media backwashing; container rinsing; membrane concentrate; pasteurization or retort chamber; and cooling tunnel.

Wastewater management

The company has had wastewater quality requirements since 2 December 1993 (the seventh revision was carried out on 10 May 2006), a relatively long time compared to its water resource management requirements. Documents received from TCCC note that meeting wastewater quality requirements is mandatory for all facilities, COBOs and FOBOs alike. Compliance with wastewater requirements is assessed during third party global audits.

The Coca-Cola wastewater requirements make it mandatory for all bottling operations to meet applicable regulatory requirements concerning the management and discharge of wastewaters; maintain an effluent quality that will have no adverse effects on fish or other aquatic biota in receiving waters; and maintain and operate treatment facilities in an efficient manner. The company has developed its own wastewater quality parameters as well and all bottling operations (COBOs and FOBOs) are required to apply for these requirements by 31 December 2009.[38] Detailed wastewater quality guidelines were also issued by the company in August 2001 (revised in January 2006) to provide approaches and options to meet the TCCC wastewater requirements.

Additionally, the wastewater quality requirements call for the implementation of management practices and controls in accordance with the stricter of local regulations or TCCC requirements. Plants are required to get their treated effluent analysed once a year by an accredited laboratory and send the results to the corporate office.

Monitoring and tracking compliance with The Coca-Cola Company's water resource management requirements

As reported by Coca-Cola, the company's requirements as well as applicable legal and regulatory requirements[39] on water resource management are enforced by TCCC through a third party independent audit programme, which was introduced in 2006. Until 2006, staff members conducted internal audits. The third party audit agency appointed to conduct these audits for all company operations worldwide is M/s LRQA (Llyod's Register Quality Assurance).

The documents received from the company state that with respect to the environment, the audit programme assesses: (i) the EMS (environmental management system) at production facilities; and

[38] Coca-Cola documents note that existing fully operational facilities do not have to meet the 'new facility' limits until they undertake a major upgrade of the plant or establish wastewater treatment facilities

[39] Entitled EOSH (environmental, occupational safety and health) audit programme; EOSH includes components of environment, quality, and safety in it.

(ii) compliance with applicable environmental laws and company standards. Every plant is normally audited once in three years; however, for bottling units with identified high risks, follow-up audits take place within one year. As stated in the documents received from Coca-Cola, the environmental auditing programme began in 1992 for COBOs; the programme was expanded in 2005 to include FOBOs.

The audit committee of the board of directors at TCCC reviews the results of the audits conducted in individual plants. It is the responsibility of individual plants (COBOs and FOBOs) to design and implement corrective actions against instances of non-compliance identified in the audit reports. The documents received from Coca-Cola state that failure to take corrective action by a bottler constitutes a breach of the bottler's contract with TCCC, thereby entitling the company to take legal action to terminate the contract or take other remedial measures as applicable.[40] The respective divisions have the scope to monitor compliance with these requirements, provide support to the plants if requested, and ensure that the corrective actions identified have been complied with before the bottling facility faces the audit programme.

To quote a document provided by Coca-Cola,[41] 'the audit programme assigns ratings on each finding; ratings are identified based on the severity of the environmental impact and business risk to the company'. There are, accordingly, five types of risk ratings, each with related corrective action requirements, if applicable (Table 3.6).

Table 3.6 Categories of environmental audit findings in the Coca-Cola systems

Environmental audit finding category	*Description of findings*	*Corrective action required*
Critical risk	Any findings that can cause significant environmental concern or result in major legal liability, thereby severely putting the company's integrity/reputation/legal right to operate at risk	Closure order; corrective action needs to be initiated immediately and completed before the related operation is restarted
High risk	Any findings or structural shortcoming that can cause environmental concern or result in legal liability, thereby putting the company's integrity/reputation/legal right to operate at risk	Corrective action needs to be initiated immediately. High-risk findings are closely monitored. Follow up audits are conducted in high risk bottling operations within one year instead of the normal

[40] The nature/content of the 'other remedial measures as applicable' have not been shared with TERI.
[41] Documents received on 8 June 2007 and 18 June 2007.

		cycle of three years
Potential risk	Any findings that have current or potential high impact on environmental performance or any identified structural shortcoming to an EMS element	Corrective action should be included as a priority within the ongoing activities of the bottling operation
Improvement opportunity	Any finding with a low impact, and which is not a structural shortcoming to an EMS element	Findings should be included in the corrective actions programme
Strength	A successful practice over and above the TCCC requirements, which needs to be shared with other bottling units	Not applicable

EMS – environmental management system; TCCC – The Coca-Cola Company

Source Documents received from Coca-Cola India

The audit programme offers five different stages or types of certification with respect to the environment: E1, E2, E3, E4, and E5 (E: evolution). As noted by Coca-Cola, the emphasis is initially on preventing risk, followed by compliance and certification of compliance (Table 3.7). In addition to having to undergo the audit process required by TCCC, TCCC plants can also choose to be certified against ISO standards, primarily ISO 9001 quality standards and ISO 14001 environmental management standards.

Table 3.7 Stages of TCCC (The Coca-Cola Company) audit certification

Stages of TCCC audit certification	*Description of each stage*
E1	The operation demonstrates a satisfactory level of compliance
E2	A satisfactory level of compliance
E3	The operation is certified to all TCCQSe3 (three facets of the Coca-Cola Quality System): quality; environment; safety, and loss prevention, implying it is eligible for a Coca-Cola system certification
E4	Surveillance
E5	'Top-up' certification

Source Coca-Cola, various documents against TERI questionnaires

In response to enquiries from TERI, Coca-Cola notes that the company's requirements do not explicitly necessitate the assessment of the effects of Coca-Cola bottling operations on groundwater in the region of operation; and the water resource scenario of the region is broadly covered by the audit programme so that contingency plans can be made for business continuity, if necessary. Water is one of the components in an audit programme with three broad facets: environment, quality, and safety. As per information received from Coca-Cola, aspects of water would be audited under both the facets, environment and quality, the latter in terms of water as a raw material for production. With respect to

the methods employed to assess water availability at the site of a bottling operation at various levels of the TCCC administrative structure, the answers received from the company are given in Table 3.8.

Table 3.8 Assessing water availability at different levels of TCCC (The Coca-Cola Company) operation

Administrative level	*Method of assessment*
TCCC, Atlanta	The environment and water resources team has launched programmes, for example, GWRA (Ground Water Risk Assessment), 2004, to understand and remain abreast with the water availability scenarios for all plants. The GWRA was conducted in all the six plants being assessed
Division level (India)	CCI has launched various programmes[42] and the division eKO team tracks water availability, by plant, at the block level (from CGWB data)
Bottling operations	A water resource management team collects information on water supply, usage, and regional water availability status through consultation with government and private agencies in India. A plant-level water source availability analysis based on the local situation was launched in India in 2007

CCI – Coca-Cola India; CGWB – Central Ground Water Board

Source Coca-Cola India

TCCC launched a groundwater risk assessment programme in 2004, and all company- and franchisee-owned operations in India participated in the assessment. The framework comprised a checklist-based data collation approach on six interrelated categories with respect to water: watershed; supply reliability; efficiency; supply economics; compliance; and social and competitive climate. The checklists serve as a starting point for further investigation and quantitative assessment for evaluating the diverse physical, business, political, and social risks related to water.

The Coca-Cola Company's engagement with its stakeholders

According to documents received, the company maintains a dialogue with stakeholders, including employees, bottling partners, suppliers, customers, share owners, consumers, government agencies, unions, and NGOs, to build trust and mutually beneficial relationships between the business and society. Formal advisory bodies and working relationships are also established for this purpose. For example, the India Advisory Board, formed in 2003, comprises professionals in economics, law

[42] Ground water development analysis by river basin, conducted by the International Water Management Institute, Colombo, in 2005, was mentioned by the Coca-Cola India management; however, no details were shared with TERI.

and industry; this board provides guidance on operational, environmental, and social issues, and corporate governance in India. In the realm of water, the company held its first stakeholder forum in 2004 with external experts, management personnel, and employees to discuss water issues facing the world and its business. Subsequently, as noted by the company, its water stewardship actions are being implemented amongst the larger community, and not just near its plant locations. In India, apart from plant-specific water stewardship initiatives, these include rainwater-harvesting projects in the city of Delhi, community drinking water projects planned for 1000 schools by 2010, and watershed development projects in the states of Rajasthan and Tamil Nadu, which are located several hundred kilometres away from the nearest plant locations.

The Coca-Cola Company's citizenship framework

As per the *Citizenship Report 2004*, TCCC has established a citizenship framework in four broad areas to conduct its business in a sustainable manner: marketplace, workplace, environment, and community. Also, in 2004, TCCC undertook initiatives to address three key areas: water; health and wellness; and HIV/AIDS in Africa.

Prior to 2004, TCCC's citizenship journey had primarily been philanthropic in the form of cash contributions, product donations, and use of resources such as trucks and advertising space for community initiatives. Subsequently, in July 2005, a new framework for long-term, sustainable business success called the 'Manifesto for Growth' was launched,[45] which integrated all facets of the business, identified as people, profit, portfolio, partners, and planet (5 Ps), and established the role of TCCC's bottling partners in its long-term success. Of the 5 Ps in TCCC's Manifesto for Growth, 'planet' states that sustainable growth also required the company to be a committed global citizen, who makes a difference. The company further states that the focus areas within 'planet' have been water stewardship; sustainable packaging; and locally relevant initiatives.

Implementing citizenship initiatives: the structure

As per information provided, country divisions provide the operating framework and guidance on projects and partners to the bottling operations; divisions also provide financial, technical, and monitoring support if required by the bottlers. Bottling operations, being separate legal entities, have their own budget and plans for

[45] TCCC (The Coca-Cola Company) Corporate Responsibility Review (published in July 2006).

citizenship, on which the division exercises no control. Therefore, each bottling operation could take up citizenship initiatives as per the local community's needs and/ or resources and capability available. TERI was informed that while it is not mandatory for bottling operations to conform to the division guidelines on citizenship, CCI actively engages with the bottling operations to align them with its citizenship programme.

According to the documents received, a CEF (Community Engagement Framework) has been developed to guide the citizenship initiatives of bottling operations. The CEF is a citizenship tool that provides guidelines on mapping or identifying the community, conducting need assessment to determine potential concerns that a particular community faces, identifying key stakeholders, matching the community needs with the company's objective, and finalizing the area of intervention. Designed to bring about clarity in Coca-Cola's citizenship interventions and allow divisions, regions, and units to follow a standard practice from initiation to execution of projects involving the community, the CEF also aims to define roles and responsibilities of the division offices and the bottling operations. However, the implementation of the CEF programme is the prerogative of the bottling operations.

Mainstreaming corporate social responsibility at Coca-Cola India

The India division of TCCC has recently evolved its own approach to citizenship under the given global framework. Table 3.9 summarizes the citizenship approach of TCCC in India up to 2004, and beyond.

Table 3.9 Summary of The Coca-Cola Company's citizenship approach

Up to 2004	*2005 onwards*
Corporate philanthropy	Partnership/collaboration model was initiated
Top-down approach driven by the company headquarters	Participative approach between the company and its bottlers
Reactive to community and business needs	Proactively assessing the environment and needs
Community connect limited	Projects in select areas in accordance to strategic platforms
Initiated small partnerships with NGOs (non-governmental organizations)	Community-centric
	Partnerships with many renowned NGOs
	Learning from stakeholders, including activists

Source Presentation made to TERI project team

As per the documents received, CCI has chalked out a plan of action till 2010 to address perceived gaps in its CSR framework. In the realm of water, the division aims to achieve leadership in water

management by adopting water stewardship initiatives under the 4 Rs (reduce, reuse, recycle, and recharge) Policy. Table 3.10 illustrates the apportioning of roles and responsibilities between the divisional headquarter, CCI, and bottling units (including COBOs and FOBOs) in the citizenship framework being established in India.

Table 3.10 CCI (Coca-Cola India) Citizenship Framework – roles and responsibilities

<table>
<tr>
<td>CCI (division)

▪ Technical support
▪ Support in identifying partners
▪ Communication tools
▪ Monitoring and evaluation tools
▪ Financial support
▪ Creating engagement opportunities
▪ Lead national initiatives
• Water stewardship
• Sustainable packaging
▪ Monitoring and governance for division funded projects
▪ Award and Incentive programmes for bottling units</td>
<td>HCCBPL bottling headquarters

▪ Implementation
▪ Identifying local community and projects
▪ Community mobilization
▪ Funding locally relevant projects
▪ Monitoring and sustenance

Franchisee bottler
▪ Implementation
▪ Identifying local community and projects
▪ Community mobilization
▪ Funding locally relevant projects
▪ Monitoring and sustenance</td>
</tr>
</table>

Source The Coca-Cola Company

As conveyed by CCI, the company has been supporting water stewardship programmes, PET recycling, and disaster relief and rehabilitation efforts in the country. The details of the water-based initiatives, provided by the company, are summarized below.

- *Conservation* According to CCI, projects have been initiated across the country to promote and implement rainwater harvesting through recharge structures, shafts, check dams, revival of water bodies, rooftop harvesting, and so on.
- *Access* This initiative attempts to help communities with last mile access to potable water. Examples cited by CCI refer to Wada, where water is supplied through pipelines and tankers; Tamil Nadu, where potable water is provided to 100 schools in partnership with Rotary International (Chennai chapter); and an MoU (memorandum of understanding) signed with UN (United Nations) Habitat to provide drinking water to 150 schools of West Bengal.
- *Awareness* According to CCI, many initiatives have been undertaken to engage with stakeholders and spread awareness on the need to conserve water and recharge rainwater. These include the organization and sponsorship of workshops, developing water calendars, showcasing working models of rainwater-harvesting structures, organizing awareness

marches and campaigns, and utilizing the electronic media to disseminate information on issues and solutions pertaining to groundwater.

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CHAPTER 4A Kaladera

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CHAPTER **4A** Kaladera

Executive summary

The plant is located in a water-scarce, drought-prone area

The HCCBPL (Hindustan Coca-Cola Beverages Pvt. Ltd) bottling plant is situated in the Kaladera watershed in Govindgarh block of Jaipur district in the state of Rajasthan. The area witnesses semi-arid climatic conditions, receiving an average annual rainfall of about 600 mm, and experiences frequent droughts (eight years in the past 25 years).

The Rajasthan Water Policy, 1999, states that water resources in Rajasthan are extremely unevenly distributed both temporally and geographically. It strongly advocates judicious and economically sound allocation of water resources to different sectors, with water supply for drinking as the first priority followed by irrigation, power generation, and industry sectors. The policy also observed that the water table in some areas of the state is going down at the rate of 3 metres per year due to severe groundwater exploitation.

The area has witnessed a shift towards water-intensive crops in the past 20 years

Cropping pattern in the study region has changed over the past 20 years (1984/85 to 2004/05). There has been a marked shift towards cultivation of water-intensive crops like groundnut. Area under groundnut cultivation increased from approximately 1600 ha (hectares) in 1984/85 to 18 414 ha in 2004/05 (about 12 times increase). Further, the average cropping intensity, defined as the ratio of the gross sown area to net sown area, has gone up from 1.3 in 1984/85 to 1.7 in 2004/05 over the past 20 years.

The region was assessed to be an overexploited zone in 1998 but has not been notified

The Kaladera area was assessed to be in the overexploited zone by the CGWB (Central Ground Water Board) way back in 1998. However, it has not been notified as such by the CGWA (Central Ground Water Agency). It is not clear (reports relating to due diligence, pumping tests, and rapid EIA [environmental impact assessment] were not made available to TERI 'due to reasons of legal and strategic confidentiality') whether the HCCBPL, Kaladera – which commissioned its operations in 2000 – took the '1998 assessment' into cognizance while establishing the

plant. It was only in 2004/05 that RIICO (Rajasthan State Industrial Development and Investment Corporation) refused to give consent for the establishment of a water-intensive industry in the area. The overexploited nature of the groundwater aquifer is borne out by the independent assessment undertaken in this study wherein the mean annual groundwater draft has been estimated to be at least 135 percent of dynamic groundwater reserves. This indicates that annual extraction of groundwater is at least 1.35 times the annual natural recharge. Agriculture withdrawals alone account for more than 100 percent of the natural groundwater recharge.

The plant has never operated beyond one-third average annual installed capacity, yet water extraction by the Hindustan Coca-Cola Beverages Pvt. Ltd has significant impacts

The plant was established in 1999, and started producing CSD (carbonated soft drinks) from June 2000. In the process, the plant produces both RGBs (refillable glass bottles) and PET (polyethylene terephthalate) bottles. In the past three years (2004–06), the average annual utilization capacity of the plant was about one-third of its installed capacity. Every year, the peak season of production is April–June and the off-peak season is November–January. The higher water intake in the summer months (particularly in May 2004) clearly indicates that the higher side withdrawals occur in acute water-stress period. The low-capacity utilization could either be due to reduced market demand for Coca-Cola products or due to the sensitivity towards groundwater exploitation.

The HCCBPL, Kaladera, operations have been found to result in an averaged localized drawdown (considering local extent of the aquifer of approximately 1.5 km radius around the plant) in the range of 0.4–2.0 m, depending on the withdrawal rate for that particular day or week between 2004 and 2006. Albeit good recovery of the drawdown is expected in the aquifer zone, continuous daily extraction in the successive months of March, April, May, and June has put the localized state of the aquifer under additional stress, that is, in addition to irrigation withdrawals that are estimated to be higher (up to100 times) than the average annual withdrawals by the plant. The problem gets further aggravated due to the challenges imposed by erratic rainfall, semi-arid climate regime, and increasing demands from various sectors. During drought years, such as the period till pre-monsoon of 2004, the situation becomes worse as the decline in water table estimated in localized aquifer is close to 3 m. The zone of influence of the drawdown is estimated to extend to several villages including Disan, Kaladera, Kanarpura, Chak Mundaya, and Sahab Rampura. Thus, the water withdrawals by the HCCBPL, Kaladera, need to be viewed in the

context of the already overexploited condition of the aquifer where the overall withdrawal is already at least 135 percent of the total recharge.

Varied stakeholder perceptions on water problems

Stakeholder perceptions capture the views of different stakeholders on the issues of trends in water availability, quality, utilization, and access across the study villages. The section only records the views as presented by different stakeholders in the course of FGDs (focus group discussions) and key stakeholder interviews. It does not aim to make judgements nor draw conclusions based on these recorded perceptions. The perceptions have been presented here in conjunction with assessment findings wherever possible, although the assessments were not done with a view to confirming the perceptions.

While majority of the stakeholders perceived water tables to be declining over the years, they expressed differing views on changes in the levels of the water table. Various reasons were put forward by the stakeholders for this phenomenon, as discussed below.

Perception Over the past decade, the water table has been dropping at the rate of 2–3 m, and the drop in the past five years was reported to be close to 3–4 m annually.
Assessment Water tables in the watershed have been declining at a rate of 0.6–1.0 m per year in past 10 years. A drop of 2–3 m per year in water tables has been observed during the summer months (specifically May) of the period 2002–04.

Perception Rainfall has been low.
Assessment The area has experienced low and variable rainfall patterns, that is, annual average rainfall of 600 mm and standard deviation of 180 mm, and has experienced droughts in eight years out of the past 25 years.

Perception There has been an increase in the area under cultivation.
Assessment Secondary data indicates that the gross area under cultivation and cropping intensity have increased over the past 20 years (1984–2005).

Perception There has been an increase in the number of bore wells both for agriculture and industrial purposes in the block including RIICO area.
Assessment Time series data related to the number of pump sets or bore wells was not available.

Perception Water use has increased due to the industries such as RIICO and, more specifically, Coca-Cola plant. In this context, some of the stakeholders expressed following concerns: (a) Coca-Cola plant has a large number of bore wells with pump sets of high capacity, (b) the pump sets of Coca-Cola plant extract water from much greater depths when compared to the pump sets used by farmers.

Assessment At the watershed level or the level of regional aquifer, the groundwater withdrawal by the plant is negligible compared to irrigation. Water use for irrigation is estimated to be more than 100 percent of the total groundwater recharge. At the localized level, overall analysis for the period between 2004 and 2006 reveals that the water extraction by the plant has been less than 3 percent of the irrigation withdrawals 70 percent of the time, and less than 1 percent for 40 percent of the time. The maximum extraction of groundwater by the plant has been observed in May during the period 2004–06 (1500 KLD [kilolitres per day] in May 2004, 720 KLD in May 2005, and 640 KLD in May 2006), which is estimated to be equivalent to 4 –9 percent of total water withdrawals by irrigation.

Physical verification of the site revealed that four bore wells have been installed in the plant. Each of the bore well calibrated during the water audit revealed a discharge of 30 m^3 (cubic metres) per hour. The depth of all the plant bore wells is approximately 100 m (that is, 330 feet) below ground level.

Perception Water quality perceptions varied across different study villages. The perceptions of the stakeholders in different villages have been summarized below.

- Khannipura: Piped water from electrified bore wells leaves a white powdery residue in the container if left undisturbed for some time, and this powder was referred to as 'fluoride'.
- Kaladera: Fluoride level in the water from the hand pumps has increased; the problem was reported for two hand pumps.
- Disan: Water quality in half of the village has deteriorated. The part of the village with deteriorated water quality is nearer to the *nullah* into which effluent from RIICO is discharged. Water extracted from electrified bore wells has become saline and water quality in the *nullah* has changed. Salinity is caused due to increase in the depth of the bore wells and percolation of effluents discharged leading to contamination of groundwater.
- Durga ka Bas: Over the past two years, water from the hand pump is muddy. This has been noticed in all seasons. Muddiness in water is a result of extreme depth of bore wells and dropping water levels.

Assessment The above-mentioned issues were examined vis-à-vis results obtained by water quality test results of water

samples collected from the villages. These samples were collected from groundwater sources such as handpumps and irrigation tube wells. The results indicated that TDS (total dissolved solid), fluoride, iron, total alkalinity, and total faecal coliform have exceeded the desirable drinking water limits prescribed by IS 10500 and WHO (World Health Organization) guidelines. Other than these, pesticides (2,4-DDT and 2,4-DDE), copper, chlorides, magnesium, nitrite, and lead also were present in few water samples. Barring the above, rest of the parameters are in conformity with the limits prescribed by IS 10500 and WHO guidelines.

Perception Majority of the stakeholder groups were of the opinion that although the effluent was discharged from the RIICO industrial area, it was from other industrial units and not from the Coca-Cola plant.
Assessment The plant is currently at zero-discharge levels as per the consent requirements; majority of the treated effluent is used for irrigation and maintenance of green belt in the plant premises. The RPCB (Rajasthan Pollution Control Board) consent also prescribes the limit for land application (hydraulic loading rate) of treated effluent. Since the ETP (effluent treatment plant) is not dynamically linked (ETP inflows and outflows are not simultaneous) to the process wastewater, hydraulic loading rate could not be validated during the technical audit. Moreover, hydraulic loading rates have not been specified for parameters other than BOD (biochemical oxygen demand) such as fluoride, TDS, coliform, and so on.

Effluent water quality mostly meeting regulatory and The Coca-Cola Company requirements

Performance assessment of the ETP was carried out along with the plant's water audit. The ETP, designed to treat 1000 kl/day of wastewater every day, is presently being underutilized, as the plant operates at only about one-third of its capacity. As a result, as mentioned above, the ETP outflow is not dynamically linked[1] to process wastewater inflow. Wastewater is being intermittently pumped from one process unit of the ETP to another.

As per the terms to operate, the ETP is discharging treated wastewater on land for irrigation and maintaining green belt. The quality of the treated discharge water indicates effective treatment for all the parameters vis-à-vis prescribed CPCB

[1] The term dynamically linked refers to the fact that the wastewater inflow rate to the ETP (effluent treatment plant) does not match with the wastewater outflow rate from the ETP. This is because of the high design capacity of the treatment plant, that is, the plant is designed for inflows that are at least two to three times more than the inflows it currently receives. This leads to storage of inflow water in the plant and is accompanied by pumpages from one treatment unit to another in the treatment plant.

(Central Pollution Control Board) discharge standards for land application except for bioassay test (test for estimating fish survival) that showed one-time exceedance.

As compared to TCCC's (The Coca-Cola Company) own treated wastewater quality standards, TKN (total Kjeldahl nitrogen) was found to exceed the limits frequently.

The Coca-Cola Company requirements in regard to siting of plants only call for assessment of water availability for business continuity

In the absence of the siting report of the Coca-Cola bottling operation in Kaladera, it was difficult to gauge the level of due diligence conducted with respect to availability of water resources in the region prior to the establishment of the plant. However, in response to queries from TERI, the Coca-Cola representatives stated that the company's requirements do not explicitly necessitate the assessment of the effects of the HCCBPL, Kaladera, bottling operations on groundwater in the region of operation apart from the perspective of ensuring a sustained supply of water for business operations. Therefore, the basic focus of TCCC water resource management practices is on business continuity—community water issues do not appear to form an integral part of the water resource management practices of TCCC.

Corporate social responsibility initiatives unsystematic in the early years; newer initiatives more structured

Initial CSR (corporate social responsibility) initiatives by the HCCBPL, Kaladera, aimed at building bridges with the local community and earn community goodwill; they lacked any specific structure with respect to both the identification of projects and their execution. Since 2003/04, however, efforts appear to have been made to enhance community participation, increase the incidence of benefits arising from CSR initiatives of the plant, and foster workable partnerships with the governmental and non-governmental agencies for community-development schemes. However, given that all the recharge shafts that were randomly visited were found to be in dilapidated conditions, the HCCBPL, Kaladera, needs to examine the sustenance angle of the CSR initiatives undertaken. The plant, however, stated that the maintenance of the water structures has been included as a CSR target plan for 2007, and would take place just before monsoons.

Detailed assessment

Site profile

The Kaladera plant of the HCCBPL (Hindustan Coca-Cola Beverages Pvt. Ltd) is located about 40 km from the city of Jaipur, in block Govindgarh, district Jaipur, in North-West India, in the semi-arid to arid state of Rajasthan. The plant is situated in the RIICO (Rajasthan State Industrial Development and Investment Corporation) industrial area in Kaladera. It draws its raw water from groundwater aquifers. Figure 4A.1 shows the delineated watershed. The delineated area falls in two *tehsils*, namely, Chomu and Amer, in district Jaipur.

Geographic

The delineated Kaladera watershed comprises an area of 309 km² (square kilometres) and lies between longitude 75.50° and 75.80°, and latitude 27.10° and 27.25°. The watershed, in general, is a plain area with minor undulations. About 90 percent of the watershed lies in the elevation range of 400–500 m amsl (above the mean sea level), as shown by the hypsometric curve in Figure 4A.2. The minimum and maximum elevation of the watershed ranges from 420 metres (amsl) to 693 m (amsl), respectively, with mean elevation of 464 m (amsl) and standard deviation of 28 m. The drainage of the area is controlled by Mendha river, located at a distance of about 11 km north-west of the Kaladera site. The watershed is an originating catchment of two small tributaries of Bagawas at latitude 27° 15′ and longitude 75° 34′ 48″.

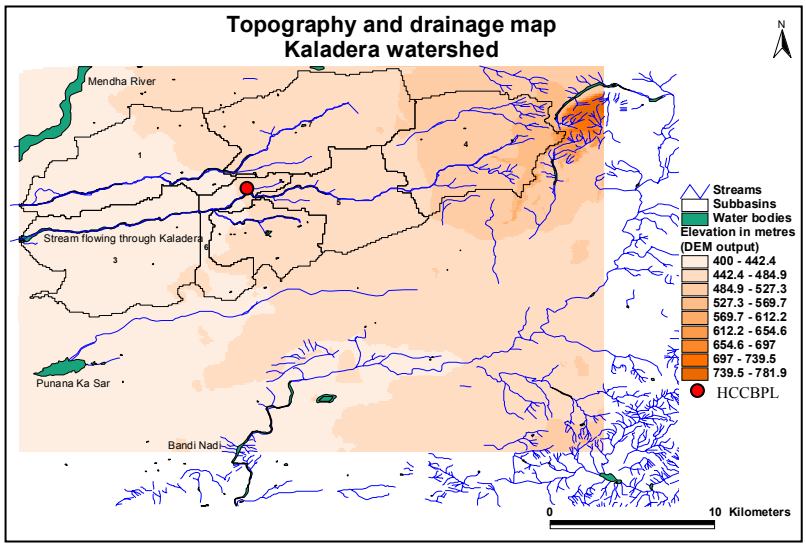


Figure 4A.1 Topography and drainage map of Kaladera watershed

Source Developed from Survey of India toposheets (1: 50 000 scale)

There are few minor ephemeral streams, which flow only during the peak monsoon season (between July and September). The drainage pattern is dendritic to sub-dendritic in nature.

Hydrometeorology

Hydrometeorological details of the watershed have been derived from Jaipur observatory data collected for the period 1988–2004 and from the climatological tables for the period 1951–80. The observatory is situated at latitude 26°49′ N and longitude 75° 48′ E at an elevation of 390 m (amsl).

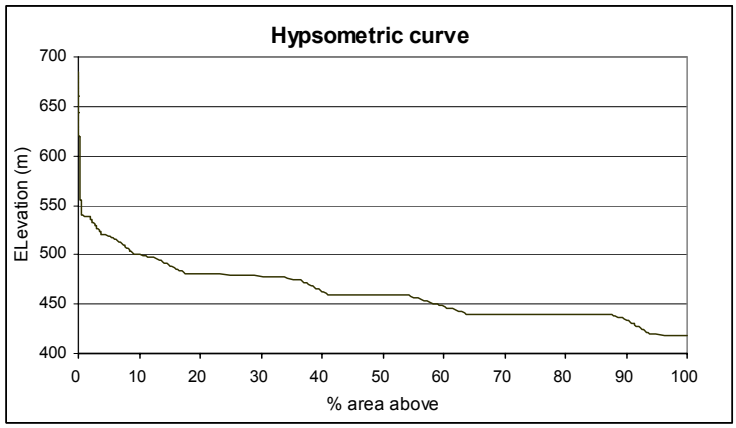


Figure 4A.2 Hypsometric curve of Kaladera watershed

Source Developed from Survey of India toposheets (1: 50 000 scale)

Rainfall

The area witnesses semi-arid climatic conditions, receiving an average annual rainfall of about 600 mm. The south-west monsoon lasts from July till about mid-September. The period from mid-September to about end of November constitutes post-monsoon period. About 90 percent of the annual rainfall occurs from June to September. July and August are the wettest months with rainy days ranging between 10 and 12 days. In a month, relative humidity levels are as high as 75–85 percent. The probability of a wet day followed by another wet day is about 30 percent in these two months. For the rest of the year, it is less than 10 percent. Annual rainfall data analysis of 100 years shows that the area experiences frequent droughts of varying intensities. The area has experienced mild to moderate droughts for eight years in the past 25 years (Rathore 2005). The standard deviation, in terms of deviation from the normal rainfall, is estimated to be about 170–180 mm. Figure 4A.3 gives the rainfall pattern of the area.

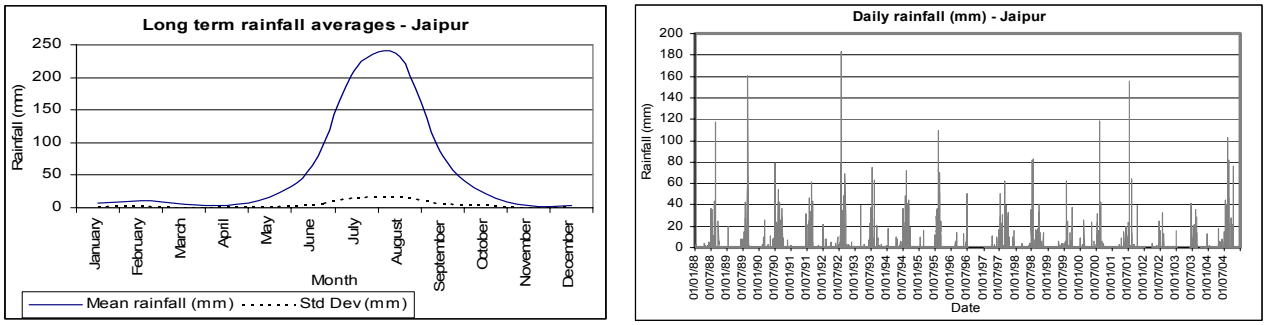


Figure 4A.3 Rainfall pattern in Kaladera watershed

Source Indian Meteorological Department

Temperature

The period from May to first half of June is the hottest in of the year when the mean daily maximum temperature is about 40.6 °C and the mean daily minimum temperature is about 27.4 °C. January is the coldest month with mean daily minimum temperature of about 8.3 °C and mean daily maximum temperature of 22 °C. Figure 4A.4 shows minimum and maximum temperature of the region.

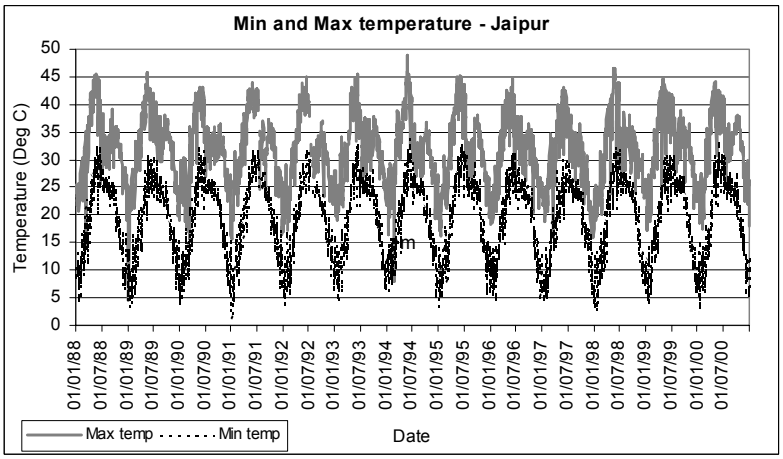


Figure 4A.4 Minimum and maximum temperature variations

Source Indian Meteorological Department

Evaporation

Potential evapotranspiration is high in May, June, and July (about 180–240 mm) and lowest in December (about 65–70 mm). The annual potential evapotranspiration ranges between 1500 mm and 1700 mm, which is 2.5 to 3 times the average annual rainfall (CGWB 1982).

Socio-economic

Rajasthan as a state and Jaipur as a district have been urbanizing at a reasonably fast pace of 31 percent and 10 percent, respectively,

between 1991 and 2001. The total population of Amer has increased from 2 28 644 in 1991 to 2 94 055 in 2001. In Chomu, the population increased from 2 48 953 to 3 26 488. The pace of urbanization was 15 percent and 10 percent in Chomu and Amer, respectively,[2] for the same decade.

The change in occupational patterns of population in the study area is shown in Figure 4A.5. The study region being mostly a rural area, agriculture was found to be the predominant occupation. However, it was observed that the share of population engaged in services and non-agricultural activities like business, trade, transportation, and labour is increasing. This highlights the gradual shift towards industrial and other tertiary services.

Both the urbanization phenomena and the prevalence of agriculture as the major occupation lead to an increasing demand for water, which subsequently puts pressure on the existing groundwater resources in the area.

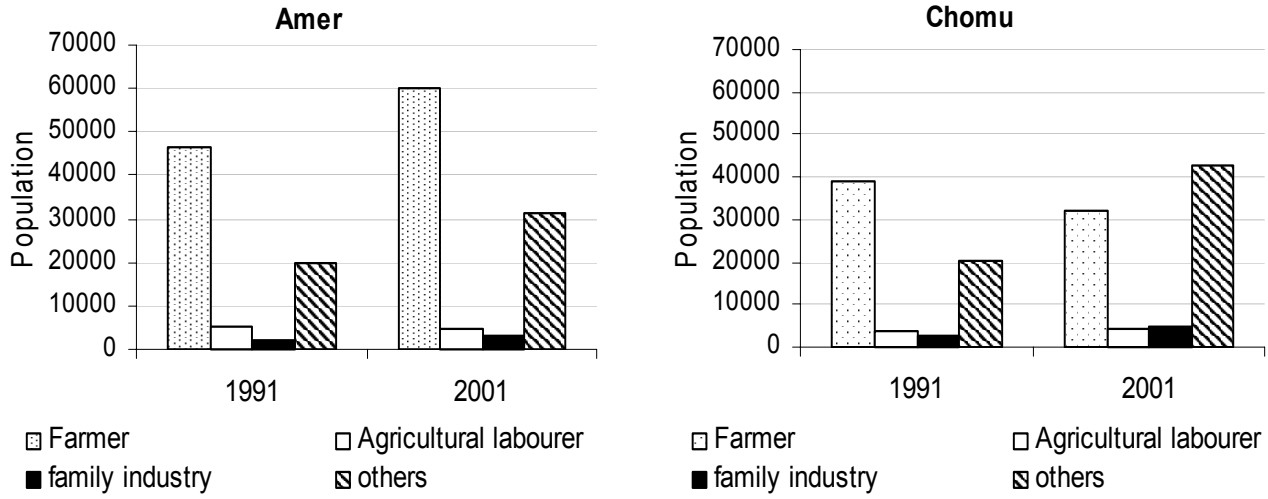


Figure 4A.5 Occupational patterns in the study area

Source Tables of Agricultural Statistics for Jaipur district, 2004/05 and past data, Department of Agriculture, Government of Rajasthan

Land use and agriculture

Cropping pattern in the Chomu and Amer *tehsils* has changed over the past 20 years (1984/85 to 2004/05). The principal crops grown in the area are wheat, barley, and mustard in the rabi season (November to March); vegetables and green fodder in the Zaid season (April to June); and bajra, groundnut, and pulses in the kharif season (July to October). In the past 20 years, the region has witnessed a shift towards cultivation of water-intensive crops like groundnut, mustard, wheat, and bajra (Figure 4A.6).

[2] Details available at <http://www.censusindia.net/results/eci14_page1.html>, last accessed on 20 January 2007.

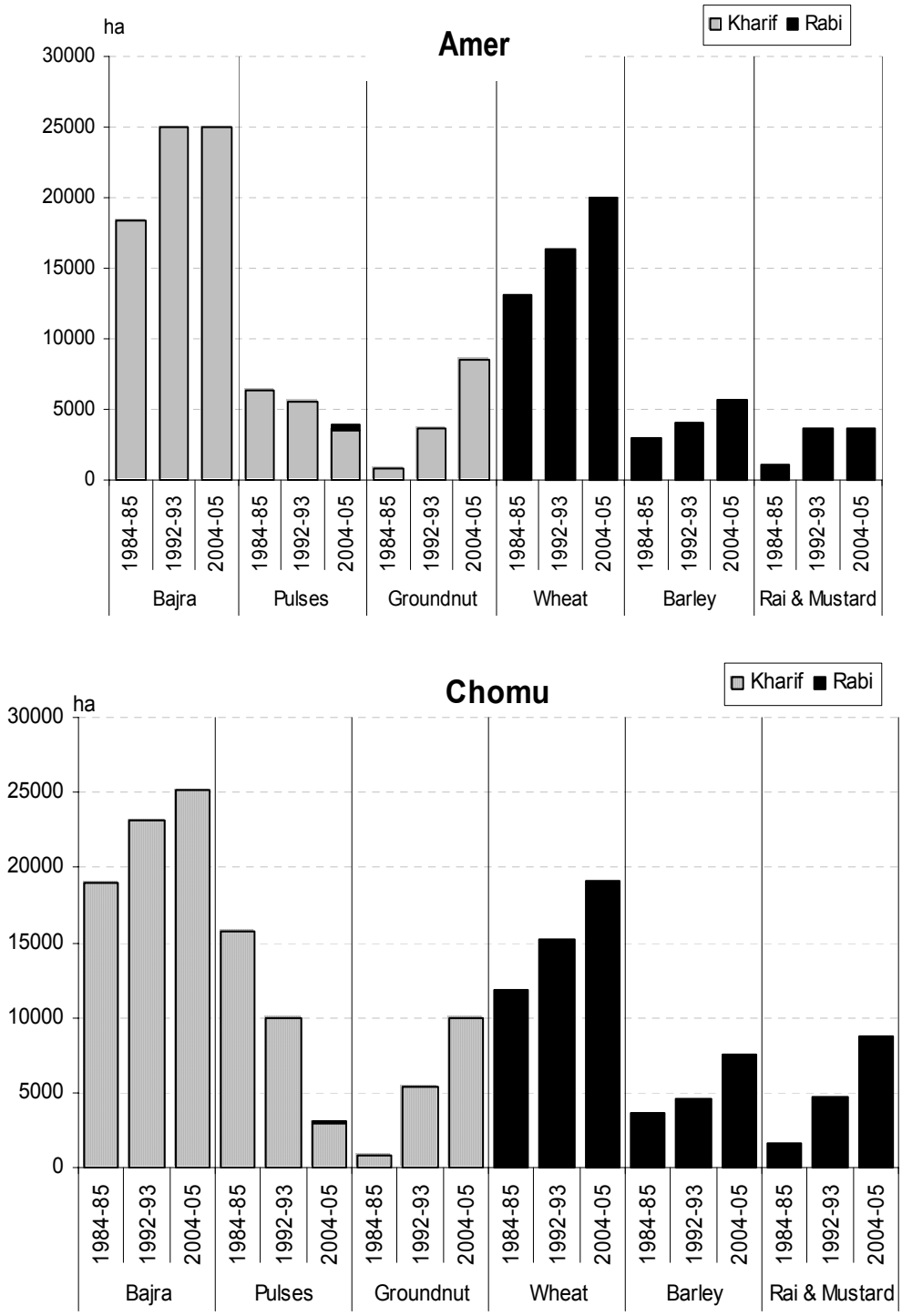


Figure 4A.6 Cropping pattern

Source Tables of Agricultural Statistics for Jaipur district, 2004/05, and past data, Department of Agriculture, Government of Rajasthan

Area under groundnut cultivation increased from approximately 1600 ha in 1984/85 to 18 414 ha in 2004/05 (around 12 times increase). Similarly, area under mustard has increased from 2693 ha to 12 290

ha (4.5 times increase). Area under wheat and bajra has also gone up significantly during this period.

Area under forests has been reported to increase from 8741 ha in 1984/85 to 13 502 ha in 2004/05, thereby showing an increase of 1.5 times during this period. Similarly, area under cultivable wasteland has increased three-fold during this period, that is from 4264 ha to 13 085 ha.

The average cropping intensity, defined as the ratio of the gross sown area to net sown area, has gone up from 1.3 in 1984/85 to 1.7 in 2004/05 over the past 20 years. While the gross area under cultivation has gone up from 125 922 ha to 163 392 ha during this period, the net sown area has marginally increased from 93 507 ha to 96 644 ha.

Table 4A.1 gives the details of the land use and cropping intensity values for the two *tehsils* over a span of 20 years.

Table 4A.1 Land-use pattern (in ha) and cropping intensity

Land-use pattern	*1984/85*	*1998/99*	*1999/00*	*2000/01*	*2001/02*	*2002/03*	*2003/04*	*2004/05*
Amer: total geographical area = 89 147 ha								
Forest land	8 178	11 245	11 393	11 410	11 410	11 512	11 512	11 410
Total cultivable wasteland	3 215	8 061	7 905	8 301	8 012	8 030	8 299	8 635
Gross sown area (A)	60 770	79 484	79 996	77 679	80 649	68 122	79 691	78 754
Net sown area (B)	45 377	49 126	49 085	47 455	47 757	44 093	46 374	46 451
Cropping intensity (A/B)	1.34	1.62	1.63	1.64	1.69	1.54	1.72	1.70
Chomu: total geographical area = 68 361 ha								
Forest land	563	1 556	1 477	2 075	2 146	2 029	2 092	2 092
Total cultivable wasteland	1 049	4 377	4 349	3 937	4 256	4 176	4 184	4 450
Gross sown area	65 152	82 761	85 715	84 751	87 022	86 015	87 970	84 638
Net sown area	48 130	51 134	50 943	51 172	50 962	50 594	51 017	50 193
Cropping intensity (A/B)	1.35	1.62	1.68	1.66	1.71	1.70	1.72	1.69

Source Tables of Agricultural Statistics for Jaipur district, 2004/05, and past data, Department of Agriculture, Government of Rajasthan

Irrigation and penetration of pump sets

Analysis of gross irrigated and net irrigated areas in the region shows that the irrigation intensity, defined as a ratio of gross to net irrigated area, has remained about 1.4 during 1999/2000 and 2004/05. Groundwater is the major source of irrigation. The groundwater table has been steadily declining over the years due to poor rainfall in the area. With declining groundwater table, the use of electric pump sets has increased compared to the diesel pump sets. Not only have the number of electric pump sets increased but their capacity has also shown a marked increase. The published data for the number of irrigation pump sets is available for 2001 (Figure 4A.7). Electricity is generally available for about three to four hours in a day when the pump sets can be used.

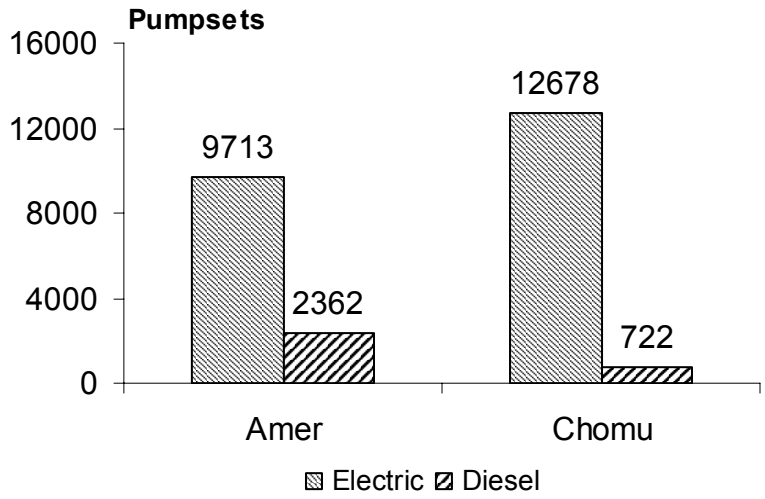


Figure 4A.7 Number of irrigation pump sets (2001)

Source Tables of Agricultural Statistics for Jaipur district, 2004/05, and past data, Department of Agriculture, Government of Rajasthan

Fertilizer and pesticide use

Fertilizer use has increased considerably in the study area as a result of increasing cropping intensity and irrigation. Consequently, average fertilizer consumption (in terms of N, P, and K) per unit area has gone up substantially between 1992/93 and 2001/02 as shown in Figure 4A.8.

As indicated by the assistant agricultural officer of Chomu *tehsil*, pesticides such as chloropyriphos, endosulfan, quinalphos, methyl parathion, and malathion are used in the region. In addition to these, bio-pesticides such as NPV (nucleopolyhedrovirus) and trichoderma are also used. Fungicides used include carbendazim, mancozeb, and thiram. The practice of fungicide usage involves application of about 1.5 g of carbendazim per kg of seed for groundnut and 3 g mancozeb per kg of seed of for mustard. For vegetables, the dose of insecticide is

1–2 ml/litre water or 600–1000 ml/ha; and dose of fungicides is 2–3 g/litre of water or 1.5–2 kg/ha.

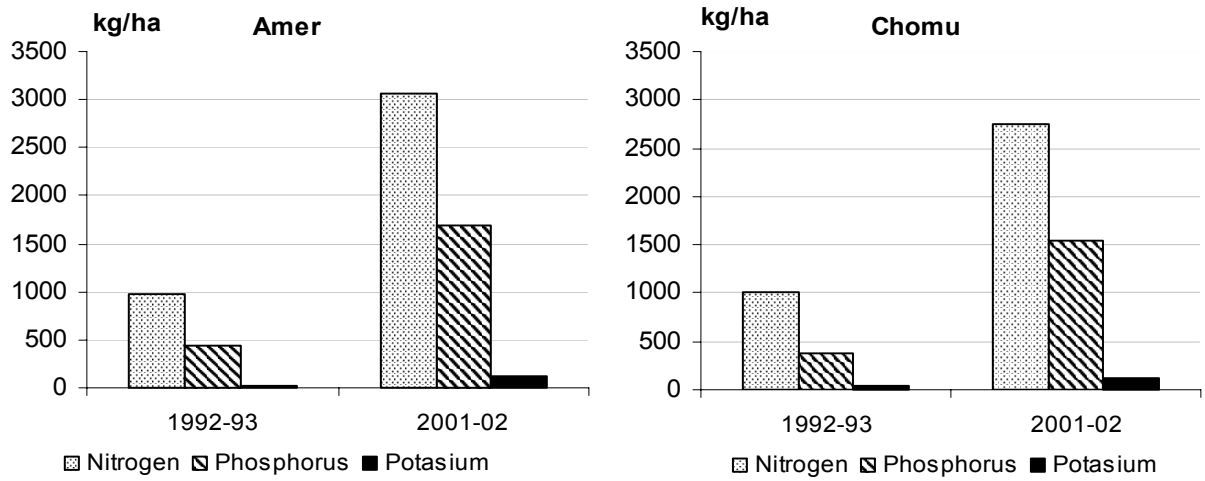


Figure 4A.8 Fertilizer consumption per unit area

Source Data collected and compiled from the Department of Agriculture in the two *tehsils*

Land use in the context of watershed

Approximately, 85 percent of the area in Kaladera is under agriculture, with ~ 7 percent of the area being covered by water bodies and streams, and 4–5 percent by trees and forests. The remaining 3–4 percent of the watershed area falls under urban and industrialized category. The soil in this region is mostly sandy loam in texture. Figure 4A.9 gives the land-use map of the watershed developed from satellite imageries.

Water situation

Hydrogeology

The area is occupied by Quaternary alluvium soil underlain by Alwar quartzites and schists. Quartzites form poor aquifers. They seem to be fractured and jointed at some places where occasionally they may form moderately potential aquifers, with yield of well/tube well lying between 150 LPM (litres per minute) and 250 LPM of water. Alluvial formations in the area constitute potential unconfined to semi-confined aquifers, the thickness of which varies from 60 to 70 m. These formations mainly consist of mix of fine to medium sands, kankars, clays, and gravel. Thickness of these sediments is continuous and about 63 m in Kaladera (CGWB 2004a). The yield of bore wells in Kaladera ranges from 300 LPM to 600 LPM of water. The transmissivity of the aquifers in Kaladera ranges from 250 m^2 (square metres) to 400 m^2 per day. At the block level, for example in Govindgarh block, the discharge of tube wells constructed varies from

66 LPM to 1010 LPM, and transmissivity ranges from 100 m² to 939 m² per day.

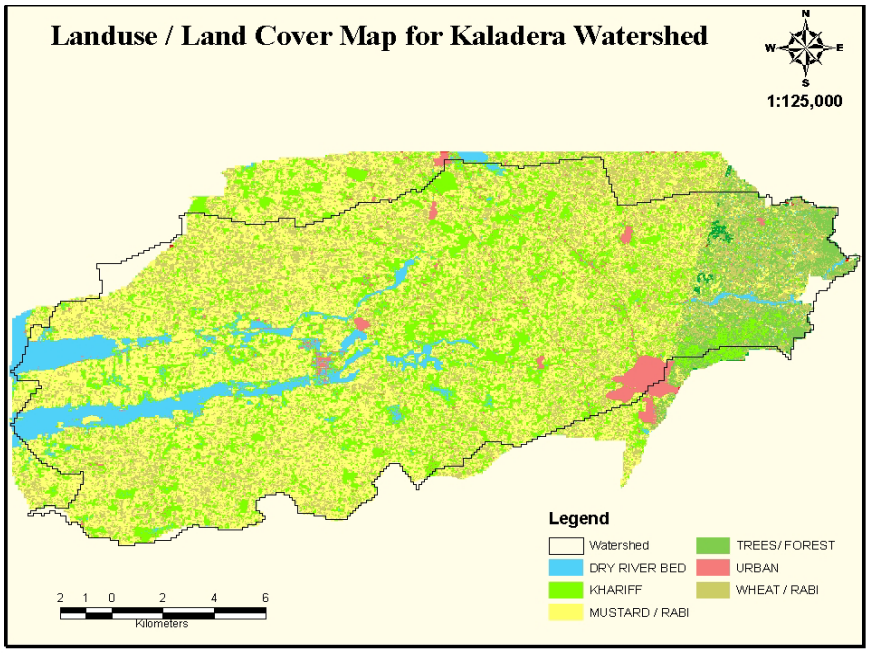


Figure 4A.9 Land-use map of Kaladera watershed

Source Based on satellite imagery from National Remote Sensing Agency

Groundwater fluctuation and movement

Depth to water level in the block area varies from about 14 mbgl (metres below ground level) to 66.70 mbgl, and at Kaladera, it is about 22–23 mbgl (CGWB 2004b). The depth to water table at Kaladera during May 1994 was 10.55 mbgl, which has gone down to 22.35 mbgl in May 2004, that is, a decline of water level of 11.80 m in the decade (at an average of 1.18 m per year). The decline in water level is a cumulative impact of below normal rainfall, moderate droughts, and groundwater withdrawals by agriculture, industry, and domestic sectors. The stage of groundwater development in Chomu and Amer *tehsils*, as reported by various reports prepared by the central and state groundwater boards, is much more than 100 percent (approximately 160 percent), which puts the entire Govindgarh block including Kaladera in the category of overexploited zones. Figures 4A.10 (a and b) give the water table fluctuations for two observation wells in the watershed. Figure 4A.11 gives the dominant direction of groundwater flow obtained from the analysis of water table data for wells in the region. The regional flow direction of groundwater in the watershed is found to be from north-east to south-west direction.

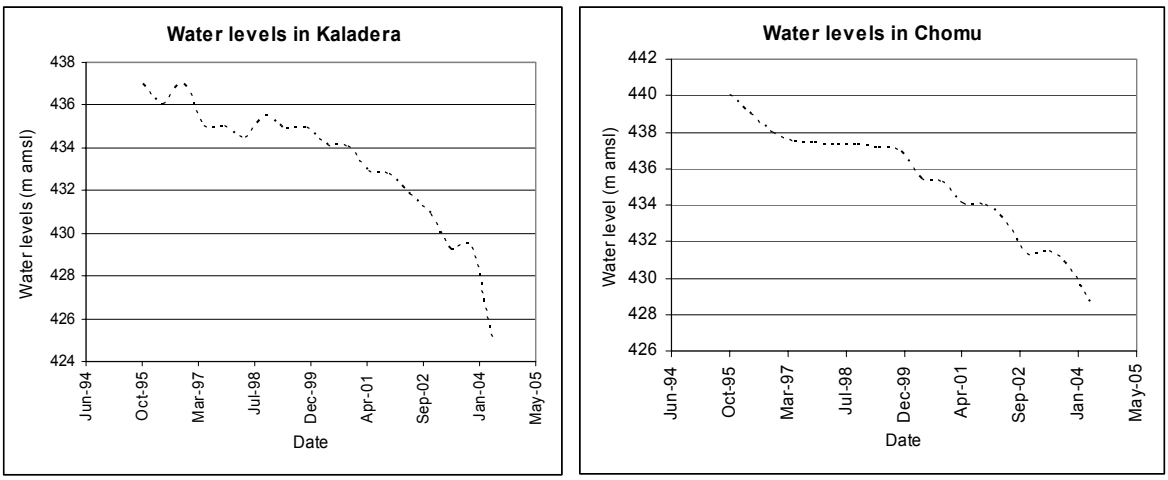


Figure 4A.10 (a and b) Water table fluctuations in Kaladera and Chomu

Source Based on data received from State Groundwater Department, Jaipur, Rajasthan

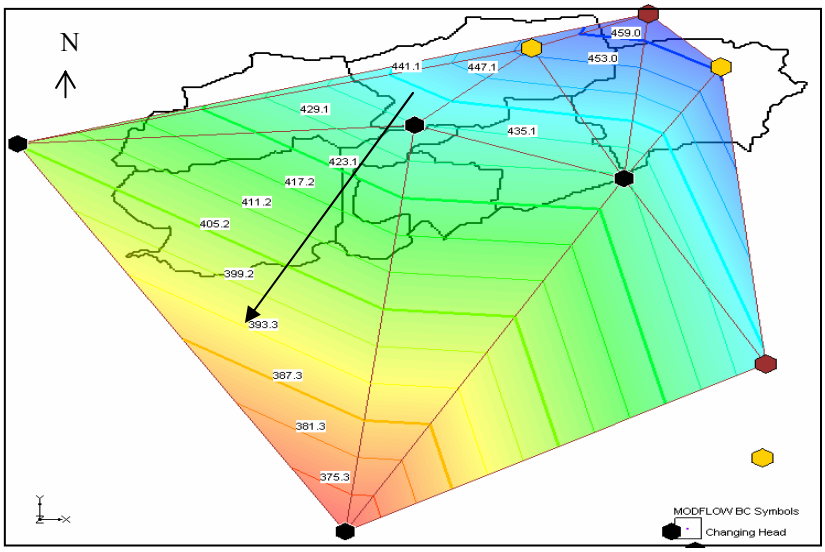


Figure 4A.11 Groundwater flow direction

Note Flow direction is shown by arrow. Shown in the background is the Kaladera watershed

Source Based on data received from State Groundwater Department, Jaipur, Rajasthan

Hindustan Coca-Cola Beverages Pvt. Ltd, Kaladera

The Kaladera plant, located in the RIICO area spread over 90 000 m², is owned and operated by the HCCBPL. The plant was first established in December 1999 but did not begin producing CSD ((carbonated soft drinks)) until June 2000. The plant mainly produces carbonated soft drinks in RGB (refillable glass bottles) and PET (polyethylene terephthalate) bottles. Other water-dependent industries in the vicinity of the plant include Rajshri pulp, Oswal paper, Rajasthan liquors, and MRK pipes.

Plant capacity and utilization

The plant has an installed capacity to produce 600 BPM (bottles per minute) and 340 BPM from two RGB lines. In addition, the plant also has the capacity to produce 150 BPM from one PET line. Out of these three lines, only two lines have been in operation since their inception—one RGB line (capacity 600 BPM) and the other PET line (150 BPM). In the past three years, plant has utilized annually less than one-third of its installed capacity as indicated in Figure 4A.12.

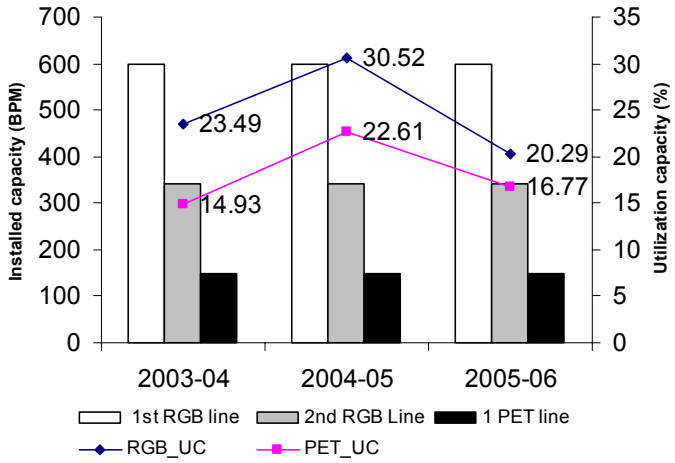


Figure 4A.12 Installed capacity and utilization capacity of the plant

Source Based on data provided by CCI

Water intake and production

Groundwater intake by the plant increases with the rise in production, depending on the type of production line (RGB or PET). Figures 4A.13 and 4A.14 show the monthly groundwater consumption and the corresponding volumes of production. As indicated in the figure, with higher production of CSDs in summer months, the water intake increases considerably during the period April–June. The intensity of water usage was significantly high in 2004, as high as 1500 KLD (kilolitres per day) in May.

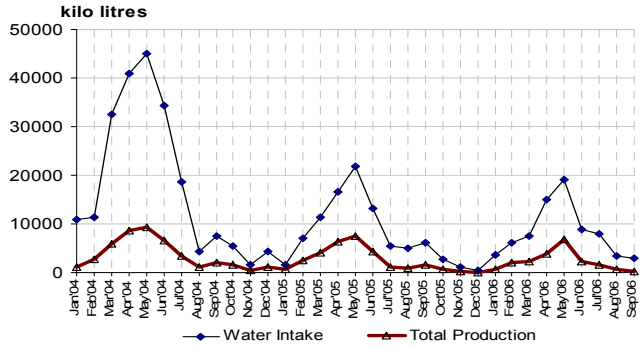


Figure 4A.13 Water consumption and carbonated soft drinks production trends

Source Based on data provided by CCI

Water utilization ratio

Based on the data provided by Coca-Cola, the annual WUR (water utilization ratio) was computed for the period 2004–06. The results thus obtained were in close conformity with the estimates provided by Coca-Cola (Table 4A.2).

Table 4A.2 Annual WUR (water utilization ratio)

Year	*WUR* (m^3/m^3)
2004	4.7
2005	3.0
2006	3.7

Source Based on data provided by CCI

The annual WUR in 2005 and 2006, in contrast to 2004, has come down. One of the reasons would be the increase in the share of PET production in relation to RGB. In 2004, with 62 percent RGB production, the WUR according to the plant estimate was 4.7 (refer Table 4A.2). On the other hand, in 2006, RGB production decreased to 49 percent and the WUR reported by the plant was 3.7.

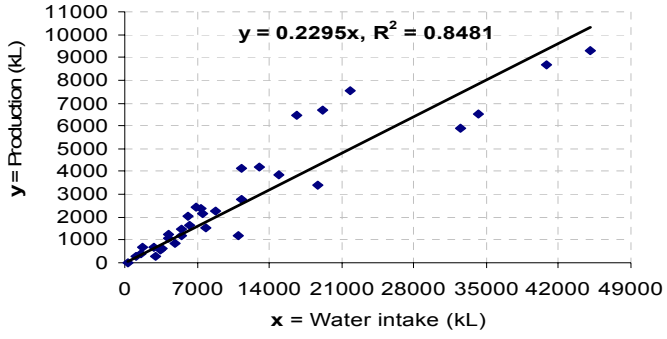


Figure 4A.14 Relationship between monthly groundwater intake and production

Source Based on data provided by CCI

Selection of villages and stakeholder interaction

Identification of villages

The Coca-Cola plant in the watershed is situated close to the border of the two villages namely Disan and Kaladera. Based on the description of the watershed in general and specifically the assessment of groundwater flow directions, the following villages for techno-social assessment were identified as per the methodology described in Chapter 2.

- Village in which the plant is located (M 1): Disan
- Village immediately u/s of the plant considering the regional direction of groundwater flow (U 1): Kaladera
- Village immediately d/s of the plant considering the regional direction of groundwater flow (D 1): Disan
- Village at the extreme u/s end of the watershed in the direction of groundwater flow (U 2): Khannipura
- Village at the extreme d/s end of the watershed in the regional direction of groundwater flow (D 2): Durga ka Bas

Figure 4A.15 shows the village map of Kaladera watershed, and villages selected for techno-social assessments.

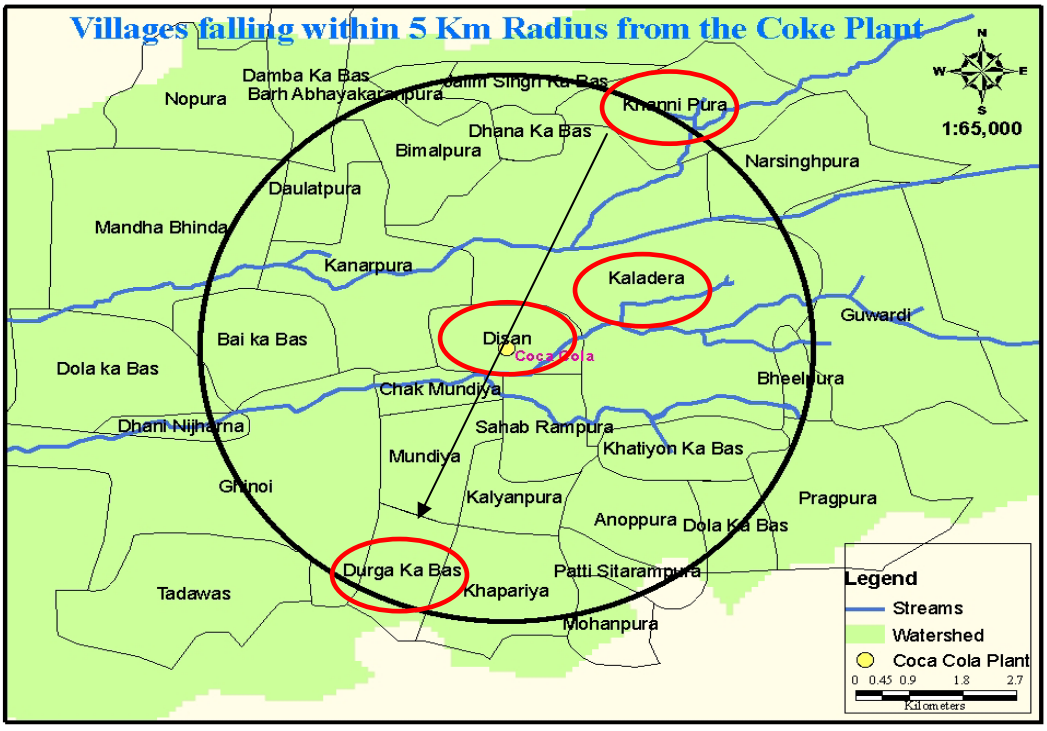


Figure 4A.15 Village map of the watershed (arrow shows dominant direction of flow)

Source Data from Survey of India toposheets and State Groundwater Development

Key stakeholder interaction

Stakeholder perceptions capture the views of different stakeholders on the issues of trends in water availability, quality, utilization, and access across the study villages. The section only records the views as presented by different stakeholders in the course of FGDs (focus group discussions) and key stakeholder interviews. It does not aim to make judgements nor draw conclusions based on these recorded perceptions.

The rationale for selection and relevance of stakeholders has been discussed in detail in Chapter 2 on approach and methodology.

Gram panchayats

The selected four villages are part of four different gram panchayats[3]. Hence, one FGD was conducted in each of the four panchayats, namely, Kaladera, Annoppura (for village Disan), Durga ka Bas, and Sandarsar (for Khannipura). Panchayat members highlighted community's perceptions on various water-related issues. Discussions with them helped in identifying the issues and areas of concern in terms of water availability, quality, utilization, and access in the area.

Women

Five FGDs were conducted among women stakeholders across the study area, including an additional FGD in Mamadiyon ki Dhani, Kaladera. This was undertaken as there is only one main domestic water source (an electric pump set) for nearly 50 households in the *dhani*.[3]

Farmers

FGDs were conducted with farmers in all the four study villages. As large and marginal farmers have different levels of access to water, both groups were approached in each village to understand their needs and perceptions. Thus, a total of eight FGDs were conducted among farmers' groups. Agricultural and cropping practices are related to the status of water quantity and quality in the region. The experience and knowledge of farmers in irrigated agriculture aided in gauging the trends in water availability, quality, and access.

Weaker sections

Four FGDs were conducted among the weaker sections[4] in all the study villages. Weaker section groups lived in separate settlement areas called *bastis*, located usually in the periphery of the village. The

[3] *Dhanis* are hamlets and lie in the midst of agricultural fields belonging to a village. The households in a *dhani* belong to the same caste.

[4] Weaker sections have been defined as follows: Weaker section constitutes both the socially weak and the economically weak. SCs (scheduled castes) and STs (scheduled tribes) are communities that are considered socially weaker and are accorded special status by the Constitution of India. In the context of the study, economically weak were defined as community or persons who are deprived of land and/or lack the essentials for a minimum standard of well being and living.

experiences of the members of these groups were crucial in assessing the trends in water availability and more importantly access.

Non-governmental organizations

An NGO (non-governmental organization) named 'PRIA (Participatory Research in Asia)', which is working closely with panchayats was interviewed. Discussion with its representatives helped in getting an overview of the general water scenario in the region.

Key persons

Three activists belonging to Jan Sangharsh Samiti, a civil society organization, were interviewed. The Samiti has been at the helm of protests against the Coca-Cola plant in Kaladera. Interviews were conducted with each of the representatives to understand the reason(s) and the ideology behind the protests.

An ex-block *pradhan*[5] and an ex-*sarpanch*[6] of Kaladera panchayat were interviewed. Interviewing them helped in understanding various dynamics of the protests against the Coca-Cola plant.

Two block officials and a local schoolteacher were interviewed to get a broader understanding of the water scenario in the region.

Representatives of the HCCBPL, Kaladera, and the consultant, who implements some of their CSR (corporate social responsibility) activities, were interviewed to know the CSR initiatives undertaken, as also to know their point of view on the protests held in Kaladera.

Stakeholder perceptions on water quantity

The section on water quantity captures the views of different stakeholders on the issues of access and availability of water across the study villages.

Water sources

As revealed from stakeholder discussions, groundwater is the primary source for meeting different water needs in the study villages. Stakeholder groups pointed out that a decade ago, open wells were a functional source of groundwater for all purposes. Over the years, the community gradually started using hand pumps for domestic purposes to supplement open wells. Currently, water for household use is fetched from hand pumps or is provided through piped supply. Hand pumps are installed by the PHED (Public Health and Engineering Department) or under different government schemes, though the panchayat is responsible for maintenance. The HCCBPL,

[5] *Pradhan* refers to the head of the panchayat samiti, the block-level local self-government.
[6] *Sarpanch* is the head of the gram panchayat.

Kaladera, has also installed hand pumps in Kaladera through the panchayat. All applications for hand pumps are routed through the panchayat. Installation and maintenance of piped supply are done by the PHED.

It was reported that in Khannipura, Durga ka Bas, and Disan, piped water supply connections have been provided to the households by installing energized pump sets on the old open wells. Women and the weaker sections highlighted the fact that Rs 60 per month charged for piped water connections was on the higher side and unaffordable to a majority of the households. It was reported in Khannipura, only six to seven households have piped water supply connections.

Farmers indicated that for meeting irrigation requirements, groundwater is extracted using energized pump sets coupled with sprinklers. It was also reported that rainfall had been a significant source of water for crops in the kharif [7] season, but in the current situation of low and erratic rainfall, the dependence on groundwater has increased.

Changes in water availability

Various stakeholders expressed that there is a serious problem of water scarcity in the sub-watershed. The primary reason for the problem, as reported, is the drop in groundwater level over the past decade and a half. It was also perceived that the past five to eight years have seen a dramatic drop in ground water level. Farmers, panchayat members, and weaker sections reported drop in groundwater level ranging between 10 feet and 20 feet per year.

A few of the key persons interviewed reiterated the above perception of drop in the groundwater level. Those key stakeholders who are at the forefront of the agitation against the HCCBPL, Kaladera, emphasized that there has been a drop in the water table at the rate of 7–15 feet per year, and the depletion of groundwater level has intensified in the past five years. Another key person perceived the drop to be around five feet.

However, a few other key stakeholders expressed an opinion that was just opposite. For instance, the consultant involved with CSR activities of HCCBPL, Kaladera, stated that currently in Jaipur, the water table is at 225–250 feet, whereas in Kaladera, the water table is at 80–90 feet.

Table 4A.3 highlights the rating of water availability and the varying degrees of scarcity experienced by farmers, women, and weaker section groups across the study villages.

[7] Kharif is the first agricultural season of the year.

Table 4A.3 Rating of water availability

Village	*Women group*					*Farmers*					*Weaker sections*				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Khannipura					X				X					X	
Mamodiyon ki Dhani (Kaladera)					X				X					X	
Dabur colony (Kaladera)				X					X					X	
Disan			X							X					
Durga ka Bas				X					X					X	

Scale: 1 – no scarcity; 5 – scarcity very high

Reasons

Stakeholder groups and key persons put forward various reasons that led to the fall in groundwater level in the region. Although the reasons cited by the different groups were similar, the priority accorded to each varied across different stakeholders. The following reasons were noted for the drop in groundwater level.

- Low rainfall in the region
- Increase in the number of bore wells both for agriculture and industrial purposes
- Increase in area under cultivation
- Water use by industries in RIICO, specifically by the Coca-Cola plant

All the stakeholder groups spoke about lack of sufficient rain over the past several years as a significant factor contributing to the drop in groundwater level. Farmers' groups added that as a result of insufficient rains, the groundwater aquifer has not been recharged. It was also acknowledged by farmers that there has been a rapid increase in the number of bore wells used for irrigation. Earlier only a few farmers used private bore wells, now most farmers own one. Additionally, there has been an increase in the area under cultivation. In Khannipura and Kaladera, two other factors – increase in population and fewer numbers of trees in the region – were also cited as contributing to the dropping of groundwater level.

Besides the reasons mentioned above, water use by the industries in RIICO and the operations of the Coca-Cola plant were clearly articulated by stakeholder groups as contributors to groundwater depletion. It was indicated by the stakeholder groups that Coca-Cola plant draws a lot of water, as it has 24-hour supply of electricity.

Majority of the groups belonging to women, farmers, and weaker sections indicated that the presence and operations of the Coca-Cola plant were the main reason for groundwater depletion. It was pointed out that besides having large number of bore wells, the Coca-Cola plant draws water from much greater depths using pump sets of very high power when compared to the pump sets used by farmers.

The women's group in Dabur Colony of Kaladera was an exception. The group strongly indicated rain to be a major cause for groundwater depletion and expressed that HCCBPL, Kaladera, does not have a role in groundwater depletion. It was further informed that HCCBPL, Kaladera, could not be held responsible for water scarcity, as there are only two metered bore wells in the company unlike the un-metered bore wells used by the farmers in the region.

According to few of the key stakeholders, many bore wells in the Coca-Cola plant are in operation 24 hours a day. As per one of them, the depth of the bore wells in the HCCBPL, Kaladera, is 1000 feet, each equipped with high-capacity pumps to extract water from greater depths. However, a few other key persons were of the opinion that HCCBPL, Kaladera, is not the main cause of groundwater depletion. One of them stated that through the construction of water-harvesting structures, HCCBPL, Kaladera, was recharging much more water than what they extracted.

Impacts

Women, farmers, and weaker sections feel the impacts of the dropping water table. The impact on agriculture was felt more, as it is the primary occupation in the region and majority of the families are dependent on income from agriculture. The sense of insecurity, therefore, amongst these groups is high as also is the anxiety related to access and availability of water in the future.

Farmers expressed that the water stress has serious repercussions on their livelihood. They highlighted both the impacts and coping measures related to water stress in the region, some of which are given subsequently. These are as follows.

- Reduction in yield levels
- Increase in costs incurred for irrigation
- Increase in land under fallow due to inadequacy of water for irrigation
- Adopting water-saving techniques like sprinklers for irrigation (a coping measure)

Women feared that in a few years, they might not have enough water even for drinking purposes. The impacts of water stress felt by women and their coping strategies are highlighted below.

- Conflicts between women as they have to queue up to fill their vessels in the morning
- Limited water to complete all household chores, hence, often clothes cannot be washed
- Inability to provide adequate water to cattle to drink, which affects the yield of milk
- Wasting several hours of the day in filling and fetching water

- Increased stress for working women (mostly labourers) as they have to leave for work in the morning and do not have time to wait in queues for water
- Travelling long distances in the summer when the nearby hand pumps get dry
- Extreme difficulty and strain in using hand pumps, especially for older women
- Insufficient water to bathe regularly in summers

The coping measures that women adopted have been indicated below.

- Filling up buckets of water at night to avoid long queues in the morning
- Wearing the same clothes several times to avoid frequent washing
- Submitting applications to the panchayat for installation of new hand pumps or a tank
- Installation of new electrified bore wells with contribution from the users
- Paying for installation of a new piped network

Perceptions on water quality

Problems in water quality were indicated in village Disan. It was perceived that the water quality in half the village had deteriorated over time. Stakeholder groups further added that the part of the village where water quality has been affected falls nearer to the *nullah* (stream) into which effluent from RIICO is discharged. Farmers reported that the deterioration in water quality has impacted yields and crop productivity. The issue was further stressed upon by the women members of the panchayat. They indicated that there has been a change in the taste of food cooked with the water. Two main reasons were cited for the change in water quality in village Disan. First, excessive withdrawal of water has led to increase in salinity and fluoride in the water. Second, effluent discharged from the industries in RIICO is percolating down and affecting groundwater quality.

The panchayat members of Kaladera and Khannipura also expressed concerns related to water quality. Kaladera panchayat members reported that fluoride level in hand pumps has increased and pointed out two hand pumps that had fluoride problem. In the opinion of some of the stakeholders, the high fluoride level was the result of going deeper for boring, as the water level decreased. In Khannipura, panchayat members indicated that water quality had changed over the past 15 years. The water was described as having become '*pheeka*' (tasteless) and '*halka*' (light), thus leading to lower agricultural yields. Further, the women's group in Khannipura village stated that water from their new electrified bore wells leaves a white residue in the container and referred to this residue as fluoride.

One of the key persons expressed concern that the HCCBPL, Kaladera, is releasing dirty water into a drain outside the plant and even claimed

to having seen it. It was also reported that effluent that was discharged outside the plant contained some harmful substances and when cattle consumed that water they died. On the other hand, a former sarpanch indicated that the problem of effluent is caused by various other industries and not by the Coca-Cola plant. It was pointed out that the HCCBPL, Kaladera, is the only plant at the RIICO estate, which has a recycling process for reusing wastewater, whereas the rest of the factories spew their effluents into the drain. Majority of the stakeholder groups were also of the opinion that the effluent was discharged from other units of RIICO, and not from the Coca-Cola plant.

Protests and agitations

Kaladera has been frequented by representatives of civil society organizations that voiced issues that echoed anti-multinational and pro-*swadeshi* principles. Some of the key activists expressed that they were protesting against the HCCBPL, Kaladera, as it is exploiting water resources. They also believed that the beverages produced at the facility are harmful to health.

The key premises for their protests and agitation against the Coca-Cola plant are as follows.

- HCCBPL, Kaladera, is exploiting and exporting local water resource
- The beverage produced by the HCCBPL, Kaladera, is harmful to health
- Coca-Cola is a multinational company

The workers of the Jan Sangharsh Samiti, which has been active in the protests against the Coca-Cola plant in Kaladera, have tried to compare the impact of the Coca-Cola plant on water resources with the impact on farmers. As per their estimation, after accounting for higher capacities and usage of pump sets of the company, one tube well of the HCCBPL, Kaladera, is found to be equivalent to 7000 tube wells of farmers.

The key persons acknowledged that there were other factories in the area that consumed water but they believe the greatest use of water is by the Coca-Cola plant. It was also pointed out that in the case of agriculture, the water was being used locally for feeding the community and was going back to the earth, while in the case of Coca-Cola's use of water, the local precious commodity was being exported. Other stakeholders, notably farmers and women, also shared this concern stating that the HCCBPL, Kaladera, is using local water and exporting it by means of their product.

As a response to the agitations and protests being organized against them, the representatives of Coca-Cola plant pointed out that the initiation of the protests has been from 'outside' Kaladera, specifically

from Jaipur. They alleged that those who come from 'outside' are all hired and paid people, whose concerns are not related to the issues of water. They are more concerned about Coca-Cola being a multinational company. According to them, a part of the local community supports the protests, whereas a part of it is neutral. Further, they added that complaints against them do not mention the objective or motive to do so, and has to do more with inviting media attention.

Regulatory and governance structures and compliance

Governance issues in the context of the establishment and operation of the bottling unit by the HCCBPL at Kaladera comprise an assessment of the following.

- Brief reviews of the water policy in Rajasthan and the draft Rajasthan Ground Water (Rational Use and Management) Act, 2005; the latter is pending in the state assembly since 2005.
- Compliance for the HCCBPL, Kaladera, within the ambit of state legal and administrative framework related to the establishment and operation of the plant. This is based on secondary information provided by CCI and wherever possible verified through discussions/ data from state offices/departments.
- Compliance of the HCCBPL, Kaladera, with respect to TCCC requirements based on secondary information provided by CCI.

The Rajasthan State Water Policy

Water resources in Rajasthan are acknowledged by the water policy of the state, drafted in 1999, to be relatively scarce and also extremely unevenly distributed, both temporally and geographically.[8] Also, groundwater exploitation in some areas of the state is such that the water table is going down at the rate of 3 m per year. Given these facts, the Rajasthan State Water Policy, 1999, advocates the judicious and economically sound allocation of water resources to different sectors – with drinking water supply as a first priority followed by irrigation, power generation, and industrial sectors – and the conjunctive use of surface water and groundwater. It also brings out the need to provide assured minimal water supply during drought periods, although it contains no policy suggestions on possible methods of achieving this. Besides, the policy calls for beneficiary participation in all aspects of water management and planning; the introduction of appropriate user charges as a way of encouraging water conservation measures; and the recharge of groundwater aquifers to mitigate the excess demand for drinking water, as well as for industrial and other purposes.[9]

[8] Rajasthan State Water Policy, 1999, Government of Rajasthan.
[9] Details available at <http://cgwb.gov.in/gw_profiles/St_Rajasthan.htm>, last accessed on 3 June 2007.

Currently, a draft of the Rajasthan State Water Policy, 2005, is under discussion;[10] this states that all development projects in the state shall be prepared keeping in view the availability of water and priority of utilization. While overlapping with most of the objectives in the State Water Policy, 1999, the draft Water Policy, 2005, seeks to introduce incentives and disincentives for efficient utilization of water and explicitly states that water allocation priorities and the pricing structure should be based on purpose of water use and availability of water in the region.

The State Water Policy, 1999, also observes the need to enact a comprehensive law to promote conservation and management of water resources of the state.

Draft Rajasthan Groundwater (Rational Use and Management) Act, 2005

The objective of the draft Rajasthan Groundwater (Rational Use and Management) Act, 2005, is to promote conservation, augmentation, equitable distribution, and sustainable use of groundwater resources within the state of Rajasthan. The 2005 draft version does not contain any clear guidelines on water allocation during water distress situations.

The Rajasthan Draft Groundwater Legislation recognizes an important policy tool in the form of differential user charges for water, based on the nature of commercial activity and the groundwater characteristics of the block, although it too does not provide any specific road map for the allocation of water during phases of water scarcity. The draft bill also seeks to address the problem of unchecked water extraction by setting in place well-defined duties and functions for a proposed Rajasthan Ground Water Authority.

State legal and administrative framework

The RIICO industrial area in Kaladera, where the Coca-Cola plant is located, was established in 1994. The Coca-Cola plant, HCCBPL, Kaladera, occupies a total of 90 000 m^2 area in the Kaladera industrial estate. Water charges have to be paid by the plant at regular intervals on the basis of the meter readings on water consumption; the payment of water charges to the RPCB (Rajasthan Pollution Control Board) is as per the rules laid down in the Water Cess Act, 1977. The plant has sunk four bore wells in its compound to draw groundwater for industrial and domestic use, within permission for a maximum of five bore wells for sourcing groundwater; this is based on an application made to RIICO by Coca-Cola. Box 4A.1 summarizes the water-related aspects of the agreement between Coca-Cola and RIICO.

[10] Details available at <http://www.rajirrigation.gov.in/docs/DraftStateWaterPolicy.pdf>, last accessed on 3 June 2007.

Box 4A.1 Water-related aspects of the lease agreement between RIICO and Coca-Cola for the Kaladera plant

- Serial no. 2(k) of the lease agreement bars the Lessee to excavate (digging, levelling or dressing) any part of the premises. But 4(a) removes the restrictions and permits the HCCBPL (Hindustan Coca-Cola Beverages Private Ltd) to sink a maximum of five bore wells in the premises for the industrial use and other purposes. This exception is given to the HCCBPL with out requiring the Lessee to make additional payment towards premium or additional charges to RIICO (Rajasthan State Industrial Development and Investment Corporation).
- Agreement also permits the HCCBPL to install water connection through water mains against the reservations under Serial No. 1 (a) at the site as approved by the RIICO to meet the project requirements. The Lessee shall install water meters and pay water charges on actual basis as prescribed by RIICO.

For establishing a new industrial unit in the RIICO industrial area, the industrial applicant is required to submit an application for land allotment in a given format along with a detailed profile of the proposed project, a no objection certificate (Consent to Establish) from the RPCB, and certain other documents (Box 4A.2). The project profile/outline is required to justify the land requirement, water demand, power demand, and effluent details – if any – of the proposed industry for which permission is being sought, and must also provide a layout plan or a map for proposed land utilization along with the constitution of the company. Both the land allotment form and the project profile require the applicant to mention the amount of water (in litres per day) required for operations, along with the requirement for power.

Box 4A.2 Copies of documents to be enclosed with application for land allotment to Rajasthan State Industrial Development and Investment Corporation

- Partnership deed/ Memorandum and Articles of Association (if available)
- Provisional registration in case of SSI (small scale industry) units
- Certificate required for concession
- Consent to establish from Rajasthan Pollution Control Board and details of effluents
- Project outline/project profile

Piped water is supplied by RIICO to industrial establishments in the Kaladera industrial area. As intimated to TERI during an interview with RIICO administrative personnel, it is mandatory for all industrial units in the Kaladera industrial area to take one piped-water connection with a pipe diameter of 1 inch. For more intensive water requirements, RIICO gives permission to the units to dig bore wells based on the water requirement of the applicant industry, as well as on the studies in the area by the SGWD (State Ground Water Department) and the regional RIICO field officer on the yield of water per bore well. Given the limited access provided to TERI, and also the CGWB (Central Ground Water Board) assessment of Govindgarh block being overexploited, which is not yet notified by CGWA (Central Ground Water Agency) for registration and regulation, it was difficult to establish (i) whether formal requirements of consultations between

RIICO and SGWD exist; and (ii) the nature and extent of consultations, if any, between RIICO and SGWD with respect to the digging of bore wells by the Coca-Cola plant in Kaladera.

It was also intimated to TERI that RIICO's policy for water-intensive industries requires focusing on maximizing water reuse/recycle. TERI was unable to assess whether RIICO has instituted such a system formally.

In addition to the provision of water, RIICO also provides infrastructural support for the drainage of wastewater to industries in the Kaladera area. Basically, this appears to comprise a *nullah* leading to the Bandi river. However, the Coca-Cola plant in Kaladera does not discharge wastewater outside the factory complex as per the terms of the Consent to Operate renewed in January 2006 by the RPCB. The Consent to Operate taken for industrial operation, which is renewable every three years, states with respect to effluent disposal: 'Industrial effluent shall be recycled and reused in the process or plantation within factory premises'. Therefore, water that cannot be used for domestic or industrial purposes after being recycled is now used for gardening purposes within the compound of the plant; there is also a fish tank that is fed by water treated by the effluent disposal system in place.

With respect to the Kaladera industrial area in general, TERI was informed during the interview at RIICO that water-intensive industries are not being allowed any longer since the area has been assessed as an overexploited zone[11] by the CGWB. In this context, a CGWB report (2002) posits the Govindgarh block, where Kaladera is situated, as amongst the overexploited blocks in the state, as per an assessment on 1 January 1998 (CGWB 2002). Another assessment (CGWB 2005) reiterates this but no official notification has been issued by the CGWA, the relevant authority, to date declaring the area as an overexploited one. Such a declaration would necessitate the registration of bore wells in the region, and the regulation of water extraction activities discussed in Chapter 3. However, as noted in Chapter 3, Govindgarh is amongst the several identified overexploited groundwater zones in the country, which are yet to be notified for registration and regulation by the CGWA.[12]

As per the responses received to a set of questions sent to Coca-Cola India, the company reports to have assessed water availability at the block level while establishing the plant. However, it is not clear whether Coca-Cola India took into account only published literature

[11] According to Prof. M S Rathore, Institute of Development Studies, Jaipur, the Kaladera area was most probably declared an overexploited zone by the State Ground Water Department in 2004/05 (as per interview with study team).

[12] As per documents received by TERI from CGWA (Central Ground Water Agency), 746 out of a total of 839 identified overexploited blocks in the country are yet to be notified; as noted during the interview with CGWA personnel, this is largely due to administrative constraints like an inadequate number of trained personnel, and so on.

and official notifications from the CGWB and other state organizations, or whether it also took cognizance of any other investigations that were ongoing at the time of establishment of the plant. Also, the company has not indicated to TERI whether it took cognizance of the fact that their facility is located in a zone, which as noted above, had been identified as an overexploited area in 1998. Therefore, the extent of scrutiny by the state agency, RIICO, while allotting land for the establishment of a water-intensive industry assumes importance in the following context: (i) the availability of adequate water in the area from a long-term perspective, and (ii) gauging the appropriateness of the demand for water by the industrial applicant.

Also, it could not be verified from the discussions[13] whether formal requirements of consultations between RIICO and SGWD/CGWB exist. It was also difficult to establish the nature and extent of consultations, if any, between RIICO and SGWD/CGWB before permission was accorded to the HCCBPL, Kaladera, to dig bore wells in their Kaladera plant. Further, the process employed by RIICO to gauge the appropriateness of the applicant's water requirement was not clear from the documents available.

Categorization, consent, and water cess

The RPCB constituted under the Water Act undertakes the functions relating to pollution prevention and maintaining or restoration of the wholesomeness of water. In this context, the Consent to Establish, which as indicated above is a 'no objection certificate' issued by the RPCB, has to necessarily be appended by an entrepreneur along with other documents when applying to RIICO for the allotment of land to establish an industrial unit; it will be noted while discussing the conditions imposed in the Consent to Establish discussed below that the source of water for industrial activities – ground or surface – is not a subject of reference in the consent given by the RPCB. The Consent to Establish focuses largely on the disposal of wastewater or industrial effluents.

All industries in Rajasthan are categorized by the RPCB as 'red', 'orange' or 'green', depending on their potential to cause air and water pollution, with red being the most polluting and green the least. The RPCB's operation, compliance, and monitoring provisions for each industrial category differ (Table 4A.4). The HCCBPL, Kaladera, belongs to the red category of industries.

[13] A questionnaire was also sent to RIICO (Rajasthan State Industrial Development and Investment Corporation) from TERI with a request for answers (Appendix XX). However, RIICO did not provide any written answers although TERI also organized a follow-up visit on the basis of the questionnaire.

Table 4A.4 Differing provisions for red, orange, and green industries

Industrial category	*Validity of Consent to Operate*	*Frequency of site inspections*	*Sample of trade effluents and/or air emissions*
Red	Up to a period of three years	Shall not exceed once in three months	Shall not exceed once in six months
Orange	Up to a period of five years	Shall not exceed once in six months	Shall not exceed once in 12 months (with authority of regional/ head office)
Green	Up to a period of 15 years	Shall not exceed once in 24 months	Shall not exceed once in 24 months (with authority of regional/ head office)

Source RPCB (1998)

Once the industry is established to operate, the industry would require to apply for a 'Consent to Operate' from the RPCB. Subsequently, it has to comply with the conditions as laid down in the consent.

In addition to the above, as per the provisions of the Water (Prevention and Control of Pollution) Cess Act, 1977, as amended in 1991, the relevant state pollution control board is also responsible for the collection of water cess. The HCCBPL, Kaladera, pays differential water cess at an average rate of 20 paise/kl (kilolitre) to the RPCB; as per the documents provided by Coca-Cola, the plant has paid Rs 5737.00 as cess to the RPCB for the period 1 September 2006 to 31 March 2007.

Compliance with regulatory and The Coca-Cola Company requirements

The Consent to Establish, issued by the RPCB, has to necessarily be appended by an industrial applicant along with other documents when applying to RIICO for the allotment of land. The Consent to Establish was issued by the RPCB to the HCCBPL, Kaladera, on 11 August 1998; another was issued on 25 March 2003 for the installation of a new production line. Both the consents lay down conditions for wastewater disposal, but do not lay down norms for using water. Table 4A.5 gives the compliance against water-related conditions in the 1998 Consent to Establish by the facility.

Table 4A.5 Compliance with conditions specified in CtE by HCCBPL, Kaladera

Requirements	*Compliance in Kaladera plant; remarks if any*
General	CtE (Consent to Establish) issued on 11 August1998
Limit on discharge for wastewater	1360 KLD Based on May 2006 data provided by Coca-Cola and considering all 31 days of operation, the daily effluent generation has been estimated at about 393.5 KLD. From this, about 7 percent was recycled for floor washing and using in the toilet, and the balance was used for irrigation and discharged. This is well within the limits permitted by the CtE
Mode of discharge of wastewater	Discharge in RIICO (Rajasthan State Industrial Development and Investment Corporation) drain Since January 2006, the plant does not discharge wastewater outside its premises
Compliance with discharge standards	Discharge standards for land application by RPCB provided only for nine parameters; analysis reports/data provided by CCI suggest compliance with these parameters. Primary assessment reveals that HCCBPL, Kaladera, needs to look beyond compliance
Interlocking of pollution control devices with process	Could not be verified during the site visit
33 percent of the plant area to be covered by green cover	Green cover present; however, no physical verification was undertaken
Hydraulic loading rates suggested for land application of treated effluent	Could not be verified at the site since the inlet and outlet of the ETP (effluent treatment plant) were not dynamically linked
Monthly progress report for compliance, quarterly compliance report, and annual environmental statement to be submitted to the state pollution control board	Copies of the report received Complying with the conditions specified in CtE

Note: The compliance of the plant is based on secondary data provided by CCI; results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

The current consent to operate issued to the HCCBPL, Kaladera, was renewed in January 2006 for a period of three years. This consent advised the Coca-Cola plant in Kaladera to stop discharging industrial effluent outside the factory premises. Table 4A.6 provides a snapshot view of the conditions of the consent to operate issued to the HCCBPL, Kaladera, and the facility's compliance against them.

Table 4A.6 Compliance with conditions specified in CtO by HCCBPL, Kaladera

Requirements	*Compliance in Kaladera plant; remarks if any*
General	Copy of CtO (Consent to Operate) issued to the HCCBPL (Hindustan Coca-Cola Beverages Pvt. Ltd), Kaladera, on January 2006
Limit on discharge for wastewater	1060 kld (kilolitres per day) Based on May 2006 data provided by Coca-Cola and considering all 31 days of operation, the daily effluent generation has been estimated at about 393.5 kld. From this, about 7 percent was recycled for floor washing and used in the toilet, and the balance was used for irrigation and discharged. This is well within the limits permitted by the CtE
Mode of discharge of wastewater	Plant is zero discharge as per the consent requirement since January 2006
Compliance with discharge standards	Discharge standards for land application by RPCB provided only for nine parameters; analysis reports/data provided by CCI suggest compliance with these parameters. Primary assessment reveals that HCCBPL, Kaladera, needs to look beyond compliance
Interlocking of pollution control devices with process	Mentioned, separate power supply for pollution control equipment But could not be verified during the site visit
Monthly progress report of compliance, and annual environmental statement to be submitted to SPCB	According to the reports received from CCI the plant is complying
33 percent of plant premises to be covered by green cover	Green cover present; however, no physical verification was undertaken
Hydraulic loading rate mentioned for land application of treated effluent	Could not be verified at the site since the inlet and outlet of the ETP (effluent treatment plant) were not dynamically linked

Note: The compliance of the plant is based on secondary data provided by CCI: results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

The Coca-Cola Company requirements

In the absence of the siting report, it was difficult to gauge the level of assessment conducted with respect to the availability of water resources in the region prior to the establishment of the plant. However, compliance with the company practices on water extraction, usage, and wastewater disposal was conducted against a set of requirements and guidelines provided by TCCC. The summary of the compliance status is presented below.

Water drawal and usage

Table 4A.7 gauges compliance of the bottling unit with water resource management requirements of the Coca-Cola system.

Table 4A.7 Compliance with TCCC water resource management requirements by HCCBPL, Kaladera

Requirements	*Compliance in Kaladera plant; remarks if any*
Environmental due diligence to be conducted prior to siting of the plant	Coca-Cola reports that it was conducted; report not shared with TERI for legal and confidentiality reasons as indicated by TCCC (The Coca-Cola Company)
Documented water availability assessment	Pump test apparently conducted, report not shared for legal and confidentiality reasons as indicated by TCCC
Initial and periodic water utilization assessments	Carried out as appears in dropping water utilization ratio over the years
Implement and maintain a process for water utilization	All the bore wells are metered as per the requirements of the RPCB (Rajasthan Pollution Control Board). Also, the plant monitors raw and process water to assess water utilization
Establish a continuous improvement process for water utilization	Water utilization ratio was 8.7 in 2001; decreased to 3.84 in 2006; potential unknown
Define water utilization objectives and goals in annual business plans	Optimization of water utilization per litre of the beverage produced remains the annual objective; water conservation targets are defined each year in consultation with corporate office
Develop and execute internal and external water contingency plans	Various rainwater-harvesting initiatives have been undertaken as part of contingency measures. However, the field visits to randomly chosen external recharge shafts sites revealed that all the shafts were in dilapidated condition. HCCBPL (Hindustan Coca-Cola Beverages Pvt. Ltd) informed that the annual maintenance and cleaning of shafts is undertaken just before the monsoon season.

Note: Based on information provided by TCCC and CCI and site visits by the project team

As stated in Chapter 3, Coca-Cola has certain guidelines on water resources management. These guidelines along with their implementation in HCCBPL, Kaladera, are summarized in Table 4A.8.

Table 4A.8 Compliance with TCCC water resource management guidelines by HCCBPL, Kaladera

Guideline	*Observation in HCCBPL (Hindustan Coca-Cola Beverages Private Limited), Kaladera*
Self-assessment – water utilization	A plant-level water distribution/balance is maintained and water use is optimized at each level of the process based on in-plant trials and suggestions from the corporate office. As a result, the water utilization ratio has declined over the years. A water usage self-assessment is done annually at the plant in TCCC (The Coca-Cola Company) format; the document was shown to TERI by the plant management but a copy of the responses by the plant was not shared by Coca-Cola
Self-assessment – water supply	As per the documents received, a safe yield of the water supply source is assessed at the time of establishment of the plant. Quality of raw water is checked on a daily basis for selected parameters at the plant and once in a year by an accredited laboratory. A water supply self-assessment is done annually at the plant in TCCC format; the document was shown to TERI by the plant management but a copy of the responses by the plant was not shared by Coca-Cola (India)
The data collected during self-assessments to be used to build a water conservation plan	Since self-assessment responses were not shared, it is difficult to ascertain how information collated during self-assessments are used to build a water conservation plan
The establishment of a cross-functional team for water resources management	As intimated during the plant visit, a cross-functional team has been established at Kaladera for water resources management. This includes the Factory Manager and the Quality Assurance Manager apart from other executives; the WRM programme focuses on 4 R's for water conservation: Reduce; Reuse; Recycle; Recharge. The various initiatives undertaken include creating awareness and training employees, and technological interventions, for example, reuse of wastewater in applications like gardening and shop-floor cleaning

Note: Based on information provided by TCCC and CCI (Coca-Cola India) and site visits by the project team

Wastewater discharge

Coca-Cola corporate policy lays down company standards for effluent disposal. The applicable regulatory standards for the Kaladera plant, specified in the Consent to Operate issued by the RPCB, provides limits for nine pollutants for the treated effluent discharged from the ETP (effluent treatment plant) of the plant. All the nine parameters listed in the requirements in Consent to Operate are also part of the corporate requirements. Table 4A.9 give the compliance of the HCCBPL plant with TCCC wastewater requirements.

According to the documents received, the HCCBPL, Kaladera, attained the E1 level of compliance in 2005 under TCCC audit system (refer Chapter 3). Apart from the above, it has also received the ISO 9001 certification for quality in 2002, and the ISO 14001 certification for environmental management standards in 2004.

Table 4A.9 Compliance with TCCC wastewater management requirements by HCCBPL, Kaladera

Requirements	*Observations in Kaladera plant*
Meet applicable regulatory requirements	Yes (as per documents received; the Rajasthan Pollution Control Board officials too did not point to any anomaly)
Maintain an effluent quality that will have no adverse effects on fish or other aquatic biota in receiving waters	A fish tank is being maintained at the plant with water treated at the facility's effluent treatment plant
Maintain and operate treatment facilities in an efficient manner	Yes, as per the documents received from CCI (Coca-Cola India)
Compliance with wastewater quality requirements developed by TCCC (The Coca-Cola Company); plant to get its treated effluent analysed annually by an accredited laboratory and send the results to the corporate office	Yes, as per documents received from CCI
A detailed drainage plan of all water and wastewater streams in the facility	Yes, separate plans exist
Separate wastewater streams for process wastewater, sanitary wastewater, cooling water, and storm water	Yes, Sewage discharged in septic tanks, separate line for storm water and cooling and process wastewater taken to effluent treatment plant
Prevent the pollution (of) from water and wastewater	Adequate measures provided
Minimize the volume, strength, and hazardous nature of wastewater	Adequate measures provided; the plant has achieved 44 percent reduction in wastewater discharge (from 451 KLD to 251 KLD) from 2001 to 2006. This has been achieved by the use of recycled water in crate washing and tertiary treated water in green belt development at the site
Treatment of process water such that it is compliant with TCCC analytical standards compliant with government effluent discharge standards conducive to the long-term survival of fish in the treated effluent	Yes, as per the information provided by CCI
Sanitary wastewater to be discharged to a sewer connected, a sewage treatment plant, or a septic tank system	Yes, plant in compliance. Septic tank arrangement at site

Requirements	*Observations in Kaladera plant*
Treatment of storm water according to government regulations if applicable; else prevent the pollution of water and wastewater streams due to the run-off	Yes, separate management of storm water through dedicated drains.
Non-contact cooling water may be discharged into the local environment unless otherwise dictated by local laws or regulations	Not Applicable
If treated wastewater discharge is through infiltration, prior to infiltration the wastewater must meet TCCC requirements and local regulations	Not Applicable
If treated wastewater is disposed through land application, then	
Groundwater must be monitored quarterly within the application area, as well as up- and down gradient of the application area	No monitoring by the plant
The soil's carrying capacity should not be exceeded such that there is surface run-off	No monitoring done at present by the plant
Water intended for spray fields should not be discharged into nearby water bodies; nor should excess run-off from spray fields be allowed to enter nearby water bodies	Not Applicable; The treated wastewater meets the local regulatory requirements for land disposal. No separate TCCC standards exist for treated wastewater to be applied on land

Note: The compliance of the plant is based on secondary data provided by CCI: results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

Water-related corporate social responsibility initiatives

As reported by the plant management, a CSR action plan was initiated during 2003/04 after sporadic incidents of informal agitations outside the HCCBPL, Kaladera. CSR activities consequently began to be conceptualized in two broad areas: non-water-based community rural development initiatives and water-based initiatives. The water-based initiatives include the construction of recharge shafts, rainwater-harvesting structures, a drip irrigation project, and *bawri* (ancient step well water body) and *tanka* (surface water storage tanks) restoration programmes. Also, water-based initiatives of the HCCBPL Kaladera, are being implemented amongst the larger community, and not just near its plant locations as demonstrated by the following.

- Installation of 15 hand pumps for drinking water purposes since 2003 at various places in the village of Kaladera; also water coolers were installed at SP Saharia secondary school.
- Using the ancient concept of *tanka*, two roof top harvesting structures connected to tankas have been constructed at Saharia School (holding capacity 1 lakh litres of water) and Saharia Degree College (holding capacity of 2.00 lakh litres of water) in Kaladera. The HCCBPL, Kaladera, informed that both these projects are able

to store 3 lakh litres of water and have a recharge potential of 10 lakh litres during an average rainfall season.
- Rejuvenation of two *bawris*, namely, 'Sarai Bawri' and 'Kale Hanuman ki Bawri' in Delhi–Jaipur highway and Jaipur, respectively.
- Initiation of a pilot drip irrigation project using technology provided by a firm called 'Netafim Irrigation India Pvt. Ltd'.

In the above context, water-related projects have been sublet to a designated contractor – a Jaipur-based proprietary company, Silveron – since 2004. Plant representatives also stated that the SGWD has been providing technical expertise for the construction of the recharge shafts in Kaladera. According to documents received from CCI, the water-based initiatives of the HCCBPL, Kaladera, especially its recharge shafts, have been instrumental in impacting the rate of depletion of groundwater levels in Kaladera after 2003/04. However, during field visits to shafts randomly selected and visited by TERI, it was observed that all the rainwater-harvesting shafts, outside the plant, constructed by the HCCBPL, Kaladera, were in a dilapidated state. The plant, however, stated that the maintenance of the water structures has been included as a CSR target plan for 2007, and would take place just before monsoons.

TERI was also shown copies of requests from community representatives, namely, the Kaladera panchayat, and elected ward members; these requests identify local requirements for the HCCBPL, Kaladera, to take into consideration, for example, installation and repairing of hand pumps in particular areas. In addition to the above, interaction with plant officials indicated that a common practice of the plant has been to act upon reports of malfunction of water structures by community representatives.

Technical assessment

Regional assessment of water quantity and quality

Water resource assessment has been conducted at two levels, focusing on both qualitative and quantitative aspects. The assessment is based on primary field surveys, stakeholder discussions, and measurements, supported by the use of GIS (geographical information system)-based decision support systems.

Water quantity

This section deals with the application of the land phase of the hydrological cycle model and the groundwater flow model in an integrated manner to the study area. The key objectives are as follows.

- To understand the cumulative impact of various factors, both natural and anthropogenic, that may have led to depletion in water tables in the watershed.
- To estimate the impact of the HCCBPL, Kaladera, if any on the ground water table.

Rainfall- runoff estimation including groundwater recharge

The land phase of the hydrological cycle has been simulated using SWAT model (Neitsch, Arnold, , Kiniry *et al.* 2001). The groundwater model MODFLOW (McDonald and Harbaugh 1988) has been used to determine groundwater flow in the watershed. Both the models are dynamic, distributed models that are physically based, conceptual, and time continuous. SWAT has been tested and used successfully for ungauged river basins mainly due to its spatially explicit parameterization capability (Arnold, Srinivasan, Muttiah *et al.* 1998). Both SWAT and MODFLOW have been linked to each other in a dynamic manner such that the outputs of SWAT have been used as input to MODFLOW. The grid size of each model cell (that is, grid cell[14]) is taken as 200 m × 200 m. Model set-up, data requirements, and model calibration and validation have been discussed in Chapter 2. The subsequent sections provide the simulated results of the integrated SWAT–MODFLOW models.

Annual water balance

Based on the detailed integrated modelling exercise, an overall conservative annual water balance of the watershed has been estimated and the results are summarized as follows.

- Natural groundwater availability including seepage from irrigation: 35–42 MCM (million cubic metres)
- Groundwater draft for irrigation: 41–49 MCM
- Draft for domestic and industrial use: 3–6 MCM
- Groundwater draft for all uses: 44–56 MCM
- Stage of groundwater development: ~ 135 percent[15]
- Category: overexploited
- Average fall in water tables in the watershed: 0.6 m/year
- Maximum fall in water tables: 2.5–3 m/year

Thus, the watershed is categorized as a groundwater-over-exploited watershed where the groundwater development is more than 100 percent (that is, 135 percent) of the dynamic recharge and the water tables are declining. The industrial and domestic requirements are estimated to constitute between 8 percent and 10 percent of the total renewable groundwater availability. The agricultural requirements constitute 114–120 percent of the total renewable groundwater availability.

[14] Grid cell is defined as a cell formed by a pattern of horizontal and vertical lines forming squares of uniform size
[15] Groundwater development is a ratio of groundwater use to groundwater recharge. Its value of more than 100% indicates that the groundwater use is more than the recharge resulting in decline of groundwater tables; such areas are demarcated as overexploited areas according to the Central Ground Water Board norms.

Water yield and flows

Simulation of the land phase of the hydrological cycle shows that the mean annual water yield of the watershed – a response to semi-arid hydrometeorological characteristics, topography, land use/cover, soil characteristics, and plant water requirements – is estimated as 200 mm (approximately 28–30 percent of the mean annual rainfall). Four months, that is, July–October, account for nearly 80 percent of the total water yield. The flow duration curve derived from the simulated flows shows that flows above 1 cumecs (cubic metres per second) occurred less than 10 percent of the time in the past 25 years. Flows of approximately 0.1 cumecs occurred less that 28–30 percent of the time and 0.01 cumecs 40 percent of the time in a year. Overall, in about 85 percent to 90 percent of the time in a year, there are hardly any appreciable flows ('appreciable' is considered here as flows greater than 1 cumecs) in the watershed. Figure 4A.16 gives the water balance of the watershed for the period 1988–2004. Figure 4A.17 gives the flow duration curve for the watershed.

Actual evapotranspiration

The mean annual actual evapotranspiration is estimated as approximately 400 mm, being high in the months of May, June, July, and August. These four months account for nearly 65–70 percent of the actual evapotranspiration. Potential evapotranspiration ranges between 200 mm and 300 mm per month for these months. Total potential evapotranspiration demand is found to be approximately 1600 mm, which is 2.5–3 times the annual average rainfall received by the watershed.

Groundwater recharge and groundwater tables

The mean annual recharge is estimated to be 60–70 mm, that is, approximately 8–10 percent of the mean annual rainfall. Overall analysis of the groundwater simulation results obtained for various groundwater observation wells, including calibration as well as validation wells, shows model performance parameters R^2 values close to or higher than 0.8 (refer Chapter 2). Additional wells and observation data for the validation year 2004 have also shown a similar model performance. Scatter plots with regard to calibration and validation wells and validation period have been discussed and presented in Chapter 2. Figures 4A.18 to 4A.20 (a, b, and c) give the observed and simulation results of groundwater tables in the watershed as well as for the individual wells. The results show that the water tables in the watershed have fallen by 5–12 m in the past eight years. An average fall of 0.6–1.2 m per year has taken place in the watershed.

In Kaladera, water tables have gone down by more than a metre each year and by about 3 m in 2003/04. During the period

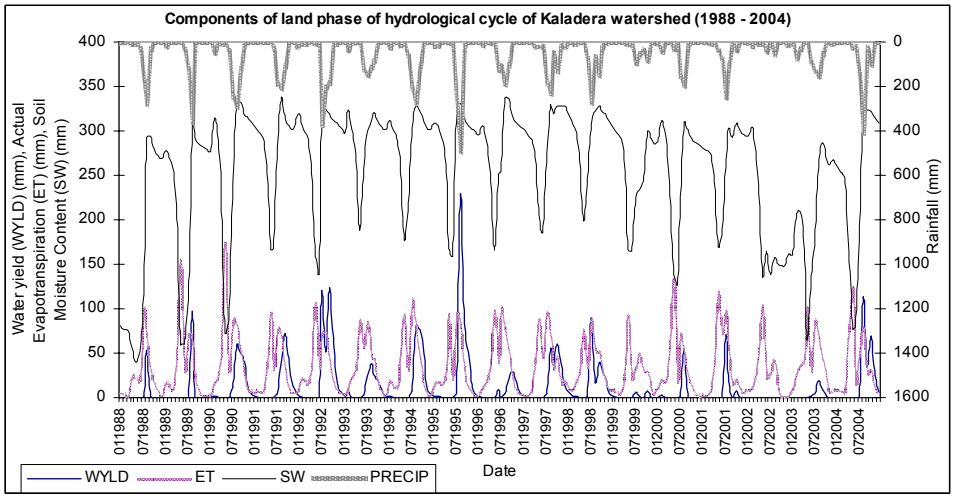


Figure 4A.16 Water balance results of Kaladera watershed

between 2001 and pre-monsoon 2004, water tables have fallen by almost 1.5–2 m per year. In the villages such as Disan, Chomu, Khannipura, and Durga ka Bas, similar trends have been observed wherein water tables have gone down by an average of more than a metre each year. Between 2000 and 2004, maximum impact has been felt as a result of climatic factors and excessive withdrawals.

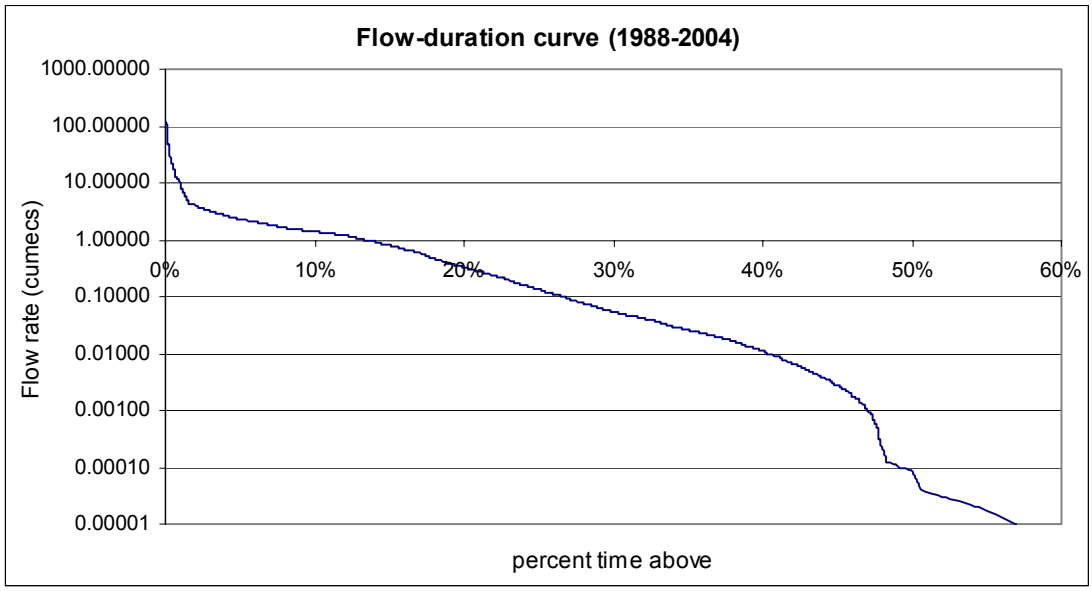


Figure 4A.17 Flow duration curve

Note WYLD (mm) (water yield): This is defined as the net amount of water that contributes to the streamflow in a sub-basin. ET (mm) stands for actual evapotranspiration from the sub basin. SW (mm) stands for soil water content, and PRECIP is the total amount of precipitation falling on the sub-basin.

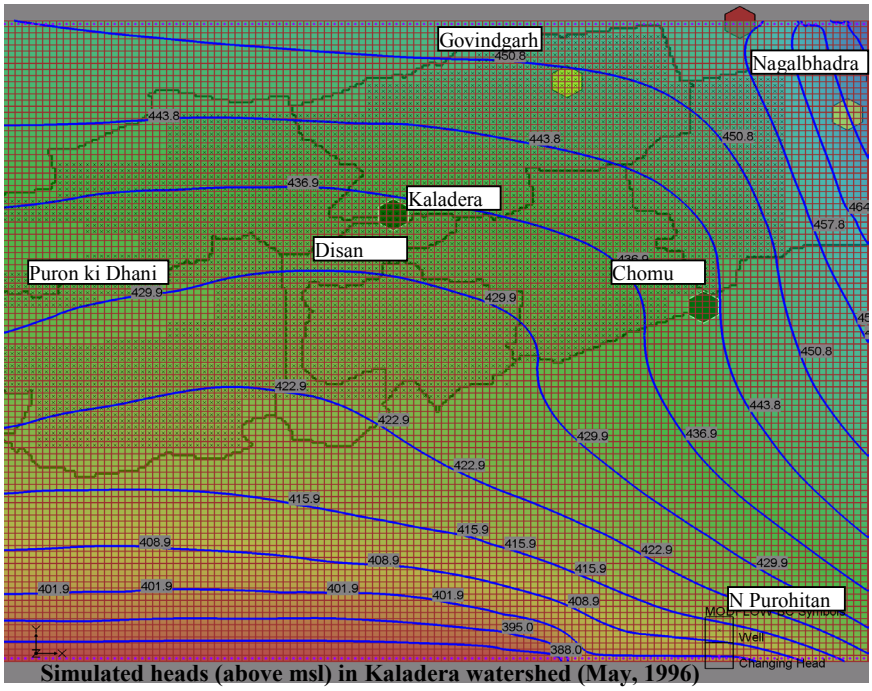


Figure 4A.18 Simulated heads (metres above mean sea level) in Kaladera watershed as on May 1996 (the background of the above figure has watershed boundary with various sub-basins, taken from SWAT)

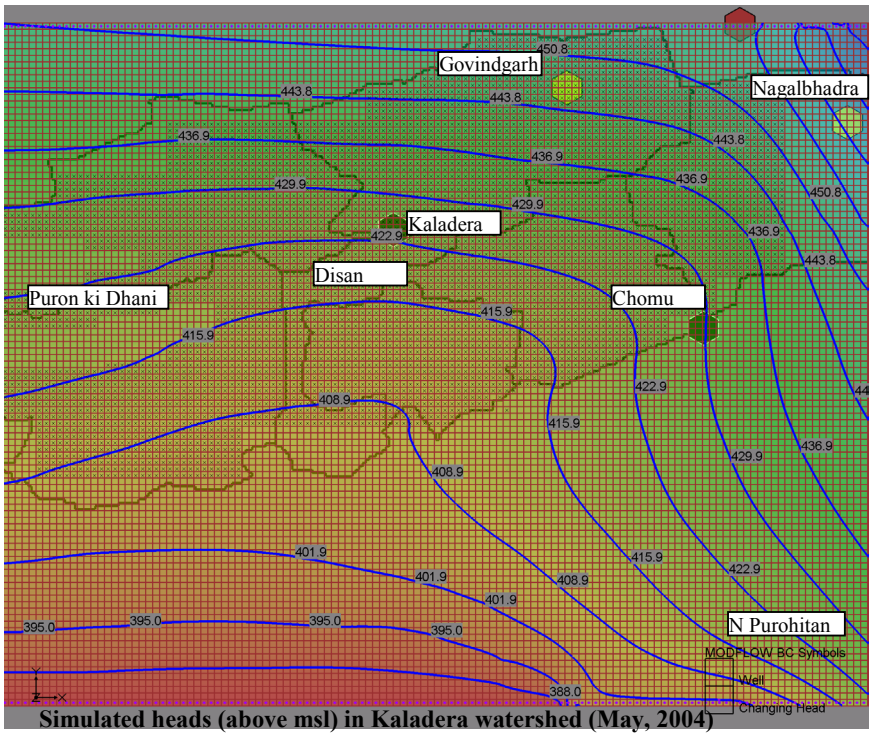
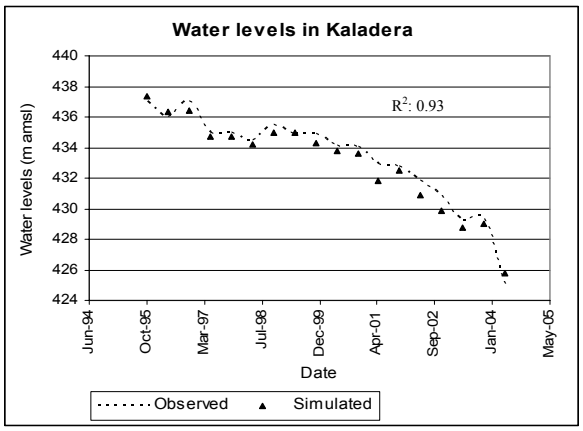
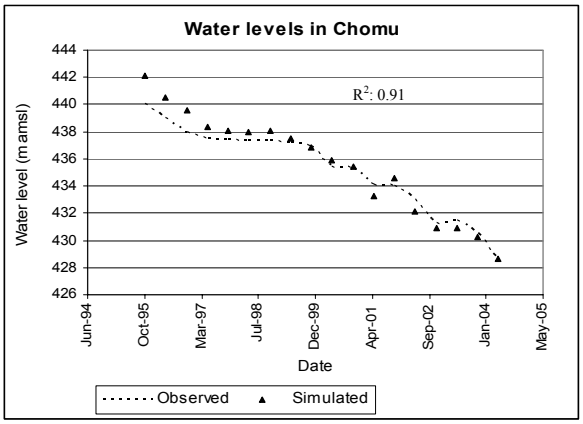


Figure 4A.19 Simulated heads (metres above mean sea level) in Kaladera watershed as on May 2004





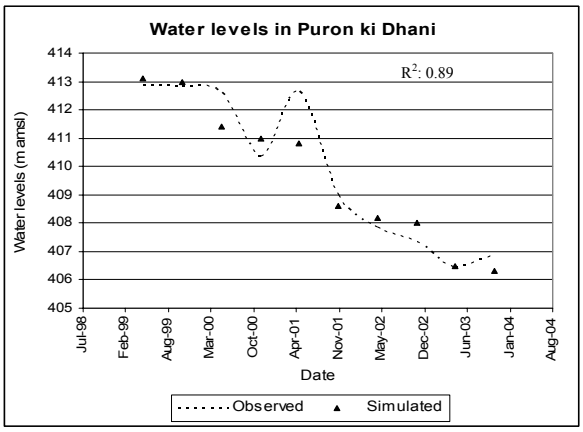


Figure 4A.20 (a, b, and c) Simulated and observed water tables for wells in the watershed

Plant water usage in relation to groundwater situation

The steering committee also recommended the study of the impact of plant extractions on the local extent of the aquifer. To capture the localized impact, the study focused on groundwater withdrawal by the plant vis-à-vis irrigation pump sets. For the purpose, the model discussed earlier was used again on a smaller grid size of 20 m × 20 m to capture the localized impact (defined as the impact on local aquifer

extent spreading radially 1.5–2.0 km around the plant location). The impact was measured by using the discharge data for the four HCCBPL bore wells provided by the plant. In addition, discharge data for irrigation pump sets was measured and was found to range between 18 m^3 and 25 m^3 per hour (as compared to the plant bore well pumpages that were measured to be about 30 m^3 per hour for each bore well). The measured value for the irrigation pump sets and the daily discharge data sets provided by the plant for each bore well were provided as an input to the model. Details of the model framework have been discussed in Chapter 2 (Approach and methodology).

Agriculture land area in the localized aquifer was derived from the land-use map obtained as satellite imagery. Figure 4A.21 gives the closer view of localized area including Kaladera industrial area based on satellite imagery. The map shows that Kaladera industrial area is surrounded by agricultural land. A closer look also reveals that the industrial area is located on the sediments of the stream flowing through that area, indicating possible high fertility of the land.

Based on the primary field survey and simulation results obtained for this localized area, the withdrawals by the agriculture sector are estimated to be about 12 000–16 000 m^3/day. The withdrawals by the HCCBPL, Kaladera, are taken on actual basis as provided for each bore well on a daily basis. The daily analysis of extractions shows that the HCCBPL, Kaladera, withdrawals are in the range of less than 1 percent to 9 percent of the total water withdrawals in a localized aquifer. The higher water intake in the summer months (particularly the month of May 2004), as can be seen in the Figure 4A.12, clearly indicates that the higher side withdrawals occur in acute water-stress period. However, overall analysis for the period between 2004 and 2006 reveals that the water extraction by the plant is less than 3 percent of the irrigation withdrawals 70 percent of the time, and less than 1 percent of withdrawal for 40 percent of the time. The subsequent section discusses the implication of these withdrawals measured in terms of the localized drawdown.

Localized drawdowns due to the Hindustan Coca-Cola Beverages Pvt. Ltd, Kaladera, extractions

The HCCBPL, Kaladera, operations result in an averaged localized drawdown in the range of 0.4–2.0 m, depending on the withdrawal rate for that particular day or week. Albeit good recovery of the drawdown curve is expected in the aquifer zone, continuous daily extractions in successive months of March, April, May, and June have put the localized state of the aquifer under additional stress, that is, in addition to irrigation withdrawals that are estimated to be very high (up to 100 times higher than the withdrawals by the plant). The problem gets further aggravated due to the challenges imposed by erratic rainfall, semi-arid climate regime, and increasing demands from various sectors. During drought years, such as the period till pre-

monsoon of 2004, the situation becomes highly intense wherein the water table drop in localized aquifer is close to 3 m. The zone of influence of the drawdown is estimated to extend to several adjoining villages including Disan, Kaladera, Kanarpura, Chak Mundaya, and Sahab Rampura. The results of the local groundwater flow model have been indicated in Figures 4A.22 to 4A.25 for 2004.

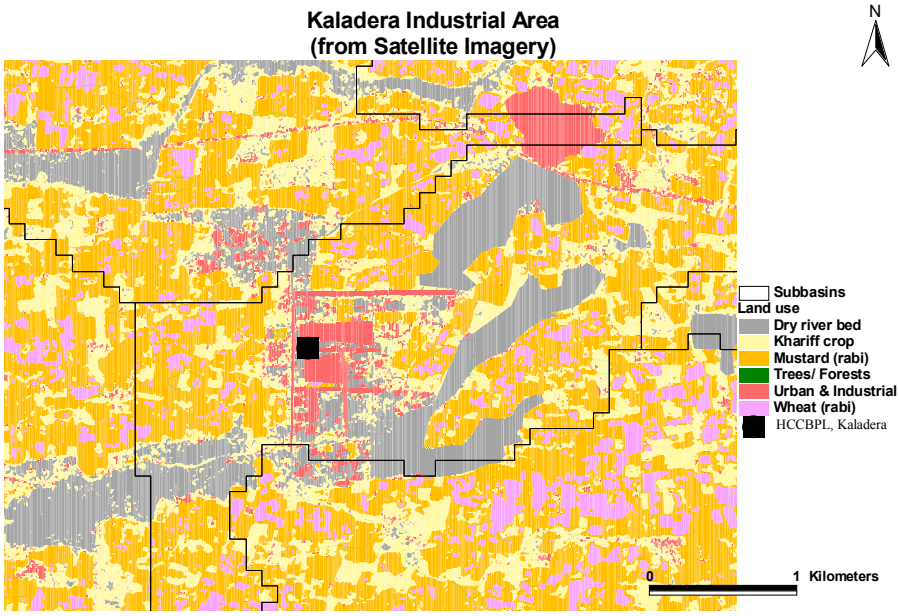


Figure 4 A.21 Kaladera industrial area on the land use/land cover map derived from satellite imagery

Source Satellite Imagery, National Remote Sensing Agency

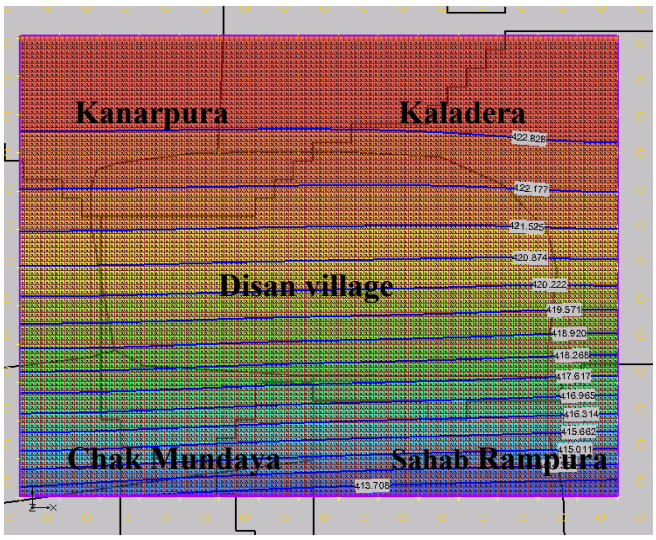


Figure 4A.22 Heads on 5 May 2004 assuming no Coca-Cola plant extractions

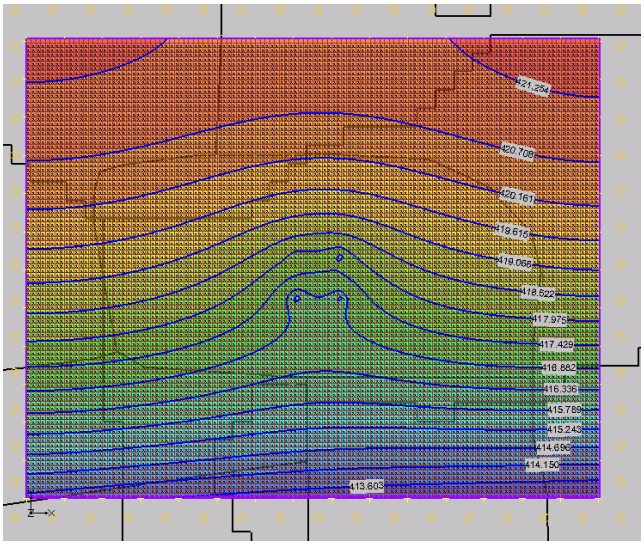


Figure 4A.23 Heads on 16 May 2004 with Coca-Cola plant extractions

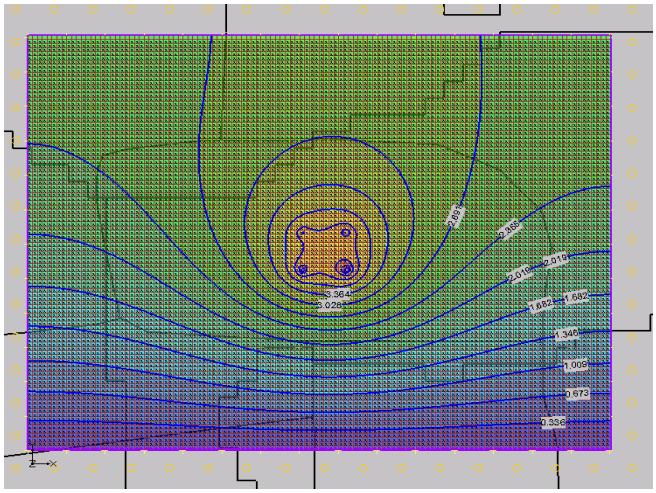


Figure 4A.24 Simulated drawdown on 16 May 2004, considering actual Coca-Cola plant extractions

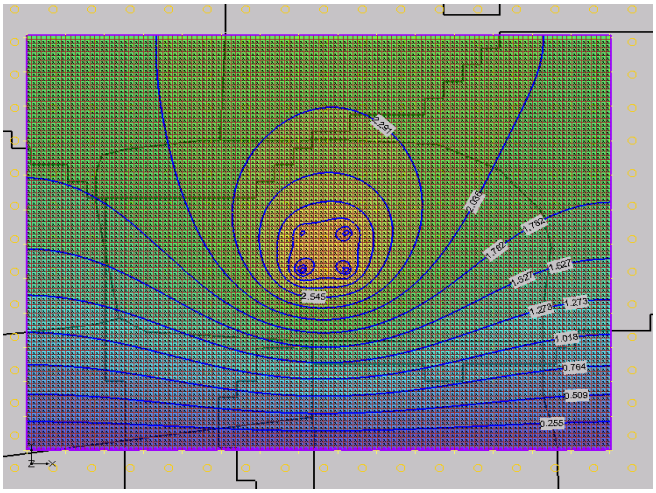


Figure 4A.25 Drawdowns on 5 May 2004, considering actual Coca-Cola plant extractions

Regional assessment of water quality

Water quality assessment for the selected villages has been undertaken for an insight into the quality of groundwater that is sourced and consumed by the HCCBPL plant at Kaladera and the impact, if any, of the agricultural management practices such as the use of fertilizers and pesticides on the quality of groundwater. The assessment here does not try to relate the regional groundwater quality to the operations of the Coca-Cola plant.

Selection of sampling location

Groundwater sampling was done in four selected villages. The justification for selection of villages has been discussed in chapter on approach and methodology.

A total of 10 locations were selected for sample collection and analysis. Table 4A.10 gives the description of sampling location and Figure 4A.26 gives the location of these sampling points on the watershed map of the area. Samples were collected from the above locations on 17 January 2007 to 18 January 2007 for the first round; 11 April 2007 to 12 April 2007 for the second round; and 19 June 2007 to 20 June 2007 for the third round. These samples were collected, preserved, and transported to the designated laboratories as per the set protocols (refer Chapter 2).

Test results

Summarized results of site-specific parameters that have exceeded the prescribed standards are presented in Figures 4A.27 to 4A.36.

Table 4A.10 Sampling locations

Village	*Location*	*Source*
Khannipura	Mr. Prahlad Singh's tube well	Tube well
Khannipura	Mrs Gaindi Bhunkar's house	Community drinking water supply tap (bore well)
Khannipura	Opposite Shekhawat General Store	Hand pump
Disan	In front of Thakur*ji's mandir*	Community hand pump
Disan	Ramunathji ka khet	Bore well
Kaladera	Near Sitaram *mandir*	Bore well
Kaladera	Shiv Market, near police *chawki*	Hand pump
Kaladera	Behind Kanhaiyalalji's house	Hand pump
Durga ka Bas	Near Yadav Tailors	Hand pump
Durga ka Bas	Mr. Sona Ram Khatodaya' house/ Mr. Shankar yadav, 100 metres away from the house of Mr Sona Ram Khatodiya's house	Bore well

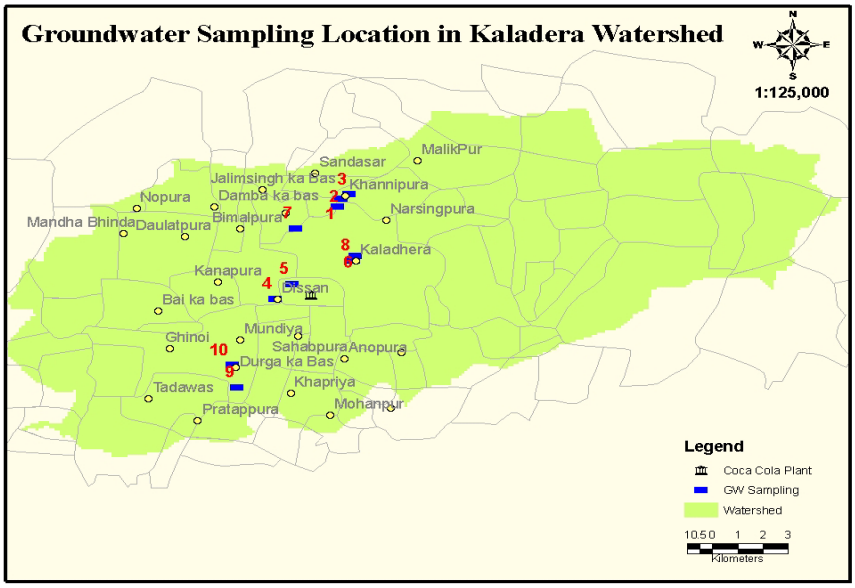


Figure 4A.26 Location of sampling points

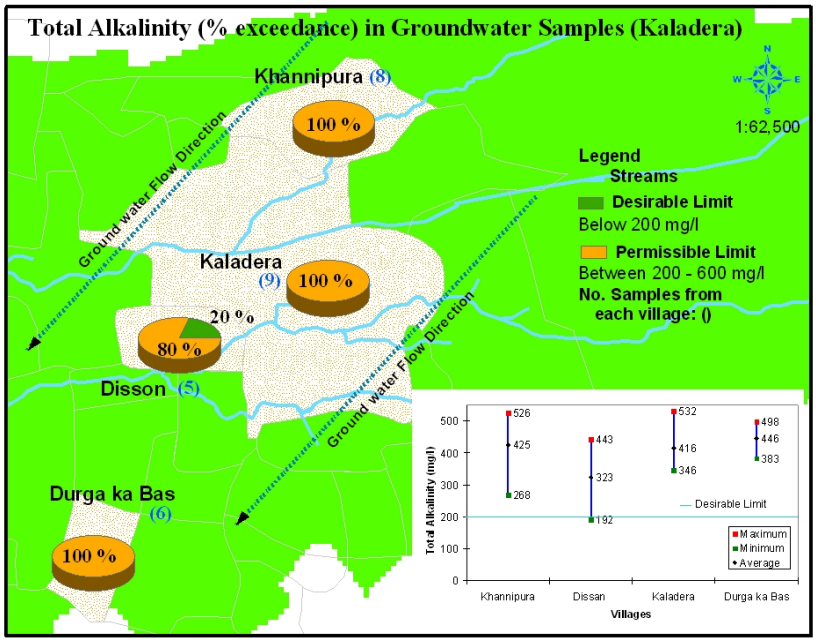


Figure 4A.27 Percent samples in Kaladera watershed exceeding the desired/maximum permissible limits for alkalinity

The regional groundwater analysis results show TDS (total dissolved solid), fluoride, iron, total alkalinity, MPN (most probable number) coliform, and faecal coliform in all the villages exceeding the standards, when compared to IS 10500. *Escherichia coli* was found to be present in bore well source at Durga ka Bas, an extreme downstream village (D 2). Nitrates were found to be exceeding the guidelines laid by IS 10500 only in case of village Kaladera (U 1). Similarly, chlorides were found only in village Disan (M 1), another village located in the vicinity of the plant. Other than these, manganese, barium, copper, nitrite, turbidity, and lead were found to be exceeding the desired (BIS 10500: 1991) limits in one or two sources mostly in the villages immediate to the plant.

Pesticide analysis results showed the presence of two pesticides, 2,4-DDT and 2,4-DDE, beyond the desired limits compared with IS 14543: 1998 in Durga ka bas, an extreme downstream village.

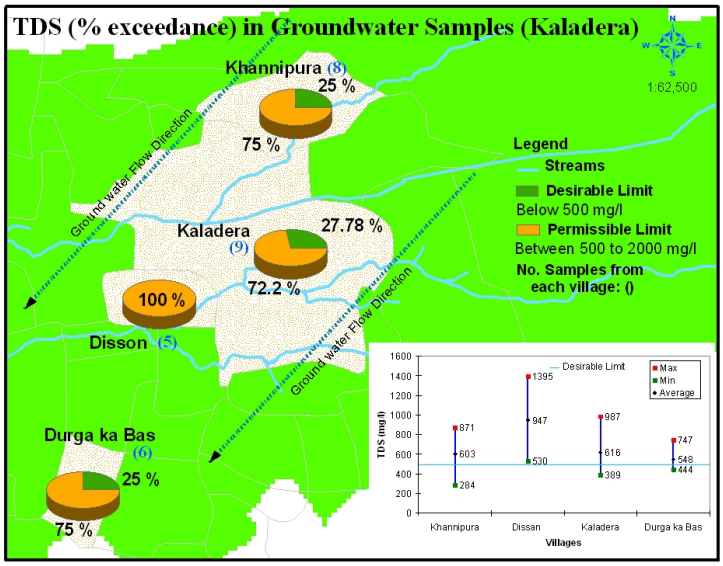


Figure 4A.28 Percent samples in Kaladera watershed exceeding the desired/maximum permissible limits for total dissolved solid

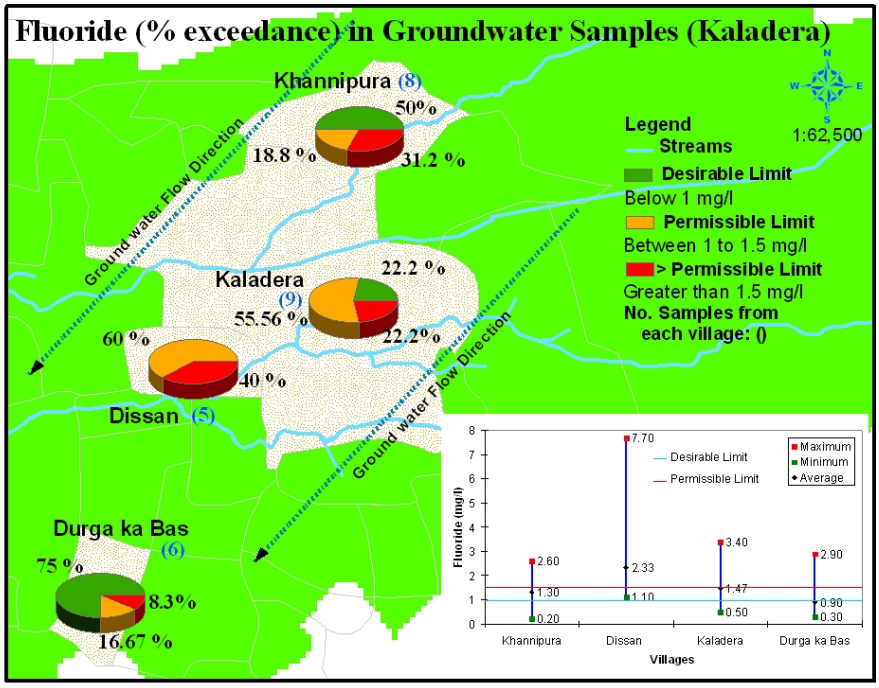


Figure 4A.29 Percent samples in Kaladera watershed exceeding the desired/maximum permissible limits for fluoride

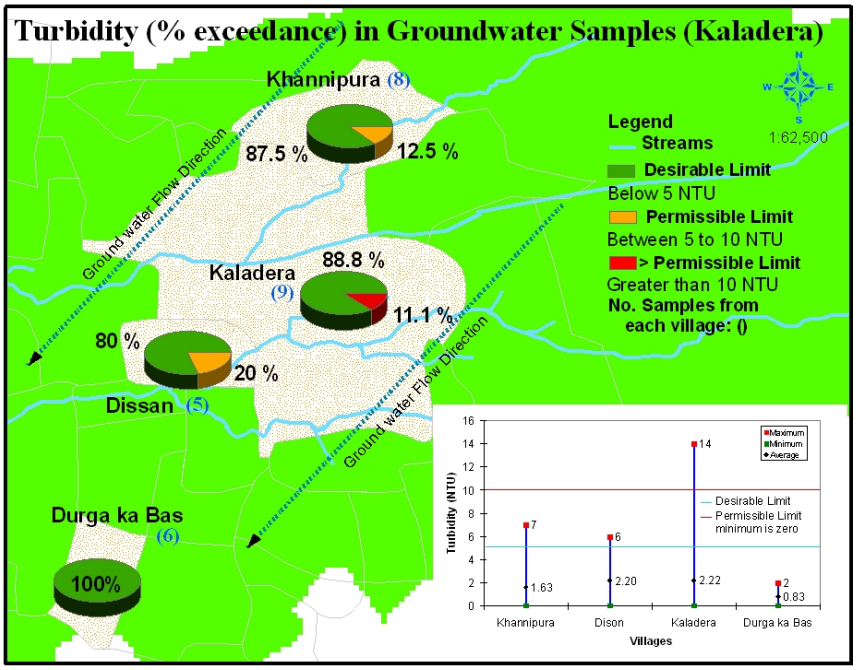


Figure 4A.30 Percent samples in Kaladera watershed exceeding the desired/maximum permissible limits for turbidity

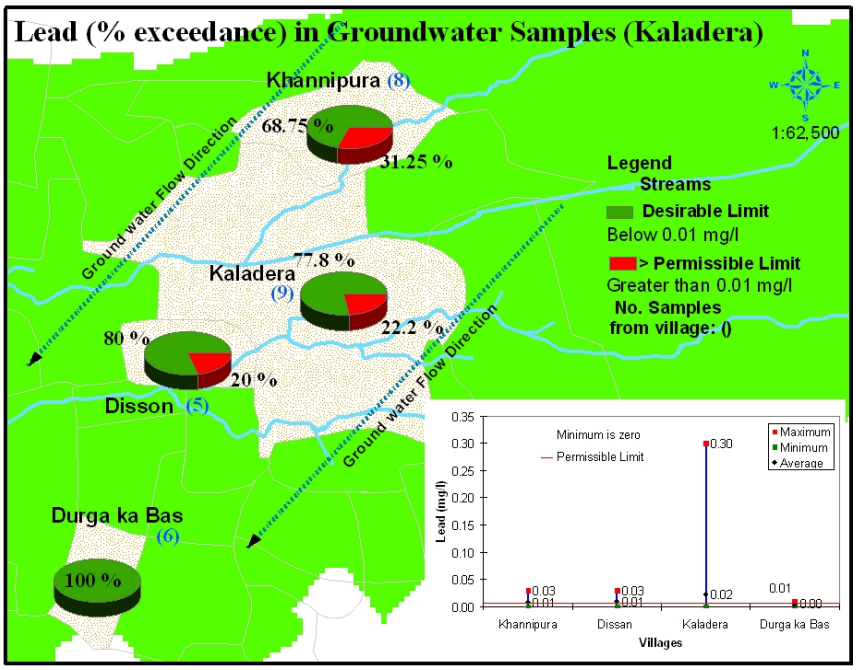


Figure 4A.31 Percent samples in Kaladera watershed exceeding the desired/maximum permissible limits for lead

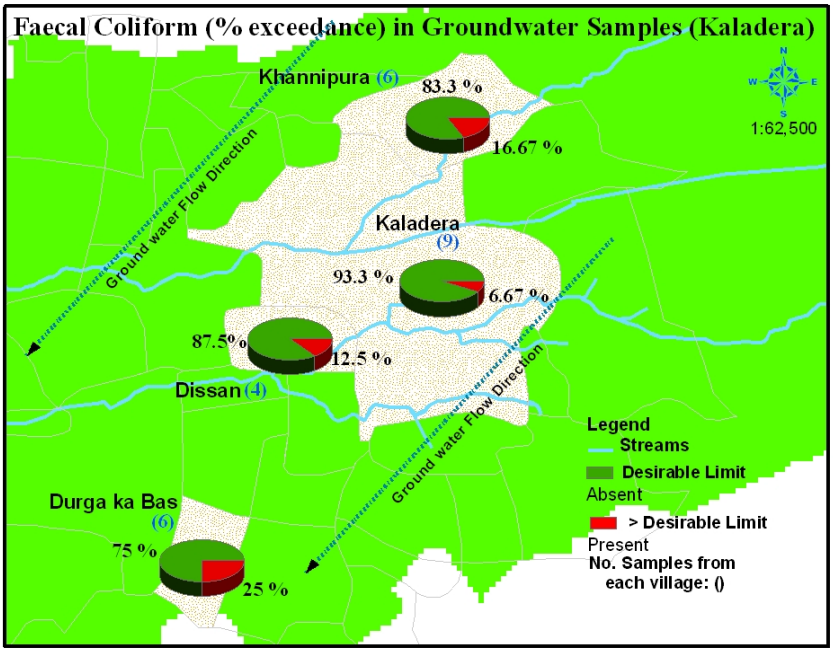


Figure 4A.32 Percent samples in Kaladera watershed exceeding the desired/maximum permissible limits for faecal coliform

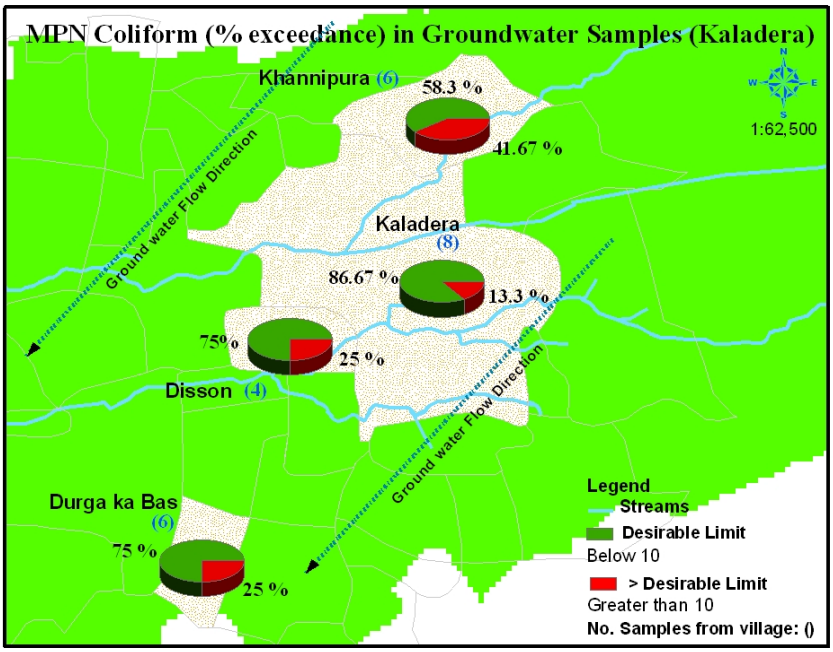


Figure 4A.33 Percent samples in Kaladera watershed exceeding the desired/maximum permissible limits for MPN (most probable number) coliform

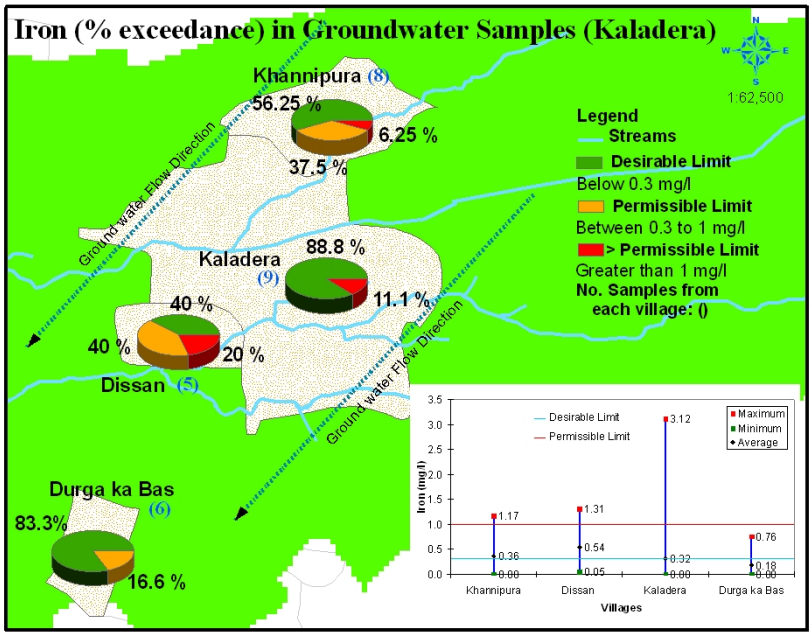


Figure 4A.34 Percent samples in Kaladera watershed exceeding the desired/maximum permissible limits for iron

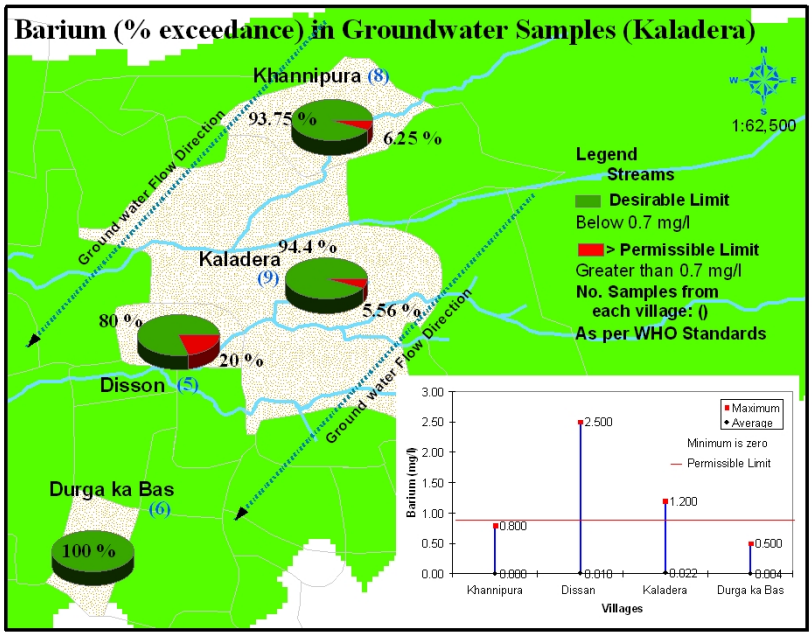


Figure 4A.35 Percent samples in Kaladera watershed exceeding the desired/maximum permissible limits for barium

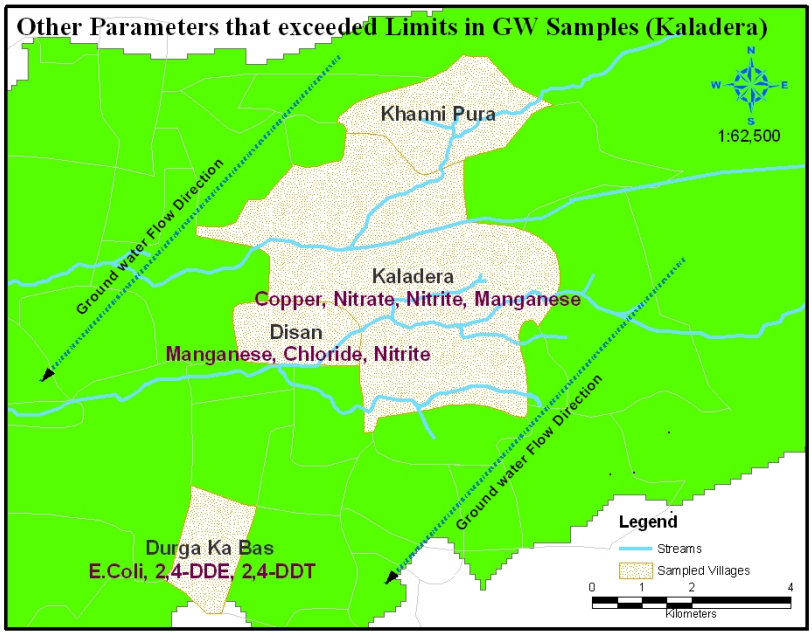


Figure 4A.36 Other parameters in Kaladera watershed marginally exceeding the desired/maximum permissible limits

Table 4A.11 presents non-conformity of water parameters to the WHO guidelines and BIS standard for drinking water. The groundwater quality test results indicate that water is not safe for drinking without treatment.

Table 4A.11 Non-conforming test parameters

World Health Organization guidelines	*BIS (Bureau of Indian Standards) 10500: 1991 dinking water specifications*
(in addition to non-conforming parameters identified under IS 10500) Physiochemical: nitrate and nitrite Heavy metals: lead and barium	Physiochemical: total dissolved solids, fluoride, chloride, nitrate, turbidity and total alkalinity Heavy metals: copper, manganese, lead, and iron Pesticides: 2,4-DDE and 2,4 DDT Microbiological: MPN coliform, faecal coliform, and *Escherichia coli*

Barring the above parameters, all other parameters meet the maximum permissible limits prescribed by IS 10500.

Plant-level assessment of quality and practice

The Kaladera plant sources its water from four bore wells. The water is pumped to a raw water storage tank where it is chlorinated. It is further sent to different sections and processes for treatment and usage in the beverage production, domestic use, and the use in the boilers and cooling towers. Wastewater discharges from the production line, boilers and cooling towers, and domestic usages are treated in an ETP (except domestic sewage, which goes to septic tanks through separate lines), wherefrom it is used for horticultural purposes.

Water quality

Table 4A.12 gives the description of points of sample collection and the sampling details.

Table 4A.12 Details of the in situ sampling locations

Sample source	*Location of sampling*	*Quantity of sample*	*Type of sampling*	*Number of samples (from each location in each round)*	*Protocol/ guidelines for sampling and testing*
Raw intake water	Raw water storage tank outlet	20 litres	Composite (one hourly for 24 hours)	1	APHA 20th ed. 1998/IS 3025
Wastewater/ effluent	ETP inlet (after grit chamber)	20 litres	Composite (one hourly for 24 hours)	1	APHA 20th ed. 1998/IS 3025
	Outlet of ETP after secondary clarifier	20 litres	Composite (one hourly for 24 hours)	1	APHA 20th ed. 1998/IS 3025
Process water	Plant process WTP outlet (after 1 micron, goes as inlet to beverage production) Soft water treatment outlet (goes as an inlet to bottle/crate washing, PET rinsing) RGB line inlet (Bottle filling unit)	20 litres	Composite (one hourly for 24 hours)	3	APHA 20th ed. 1998/IS 3025

ETP – effluent treatment plant; WTP – water treatment plant; PET – polyethylene terephthalate; RGB – refillable glass bottle

Hence, six in situ sampling locations were selected for water quality monitoring. Figure 4A.37 depicts the sampling locations on the process flow diagram of the plant.

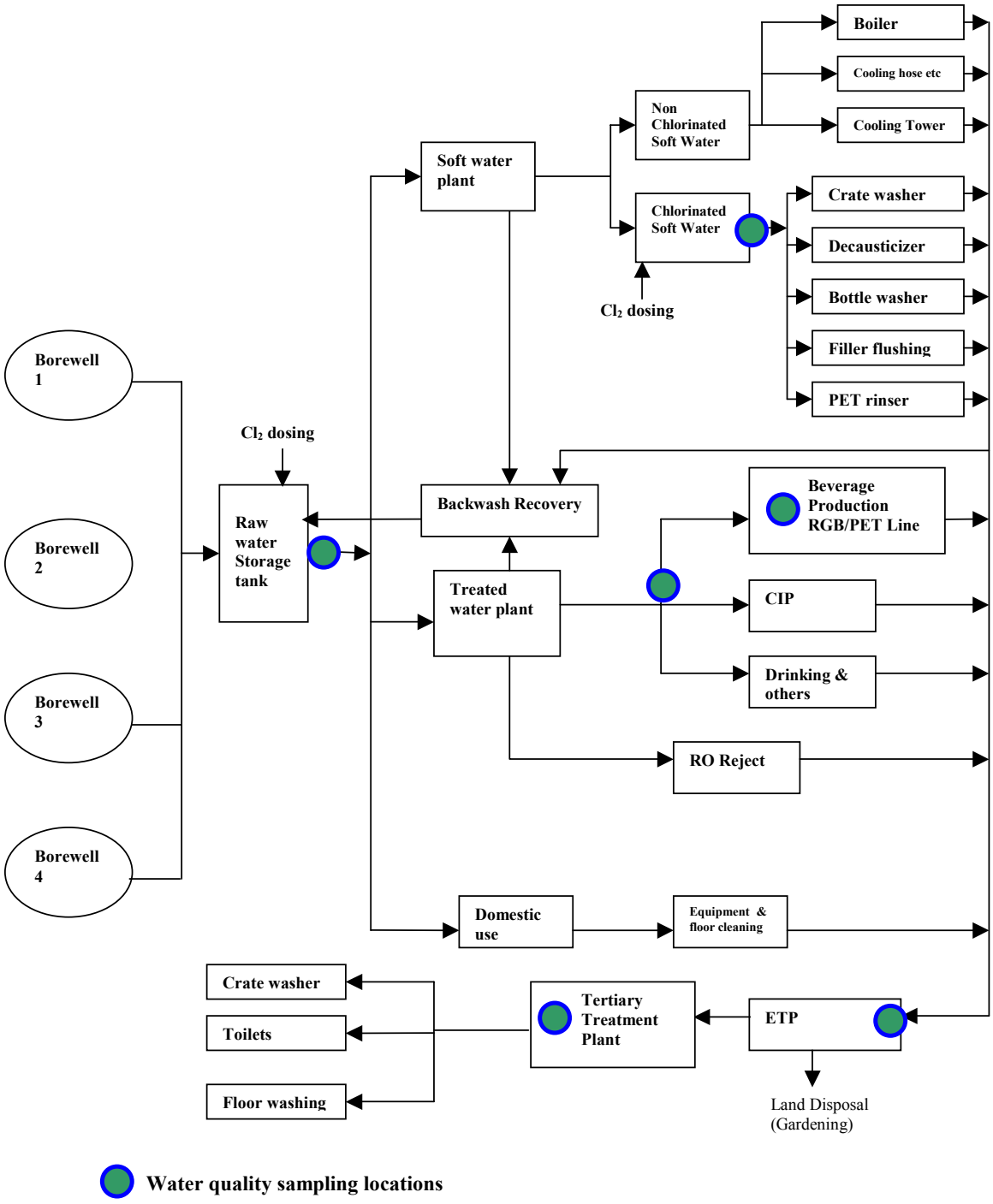


Figure 4A.37 Hindustan Coca-Cola Beverages Pvt. Ltd Kaladera plant process flow diagram and sampling locations

Source Developed from the data obtained from Hindustan Coca-Cola Beverages Pvt. Ltd plant, Kaladera

The results thus obtained have been compared, for compliance, with the relevant guidelines/limits/requirements as given in Table 4A.13.

Table 4A.13 Guidelines for compliance

Type of water Wastewater discharge	Relevant local regulation by the RPCB and CPCB guidelines, and TCCC internal quality guidelines
Raw water	Relevant national standard for drinking water (BIS 10500: 1991) and international guideline (WHO guidelines for drinking water)
Process water	Relevant national standard for drinking water (BIS 10500: 1991, IS 14543: 2004), international guideline (WHO guidelines for drinking water) and TCCC internal specification for treated water

RPCB – Rajasthan Pollution Control Board; CPCB – Central Pollution Control Board; TCCC – The Coca-Cola Company; WHO – World Health Organization; BIS – Bureau of Indian Standards

Sample collection, preservation, and transportation

For all the selected locations composite sampling was carried out from 17 January 2007 to 18 January 2007 in the first round; 11 April 2007 to 12 April 2007 in the second round; and 19 June 2007 to 20 June 2007 in the third round. Protocols for sample collection, preservation, and transportation to designated laboratories have been discussed in the chapter on approach and methodology.

Test results

In situ water quality assessment shows that in the raw water, parameters like fluoride, total alkalinity, and TDS exceed the desired limits of drinking water specification (BIS: 10500). These are in agreement with the findings of the ex situ groundwater quality. Bacteriological contamination was not found. The above parameters were found below the desired limit for the process water, that is, after treating raw water in the WTP (water treatment plant) (used for beverage production), which shows that the WTP is working efficiently.

Process water quality results show an agreement with IS 14543 and 10500 for all the monitored parameters.

The quality of the treated discharged wastewater indicates effective treatment for all the parameters compared to prescribed CPCB (Central Pollution Control Board) discharge standards for land application for irrigation except for bioassay test that showed one-time exceedance.

As compared to TCCC's own treated wastewater quality standards for discharge of treated wastewater in natural waterbodies, TKN (total Kjeldahl nitrogen) was found to exceed the limits frequently

while cadmium, TDS and anionic surfactants showed one-time exceedance[16] compared to TCCC standard for treated wastewater quality.

None of the monitored pesticides were detected in the intake raw and process water as well as wastewater in the plant.

Plant-level water audit

Water auditing exercise at the HCCBPL, Kaladera, Jaipur, involved an examination of water flows at inlet and outlet of unit processes with the following objectives.

- To establish water balance of the facility for the monitoring period
- To assess ETP/WTP inlet and discharge

Details of plant operations

The plant operations with respect to water balance can be divided into four broad segments, namely, RW (raw water), PW (process water), SW (soft water, a term used to describe water that contain few or no calcium or magnesium ion, used in boiler units as unchlorinated soft water or bottle washing after chlorination), and effluent. Figure 4A.38 shows schematic diagram of WTP and locations of meters for three rounds of auditing.

[16] One-time exceedance refers to a higher concentration level (that is, above the standard) found on one occasion or in one case. It has very less significance compared to parameters that are found to be consistently exceeding the standard.

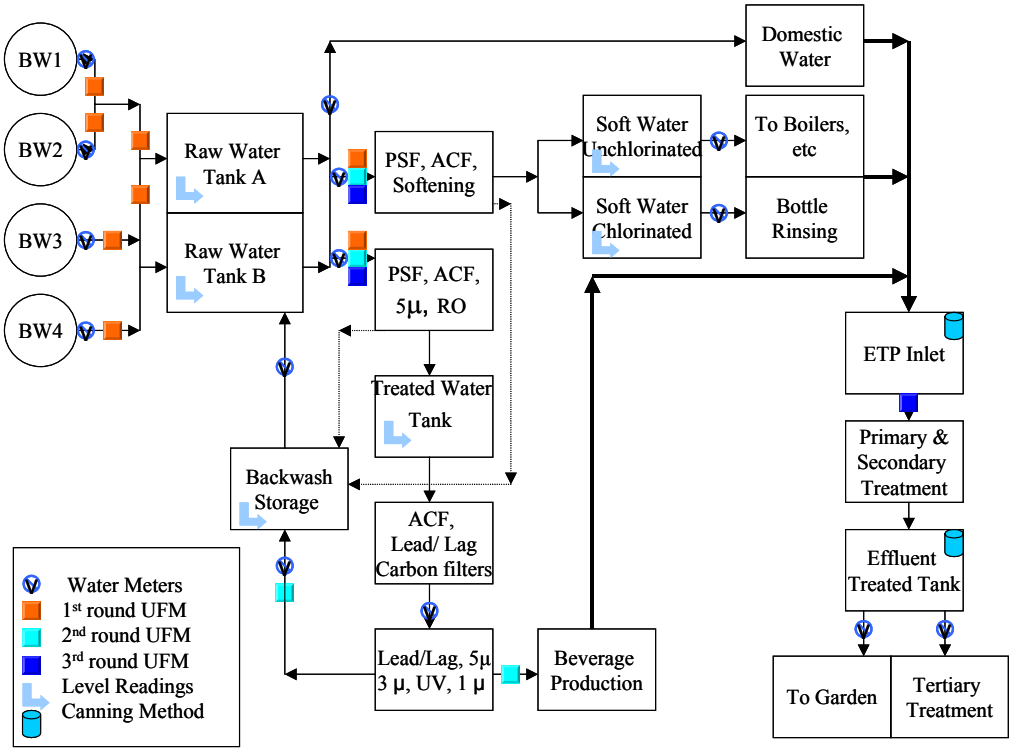


Figure 4A.38 Schematic diagram of the plant showing locations of water meter

Source Data provided by CCI

Water balance

Table 4A.14 gives water balance compiled for RW tank for three rounds of water auditing.

Table 4A.14 Raw water balance during three rounds of water auditing

Water balance component	*First round*	*Second round*	*Third round*
Inlet			
Raw water intake (m^3)	293.4	248.72	106.85
Backwash recovery (m^3)	11.61	19.478	6.39
Total Inlet (m^3)	305.01	268.198	113.24
Outlet			
Process water consumption (m^3)	259.4	136.98	97.1
Soft water (m^3)	165	63.13	44.05
Domestic water (m^3)	5.17	4.199	2.3
Total Outlet (m^3)	429.57	204.309	143.45
Storage			
Measured (inlet–outlet in m^3)[a]	–124.56	63.88	–30.21
Observed (m^3)[b]	–147.6	59.8	–25.2
Per cent error in balancing (unaccounted for water)	7.5	1.5	4.4

[a]Measured change in storage is change calculated based on the meter readings at inlet and outlet by applying continuity equation.
[b]Observed change in storage is storage change based on the difference of water level in tanks
Note Negative tank storage shows net outflow from the tank, that is, reduction in water storage level of tank.

The plant water balance derived from the audit shows that the components of the continuity equation (that is, inlet, outlet, and change in storages) are in conformation with each other. The percentage of agreement between observed change (from level indicators installed by the plant) and measured change (from our digital flow meter results) in storage with respect to inflow is in the acceptable range of 92.5–98.5 percent.

In addition to water balance, water usages for different unit processes were also calculated. Table 4A.15 presents a brief overview of observations for three rounds of water auditing;

Table 4A.15 Volume of water/effluent used in various units during three rounds of water auditing

Water use	First round	Second round	Third round
Date of monitoring	17–18 January 2007	11–12 April 2007	19 June 2007
Monitoring hours (H)	16	17	9.5
ETP outlet (for gardening) (m^3)	–	224.5	212.17
Tertiary treated water (m^3)	–	7.213	0
Production (m^3)	133.452	106.8	72.252
Daily WUR treated water	3.09	1.71	1.68
Production	PET and RGB	PET	PET (till 6:30 p.m.)

ETP – effluent treatment plant; WUR – water utilization ratio; PET – polyethylene terephthalate; RGB – refillable glass bottle

Annual WUR reported by the plant is 3.0–3.9 for the past two years while WUR calculated from auditing are 3.09, 1.71, and 1.68 for the first, second, and third round, respectively. WUR for second and third rounds is low, as only PET line was in operation. This is also due to fact that bottle washing for RGB production requires about 82 percent of water used for beverage production, while PET requires about 33 percent.

ETP is found to be designed to treat about 1000 m^3/day, whereas the maximum treated water during monitoring exercise was around 230 m^3, which shows that ETP is highly underutilized. Hence, inlet and outlet of ETP could not be linked dynamically as the storage in ETP is very high (over 2000 m^3 of storage from grit chamber to clarifier) and pumping is also done at intermittent stages. As a result of this, it was not possible to measure pollution load discharged from ETP.
During monitoring exercise, it was found that maximum effluent treated at tertiary unit was 7 m^3, while the design capacity is 220 m^3/day. Backwash, defined as reverse flow of water through the filter, done for cleaning the filter and restoring good circulation and filtration,from PW and SW was about 4–8 percent of total raw water intake.

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CHAPTER 4B Mehndiganj

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CHAPTER 4B Mehndiganj

Executive summary

The plant is located in a safe groundwater zone

The Mehndiganj watershed, in general, is a plain area and forms a part of a large river basin, namely the Ganga river basin. It witnesses an average annual rainfall of about 1000 mm, which is close to the national average of 1100 mm. More than 85 percent of the rainfall occurs during the monsoons that usually come in late June or early July for about two months. According to the CGWB (Central Ground Water Board) and GWD (Ground Water Department), Arajiline block has been categorized as a safe sub-unit where the stage of groundwater development is estimated to be approximately 72 percent.

The area is largely rural with a high population growth

In comparison to Varanasi district, which is one of the urban centres of Uttar Pradesh, the study area is largely rural, with urbanization taking place at a very slow pace. The Arajiline block is one of the rural blocks of the district. Total population of the Arajiline block has increased from 0.24 million to 0.31 million between 1991 and 2001, indicating a decadal growth rate of 32.8 percent! The density of population in Arajiline increased from 850 persons per square kilometres in 1981 to 1072 persons per square kilometres in 1991 and to over 1429 persons per square kilometres in 2001, indicating increasing pressure on land, water, and other resources in the region.

Area under irrigated paddy cultivation has increased enormously

Over the 14-year period (1990 to 2004), the gross area under paddy cultivation has gone up by 140 percent. During the same time, the area under paddy irrigation has gone up significantly by 656 percent. Thus increased emphasis on paddy cultivation in the region has led to a phenomenal shift towards water-intensive irrigation. The major sources of irrigation used are pump sets and tube wells.

Community expressed concerns on water-related issues

Perception: Pressure on groundwater sources is increasing

- All stakeholder groups reported an increasing problem of water depletion. Key persons interviewed also indicated a growing concern for decreasing water availability, including the representatives of the HCCBPL (Hindustan Coca-Cola Beverage Pvt. Ltd), Mehndiganj. All groups reported a sharp decline in the water table in the last three to six years. All the stakeholder groups reported that open wells have dried over time. Drying of handpumps was also reported.

- The key reasons cited are as follows.
  - Lack of sufficient rainfall in the last three to four years
  - Increased number of bore wells in the region
  - Increased pressure on groundwater due to drying up of surface water bodies like ponds
  - Increasing population
  - Use of water by the HCCBPL plant, Mehndiganj

Assessment

- The groundwater table data, obtained from GWD (ground water department), for the period 1995 to 2005 shows that instances of dug wells getting dry in the block have been observed since 2004, especially during the pre-monsoon period of 2005 compared to previous years since 1995. Rainfall analysis also shows that the watershed has experienced low rainfalls during 2003–05 when observed rainfall was as low as 45 percent of the normal rainfall. The lowering of water tables is a cumulative effect of low rainfall, increasing demands on agriculture, population, and industry. Although all potential causes of the drop in groundwater have not been assessed, it is clear that low rainfall has had significant impact in this area.

Perception: Groundwater quality around the plant area is poor

- Reports on the quality of groundwater were consistent across the different villages. Villages in the vicinity of the plant reported problems with groundwater quality. Farmers from Bhikaripur (U 1) reported yellowish water that was salty in taste. Panchayat members from Mehndiganj (M 1) reported muddy water from a few handpumps, while women reported that an open well in their village had dirty water. Farmers also reported that the bore wells they used had started yielding yellowish water with a salty taste. Women in Kachnar (D 1) reported that in the past three to four years,

water has acquired a salty taste, while farmers brought to notice the fact that the water had turned reddish and yellowish over this period. Members of the panchayat reported that water quality in general was fine, except in a couple of places.

Assessment

- Total alkalinity in all the monitored locations in all the villages exceeds the prescribed limits, as per IS 10500 drinking water standard.
- Parameters such as turbidity, iron, faecal coliform, and MPN (most probable number) coliform have also been found to exceed the standards in 25–35 percent of the samples collected from all the villages. Presence of iron might have led to formation of yellow colour in the water reported by the stakeholders.
- Overall analysis shows that villages in the immediate vicinity of the plant, namely, Kachnar (D 1) and Bhikaripur (U 1), report the most parameters exceeding the standards followed by Mehndiganj (M 1). This shows a need to carry out a detailed study to establish/rule out any causal relationship between water quality found in villages with the existence of the plant.

Perception: Effluent discharge practices of the plant are suspect

- One of the key issues pertaining to water quality was related to the effluent discharge by the HCCBPL plant, Mehndiganj, and the perceived consequent pollution of surface water. The communities reported that wastewater from the HCCBPL, Mehndiganj, was being discharged in a *nullah* close to it and near the GT (Grand Trunk) road, and that their protests led to this discharge being stopped. Some of the stakeholders reported that this wastewater is now being carried through a pipe to a distance of 1.5 km and discharged in another *nullah* near the village Bhikaripur.

Assessment

The representatives of the HCCBPL, Mehndiganj, corroborated the above issue. As required by the conditions of the Consent to Order issued by the UPPCB (Uttar Pradesh Pollution Control Board), effluent from the plant is now discharged into the natural drain through a pipe at a distance of 1.5 km from the plant. Also, as stated by TCCC (The Coca-Cola Company), the Mehndiganj plant has no intentions of moving towards zero discharge (or land application for irrigation) of the effluent.

Plant mostly in compliance with regulations and standards

The plant is currently operating as per the terms and conditions laid down in the CtO (Consent to Operate) issued to the HCCBPL, Mehndiganj, on 27 December 2005, with a validity period of three years.

The water quality in the process water line after 5 μ filter showed that all the water quality parameters except for nitrite were meeting the standards prescribed by IS 14543:2004 (packaged drinking water standard). Nitrite showed a one-time exceedance compared to the standards prescribed by IS 14543:2004. Rest of the parameters, including pesticides, were found well below the specified standards.

A report by the UPPCB zonal office in Varanasi notes that samples of treated effluent taken from the plant as well as from the point of discharge into a drain[1] were tested and found to be within the prescribed standards of the UPPCB. Assessment by TERI also shows that the quality of the treated wastewater (from effluent treatment plant) discharge indicates effective treatment for all the monitored parameters, and parameters were found to be within the specified CPCB (Central Pollution Control Board) limits for discharge into inland water bodies.

As compared to TCCC's wastewater quality guidelines, parameters such as TDS (total dissolved solid), total suspended solid, TKN (total Kjeldahl nitrogen), and anionic surfactants were found to exceed the acceptable limits for discharge into the natural water bodies. Of these, TSS, TDS, and anionic surfactants showed one-time exceedances.

Different perceptions expressed by stakeholders on agitations and protests against the plant

In the Mehndiganj region, protests and agitations against the HCCBPL, Mehndiganj, have been related to several issues, including that of water scarcity. The other issues that drive the protests are related to land acquisition, improper disposal of effluents, adverse impacts on agriculture, and employment.

Different stakeholder groups expressed various views regarding the protests. The views have been indicated below.

- Beliefs grounded in Gandhian principles of *swadeshi*

[1] Treated effluent is disposed off to a drain through a 1.5-km long pipe situated in village Bhikaripur.

- People in the area were adversely impacted by the operations of the plant
- Protest marches are baseless, and are instigated by 'outsiders'
- Those participating in the protest marches were unemployed youth hired from the neighbouring villages
- Expectation of material rewards by some people who, after being on the frontlines, suddenly vanished from the movement

Community concerns under corporate social responsibility framework not systematically addressed

CSR (corporate social responsibility) activities were stated by the stakeholder groups to be one-time activities and not a continuous initiative. There was a feeling among different stakeholder groups that only those who participated in the protests were the beneficiaries of these initiatives and that there was a noticeable increase in charitable activities soon after a protest march. These activities, it was felt, did not contribute to any significant development of the villages in question.

Site profile

The Mehndiganj plant of the HCCBPL (Hindustan Coca-Cola Beverage Pvt. Ltd) is located in block Arajiline, district Varanasi, in the state of Uttar Pradesh, in North India. The area for the study was delineated with 1: 50 000 scale base map (toposheet number 63K/15 and 63K/16) of Survey of India. Figure 4B.1 shows the delineated watershed and the sub-basins.

Geographic

The delineated Mehndiganj watershed, shown in Figure 4B.1, comprises an area of 105 km² and lies between longitudes 82 ° 47' E and 82 ° 55' E, and latitudes 25 ° 12' N and 25 ° 17' N. The watershed, in general, is a plain area and forms a part of a large river basin, namely the Ganga river basin. Around 90 percent of the watershed lies in the elevation range of 77–81 m amsl (above the mean sea level), as shown by the hypsometric curve in
Figure 4B 2.

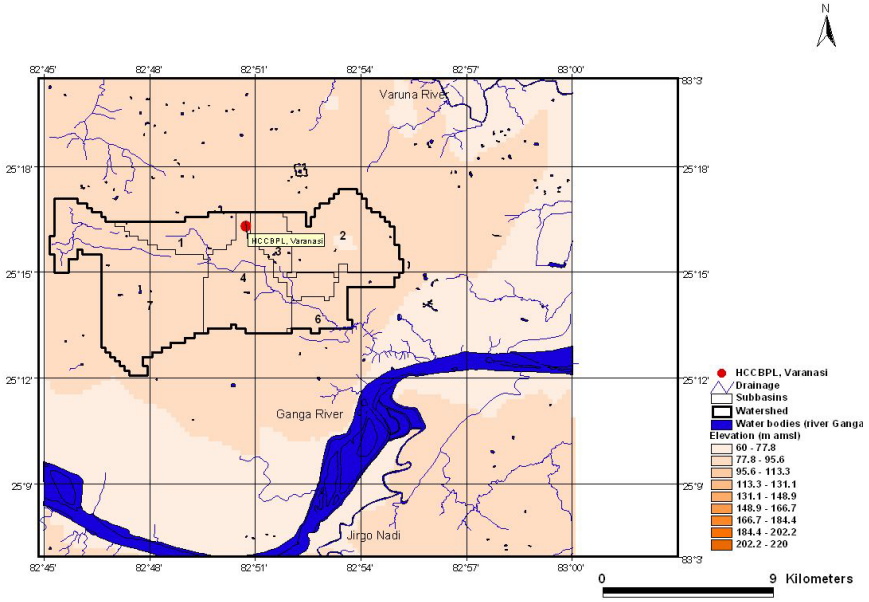


Figure 4B.1 Topography and drainage map of Mehndiganj watershed

The minimum and maximum elevation of the watershed ranges from 77.2 m amsl to 83.5 m amsl, respectively, with mean elevation of 80.2 m amsl and standard deviation of 0.8 m. The drainage of the area is controlled by Ganga river located at a distance of about 10 km south-east of the Mehndiganj plant site.

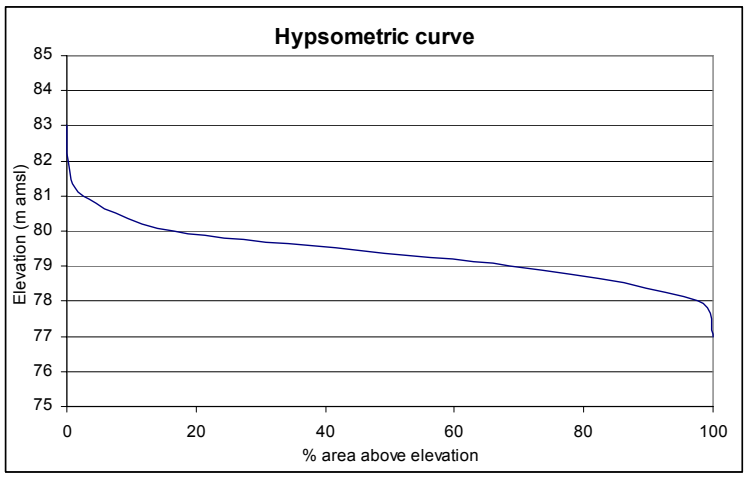


Figure 4B.2 Hypsometric curve of Mehndiganj watershed

Hydrometeorology

Hydrometeorological details of the watershed have been derived from the data obtained from Varanasi Observatory and climatological tables for the same for the period 1951–80. The Observatory is situated at latitude 25° 18" N and longitude 83° 01' E, at an elevation of 76 m amsl.

Rainfall

The area witnesses an average annual rainfall of about 1000 mm, which is close to the national average of 1100 mm (see Figure 4B.3). More than 85 percent of the rainfall occurs during the monsoons that usually arrive in late June or early July and last for about two months. The period from mid- September to about November constitutes post-monsoon period.

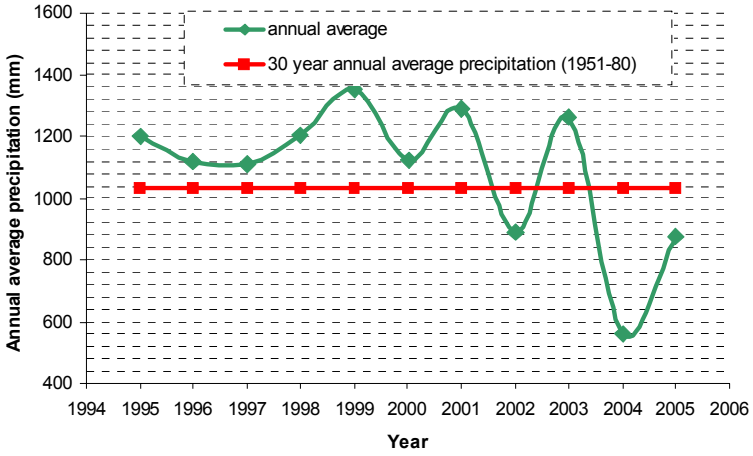


Figure 4B.3 Rainfall pattern in Mehndiganj watershed

Rainfall analysis in Figure 4B.3 shows that the watershed experienced low rainfall during the period 2003–05 when observed rainfall was as low as (–) 45 percent of the normal rainfall.

Temperature

Varanasi has a humid subtropical climate with high variation between summer and winter temperatures. Summers are long, lasting from early April till October, with the monsoon in between. Winters are from December to February. The average of daily maximum temperatures in a year is 32 °C, reaching as high as 41 °C in May. Similarly, the average of daily minimum temperatures is approximately 20 °C, reaching as low as 9.6 °C in January. Figure 4B.4 shows mean monthly minimum and maximum temperature.

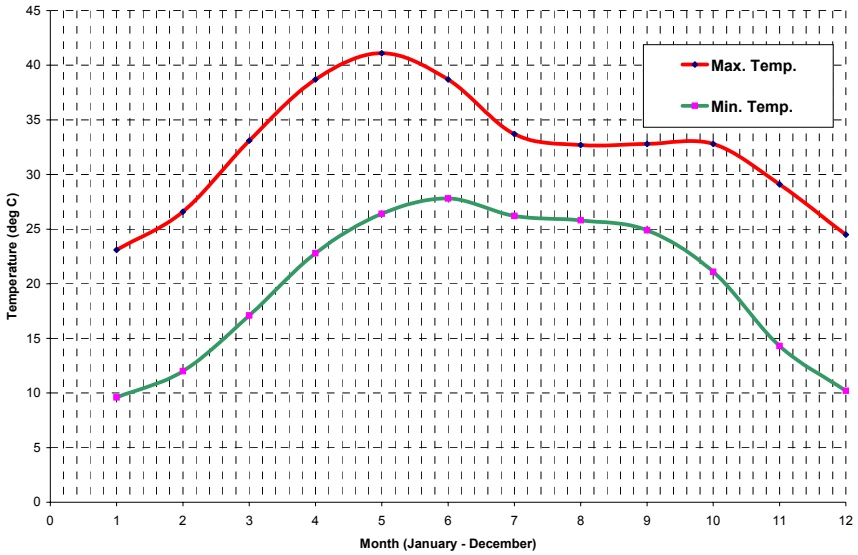


Figure 4B.4 Minimum and maximum temperature

Socio-economic

The decadal growth (1991–2001) rate of the population of UP (Uttar Pradesh) is 25 percent, which is higher than the decadal growth rate for India (21.3 percent). However, the level and pace of urbanization in UP have been lower than most of the other states. In comparison to Varanasi, which is one of the urban centres of UP, the study area is largely rural, with urbanization taking place at a very slow pace. Arajiline block is one of the rural blocks of the district.

Total population of Arajiline block has increased from 0.24 million to 0.31 million between 1991 and 2001, indicating a decadal growth rate of 32.8 percent! The density of population in Arajiline increased from 850 persons per square kilometre in 1981 to 1072 persons per square kilometre in 1991 and to over 1429 persons per square kilometre in

2001, indicating increasing pressure on land, water, and other resources in the region.

The workforce in the total population of the study region has increased by almost 4.5 percent between 1991 and 2001. The change in occupational patterns of population in the study area over the last three decades is given in Figure 4B.5.

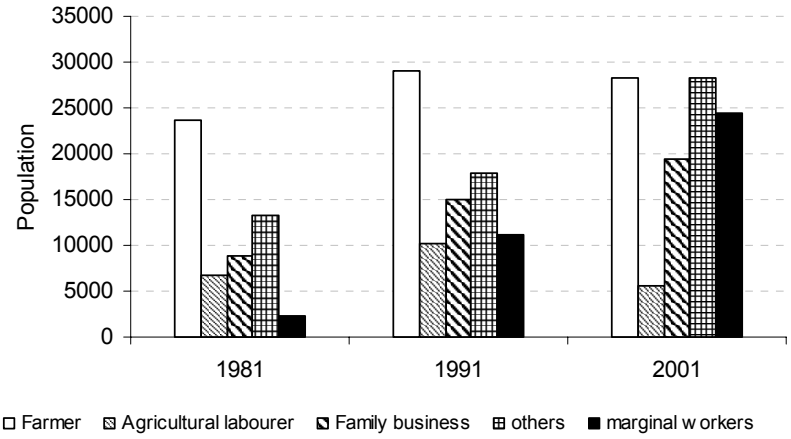


Figure 4B.5 Occupational patterns in the study area

Source Statistical Abstract of Varanasi District for Different Years up to 2004/05. Bureau of Economics and Statistics, Government of Uttar Pradesh

While the number of farmers and agriculture labourers in Arajiline shot up between 1981 and 1991, the same showed a declining trend in the last decade (1991–2001). This has been accompanied by a steady increase in other services like business, trade, craftsmanship[2], tourism, transportation, and so on.

Land use and agriculture

Agriculture is the most dominant activity, covering over 80 percent of the available land area. Nearly one-third of the total workforce in the study area is engaged in agriculture. No significant change is observed in the land-use pattern between 1990/91 and 2001–04 (Figure 4B.6). In case of Arajiline, 34 percent of land is sown more than once in a year; hence, the average cropping intensity has been 1.34 since 1990-91.

[2] Mostly are weavers and producers of world famous *Banarasi* silk sarees.

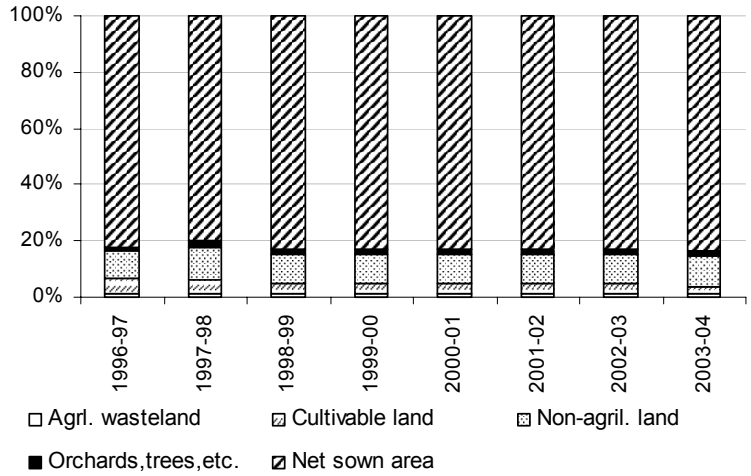


Figure 4B.6 Land-use pattern (pecent)

Source Statistical Abstract of Varanasi District for Different Years up to 2004/05. Bureau of Economics and Statistics, Government of Uttar Pradesh

Table 4B.1 gives the details of the land use and cropping intensity values for Arajiline over a span of 14 years. It can be seen that though the net sown area has remained more or less the same in the last 14 years, there has been an increase in the area sown more than once, indicating increased agricultural production, and therefore increased demand for water. As an overall trend, the gross sown area decreased after 1996/97, and started to rise again after 2000/01. Irregular rainfall could be the reason for such fluctuations. It was also observed that the net sown area in kharif season is more or less equal to net sown area in rabi season.

Table 4B.1 Land-use pattern (in ha) and cropping intensity

Land-use pattern	*1990/91*	*1996/97*	*1999/2000*	*2000/01*	*2001/02*	*2002/03*	*2003/04*	*2004/05*
Arajiline: total geographical area = 21 555 ha								
Gross sown area (A)	23 535	25 853	21 887	22 162	24 334	24 985	25 482	23 535
Net sown area (B)	17 179	17 688	17 810	17 810	17 824	17,824	17,821	17,179
Cropping intensity (A/B)	1.37	1.46	1.23	1.24	1.37	1.40	1.43	1.37

Source Statistical Abstract of Varanasi District for Different Years up to 2004/05. Bureau of Economics and Statistics, Government of Uttar Pradesh

The principal crops grown in the study area are as follows.

- Rabi (November to March): wheat, pulses
- Zaid (April to June): vegetables (brinjal, potatoes)
- Kharif (July to October): paddy, maize, sugarcane, pulses, bajra

The major cropping pattern in the study area is shown in Figure 4B.7, and the area under irrigation for each of the major crops is given in Figure 4B.8.

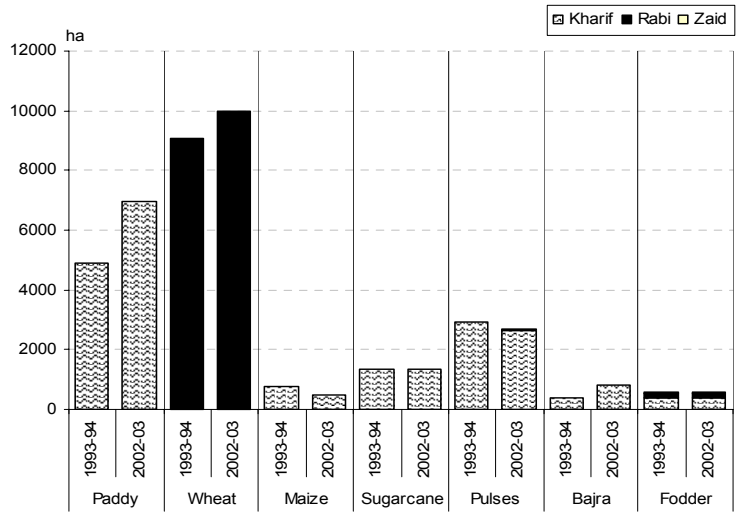
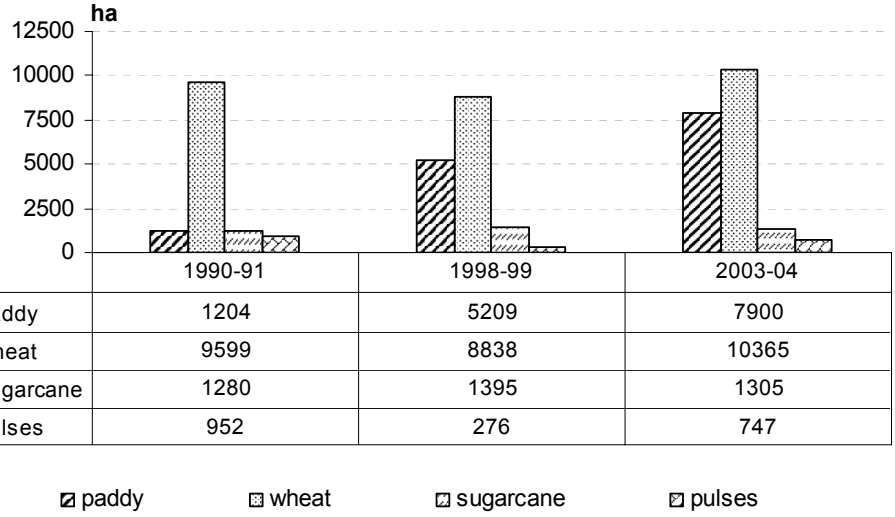


Figure 4B.7 Major cropping pattern (hectares) in the study area

Source Statistical Abstract of Varanasi District for Different Years up to 2004/05. Bureau of Economics and Statistics, Government of Uttar Pradesh



	1990-91	1998-99	2003-04
paddy	1204	5209	7900
wheat	9599	8838	10365
sugarcane	1280	1395	1305
pulses	952	276	747

Figure 4B.8 Irrigated area by crop (ha)

Source Statistical Abstract of Varanasi District for different years up to 2004-05. Bureau of Economics and Statistics, Government of Uttar Pradesh

Being an Indo-Gangetic plain, wheat–rice system is predominant. Wheat and paddy are the two main crops grown in the area, and cultivation of both has been on the rise followed by pulses, sugar cane, and corn.

Over the 14-year period (1990–2004), the gross area under paddy cultivations has gone up by 140 percent. During the same period, the area under paddy irrigation has gone up significantly by 656 percent. Thus, increased emphasis on paddy cultivation in the region has led to a phenomenal shift towards water-intensive irrigation (Figure 4B.9).

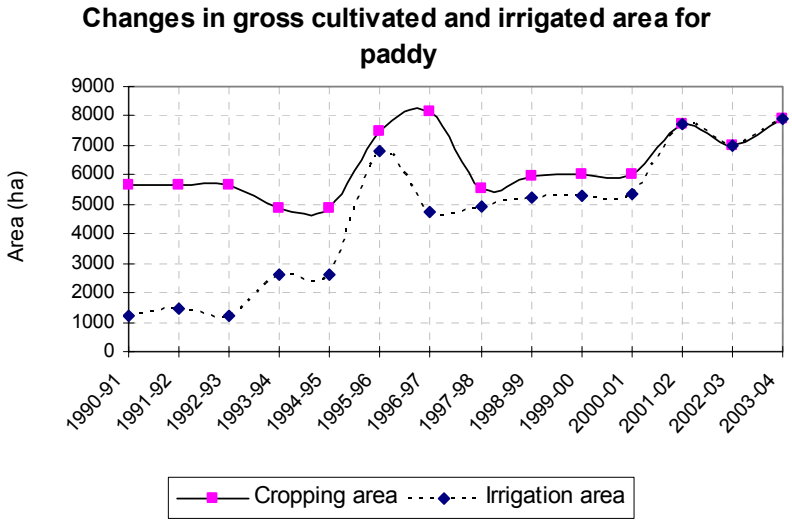


Figure 4B.9 Changes in gross cultivated and irrigated areas for paddy

Irrigation and penetration of pump sets

Groundwater is the major source of irrigation in the study area. Irrigation intensity has increased from 1.23 to 1.40 between 1999 and 2004. The major sources of irrigation are pump sets and tube wells. Of the government and private tube wells, the private ones are used more prominently. Figure 4B.10 gives various sources used for irrigation in Arajiline. There has been an increase in the number of bore wells in the region, indicating increasing exploitation of groundwater.

The number of electric pump sets is more than the diesel pump sets. Between 2003/04 and 2004/05, the total number of electric pump sets went up from 1937 to 1950 while that of diesel pump sets increased from 397 to 406.

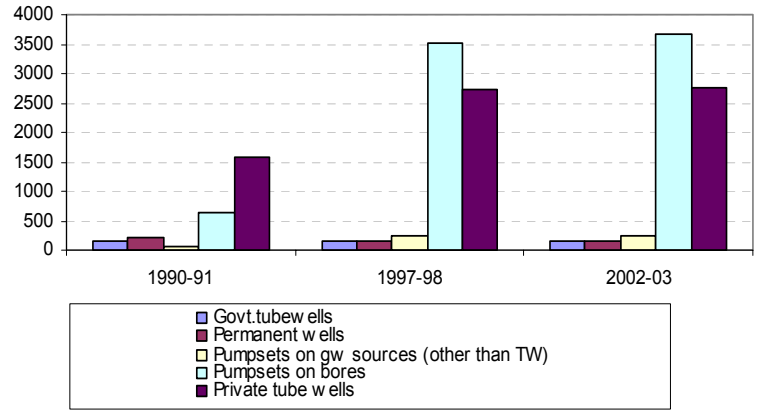


Figure 4B.10 Sources of irrigation in Arajiline

Source Statistical Abstract of Varanasi District for Different Years up to 2004/05. Bureau of Economics and Statistics, Government of Uttar Pradesh

Fertilizer use

Average fertilizer consumption (that is, urea, DAP [diammonium phosphate] and potash) per unit area has gone up substantially between 2001/02 and 2006/07 in Arajiline. This is attributed to high cropping intensity and increased irrigation potential. It was found that the usage of fertilizer has almost doubled in 14 years or so, as it grew from almost 140 kg/ha in 1991 to 300 kg/ha in 2005.

As can be seen from Figure 4B.11, the share of usage of N (nitrogen) and P (phosphorus) has almost doubled in the 12–13 years due to increasing cropping and irrigation intensity.

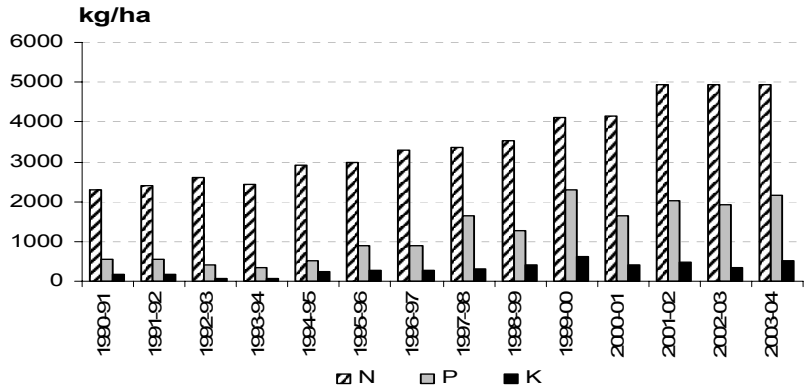


Figure 4B.11 Fertilizer consumption per unit area

Source Statistical Abstract of Varanasi District for different years up to 2004-05. Bureau of Economics and Statistics, Government of Uttar Pradesh

Water situation

According to CGWB (2005), Arajiline block has been categorized as a safe sub-unit where the stage of groundwater development is estimated to be approximately 72 percent. However, recent communication with the GWD (Ground Water Department) (personal communication) suggests that the area has been experiencing a decline in the water tables, especially since last four to five years, and, hence, in future, could fall in the category of semi-critical sub-unit if the declining trend continues. This is shown in Figure 4B.12 where observation wells in the area depict a fall in water tables since the last three to four years.

The groundwater in the block lies in semi-confined to unconfined conditions. The aquifers mainly consist of various layers of mix of sand, silt, and clay. At few places in the block, presence of clay lenses has also been reported.

The area has a number of dug wells that serve as sources of water supply in the villages. The dug wells in the block are mostly in the depth range of 13–18 m, reaching a maximum depth of approximately 30 m below ground surface. The GWD groundwater table data from 1995 to 2005 reveals that the instances of dug wells getting dry in the block have increased since 2004, especially in the pre-monsoon period of 2005 compared to previous years since 1995. This is mainly due to low rainfall during the period 2003–05.

The regional flow direction of groundwater in the watershed follows the topography and is hydraulically connected to Ganga river in the south-east. The dominant direction is found to be from north-west to east–south-east.

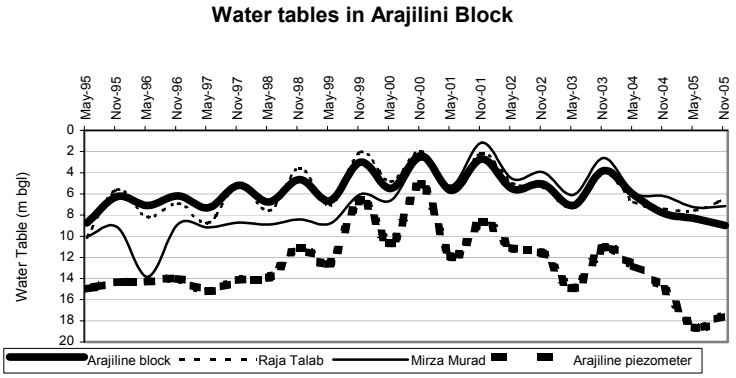


Figure 4B.12 Water table fluctuations in the study area

Based on the description of the watershed, including groundwater flow directions, the villages for techno-social assessment were identified.

The process related to the identification of the villages and the stakeholders for the study has been discussed in the chapter on approach and methodology.

Hindustan Coca-Cola Beverage Pvt. Ltd, Mehndiganj

The plant is owned and operated by the HCCBPL since June 1999. Earlier, the Indian soft drinks manufacturer Parle Kejriwal Pvt. Ltd operated the plant. The plant is located 30 km from Varanasi city in an agriculture land adjacent to the national highway connecting Varanasi and Kolkata. There are no water-intensive industries within 5-km radius around the plant.

Plant capacity and utilization

The plant only produces RGBs (refillable glass bottles) and depends totally on groundwater for its production. The potential capacity of the plant is 600 BPM (bottles per minute). The utilization capacity of the plant ranges from 32 percent to 39 percent for the period 2003/04 to 2005/06 (Figure 4B.13).

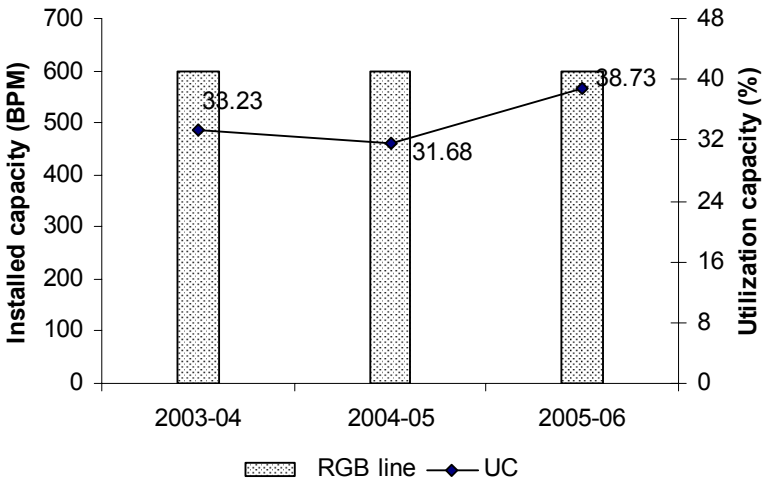


Figure 4B.13 Installed capacity and utilization capacity of the plant

Water intake and production

Daily average raw groundwater intake for the past three years (January 2003 to 2006) shows a declining trend (Figure 4B.14). The peak months for groundwater intake were April, May, and June, while December and January are the lean months. The maximum daily average intake of water was around 664 kl (kilolitres) in 2003/04, which reduced steadily to 582 kl in 2005/06.

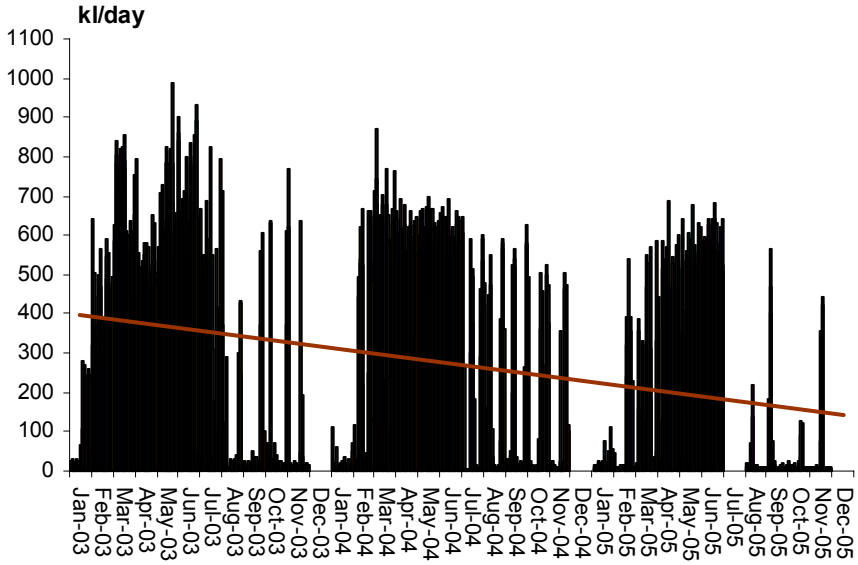


Figure 4B.14 Daily groundwater intake

Groundwater intake by the plant increases with increasing product demand in the market. Demand for CSDs (carbonated soft drinks) is higher in the summer months and as a result, the products produced by the plants in summer months (mainly in April, May, and June) shoot up considerably. Figure 4B.15 shows the monthly groundwater intake by the plant and the corresponding volumes of production for the period 2004–06.[3]

A high degree of linear correlation (r = 0.97) was observed between the groundwater intake by the plant and its total production over a 22-month period (from January 2004 to November 2005).[4] Figure 4B.16 gives the scatter diagram between monthly groundwater intake and the level of production.

[3] The plant did not provide daily ground water intake data for 2006.
[4] production data for January 2004 and 2005 was zero so WUR is not defined.

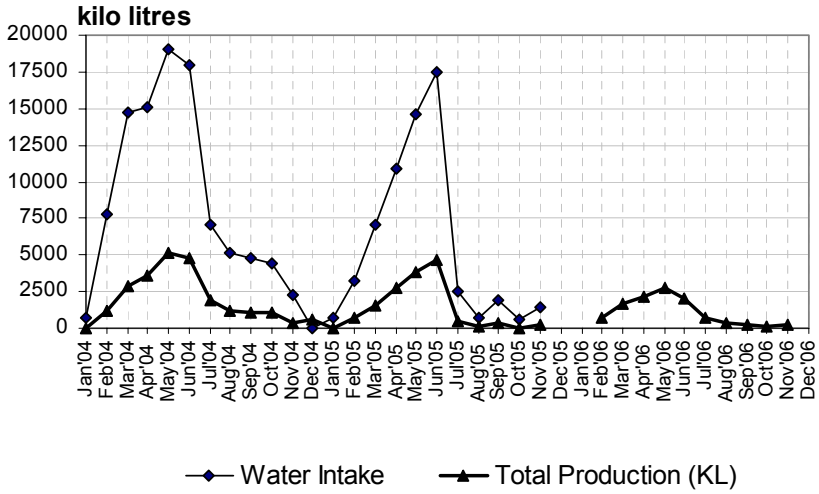


Figure 4B.15 Water consumption and carbonated soft drink production trends

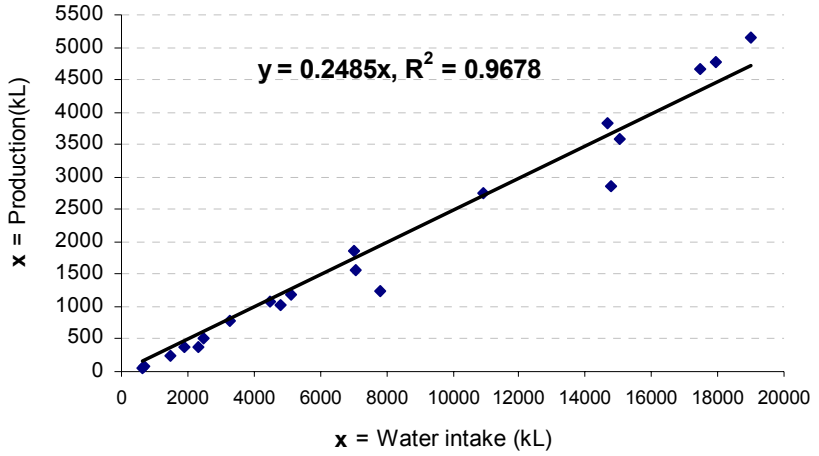


Figure 4B.16 Relationship between monthly ground water intake and production

The decline in groundwater intake by the Varanasi plant, as shown in Figure 4B.14, over the years is supported by the decline in the monthly plant production levels shown in Figure 4B.15.

Water utilization ratio

Based on the data provided by the Coca-Cola company, the annual WUR (water utilization ratio) was computed for the period 2004 to 2005. The results thus obtained were in close conformity with the estimates provided by the Coca-Cola company. The annual WUR estimated over the last two financial years for the plant is marginally different in 2004 and 2005 from what was provided by the plant (Table 4B.2). The annual WUR in 2005 has declined as compared to 2004.

Table 4B.2 Annual water utilization ratio

Year	*Plant estimate*
2004	4.32
2005	4.16

Selection of villages and stakeholder interaction

Identification of villages

The villages identified for the assessment, using the approach as discussed in the chapter on approach and methodology, are as follows.

- Village in which the plant is located (M 1): Mehndiganj (the plant is located on the border of village Mehndiganj and Kachnar)
- Village immediately upstream of the plant considering the regional direction of groundwater flow (U 1): Bhikaripur
- Village immediately downstream of the plant considering the regional direction of groundwater flow (D 1): Kachnar
- Village at the extreme upstream end of the watershed in the direction of groundwater flow (U2): Khajuri
- Village at the extreme downstream end of the watershed in the regional direction of groundwater flow (D 2): Karnadadi

Figure 4B.17 indicates the location of the selected villages in the watershed.

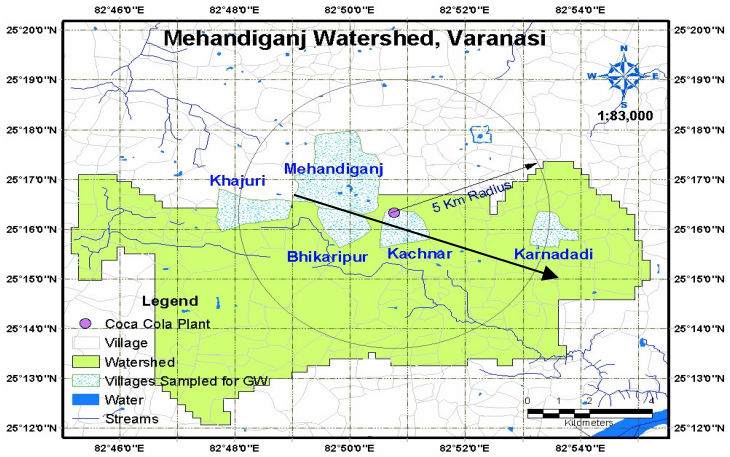


Figure 4B.17 Location of the selected villages in the study area (arrow indicates regional direction of groundwater flow)

Key stakeholder interaction

Stakeholder perceptions capture the views of different stakeholders on the issues of trends in water availability, quality, utilization, and access across the study villages. The section only records the views as presented by different stakeholders in the course of FGDs (focused

group discussions) and key stakeholder interviews. It aims to neither make judgements nor draw conclusions based on these recorded perceptions.

The rationale for selection and relevance of stakeholders has been discussed in detail in Chapter 2 on approach and methodology.

In the Mehndiganj sub-watershed, FGDs were held with key stakeholder groups, identified as those groups that are largely dependent on water, like farmers, women, those involved in the management of water resources at the local level, and the panchayats. FGDs were also conducted with weaker sections to capture the differences pertaining to access of water. Additionally, key informants, who could offer information about the water scenario in the area and related issues, were interviewed.

Gram panchayats

Each of the five villages in the study area had a separate gram panchayat comprising 11–15 members. Consequently, five FGDs were held, one with each village panchayat, and the participants included both male and female elected representatives, representing the general and reserved classes.

Women

Six FGDs were conducted with a total of about 65–70 women, one each in the five villages and an additional FGD in the settlement located right behind the HCCBPL, Mehndiganj, to understand any specific impacts due to their proximity to the plant. The participants were from different castes and aged between 15 and 60 years. Nearly 60 percent of them had no formal education, while some were graduates. Nearly 40 percent of the women reported to be working in agricultural fields, while the remaining were involved in household tasks. Majority of the families that these women represented depended on agriculture for a livelihood: 68 percent of these families depended exclusively on agriculture, while the HCCBPL, Mehndiganj, was a means of secondary livelihood for four percent.

Farmers

Ten FGDs were conducted with farmers from the five villages. Separate FGDs were conducted for large farmers and small/marginal farmers, owing to their differing water requirements. In terms of education, about 24 percent of the participants had no formal education, the remaining were educated up to different levels, ranging from primary education to graduation. Nearly 70 percent of the participants had landholdings less than 2 hr, while about 23 percent owned land more than 2 ha. Seven percent of the participants were landless.

Weaker sections

Totally five FGDs were held with members of weaker sections, one in each of the five villages. In the Bhikaripur village, all those participating in the FGDs belonged to the *Harijan* community while those in Khajuri were *Kumhars* and *Harijans*. In the village Kachnar, the respondents were *Khatik* (vegetable sellers and agricultural labourers), *Mushar* (stone crushers), *Dharkaa*r (involved in bamboo works), and *Nats* (involved in beggary and animal trading), while in Karnadadi the respondents belonged to either *Rajbhar* or *Bind* community. A majority of the participants were uneducated and all were within the age group of 20–65 years. Majority of the respondents were landless labourers and those who owned land had small holdings measuring between 3 and 12 *biswas*.[5] Most respondents in Bhikaripur, Kachnar, Karnadadi, and Mehndiganj worked as agricultural labourers.

Key persons

A number of key persons were interviewed; a brief description of each is presented below.

- Members of Lok Samiti: The leader and members of a local CBO (community-based organization) called Lok Samiti were interviewed. Lok Samiti is a non-political, non-religious, not-for-profit organization based on Gandhian principles like *swaraj*. It runs a school and carries out awareness programmes for weaker sections of society like the *dalits* and women. It has been spearheading protests against the operations of the HCCBPL in village Mehndiganj.

- Member of GBSS (Gaon Bachao Sangharsh Samiti): The GBSS is a CBO based in the village of Mehndiganj. It came into existence in 2001 with the primary objective to fight against exploitation of the villagers. The GBSS has reportedly been active in taking up with various government offices issues pertaining to waste and wastewater discharge by the HCCBPL, Mehndiganj. Consequently, it was important to get the views of this group on various issues in the village, especially those associated with groundwater depletion, environmental pollution, and so on.

- Panchayat secretary of one of the study villages: The Panchayat secretary of one of the study villages was interviewed to get background information about the village including socio-economic information, names of different CBOs functional in the area, issues of concern for the village, and so on.

[5] A *biswa* is a unit for measuring land; 80 *biswas* equal 1 ha.

- Ex-sarpanch of one of the study villages: An ex-sarpanch of one of the study villages was interviewed to get views on issues related to the operations of the HCCBPL, Mehndiganj.

- Sarpanch of a village in the vicinity of Mehndiganj: Sarpanch of a village located 3 km from Mehndiganj was interviewed, as he was reported to be knowledgeable about the area.

- District official: A senior district official was interviewed to understand the pressing issues of concern at the district level, especially those related to groundwater depletion. It was important to get views on the water situation at the district level to understand the context of the water scarcity in the Mehndiganj sub-watershed.

- Representative of KMGSK (Krishak Mahila Griha Shilpa Kendra): KMGSK is a CBO providing training to women so that they are able to generate various means of income and undertake other livelihood activities. The organization is operational in three to four blocks of Varanasi district. The representative who was interviewed has been working in the area for several years.

- Representative of GMUS (Grameen Mahila Utthan Samiti): GMUS is an NGO working in the Varanasi region since 1992. This organization works for the welfare of women and children, focusing on their health and sanitation, and education. The NGO is supported by the HCCBPL, Mehndiganj, in its various rural development activities. The representative was interviewed to have an insight into the CSR (corporate social responsibility) activities undertaken by the HCCBPL, Mehndiganj.

- Representatives of the HCCBPL, Mehndiganj: Representatives of the HCCBPL, Mehndiganj, were interviewed to understand their views on the issues that emerged through the various FGDs and interviews. Time was also spent in understanding the CSR activities the HCCBPL, Mehndiganj, undertakes as well as how they connect with the local people to carry out their outreach work. This was important as it helped understand the perspective of the company on various issues like land acquisition, water usage, wastewater treatment, and so on.

Stakeholder perceptions on water quantity

Water sources

Groups of farmers, women, weaker sections, and panchayat members reported that groundwater is the main source of water in the study

area. Traditionally, open wells had been used as a source both for domestic and irrigation purpose. Surface water sources such as ponds were also used in the past.

Presently, for the purpose of household use, mostly handpumps are used to draw water from the ground. These handpumps were installed by the government, private owners, and, in some cases, by the HCCBPL, Mehndiganj. In the villages Kachnar, Karnadadi, and Bhikaripur, some houses were reported as having access to piped water supplied by the Jal Nigam. However, the supply of water was reported to be erratic. Some women also reported that they access surface water from traditional ponds, where available. For instance, in Khajuri, *pokhras* (surface water bodies) that have been rejuvenated are being used. Open wells are being used in Bhikaripur and Mehndiganj.

For the purpose of irrigation, groundwater is drawn with the help of bore wells, powered by electric pump sets. The pumps are owned either by private owners or by the government. An older technology, the *pulley patta* (belt pump) system, consisting of a motor installed on the ground (as opposed to a submersible pump), is still being used in Bhikaripur. In 1985, the government developed an irrigation canal in the area. The village Mehndiganj lies at the tail end of the canal. Hence, farmers of the village do not get sufficient water to meet their irrigation needs. Consequently, they are left with relying on groundwater for irrigation.

Changes in water availability

All stakeholder groups reported an increasing problem of water depletion. Panchayat members and farmers added that there was a problem of access to water owing to irregular and decreased electric supply, which is used to power motorized pumps. All key persons interviewed, including the representatives of the HCCBPL, Mehndiganj, also indicated a growing concern for decreasing water availability.

It was perceived that groundwater level began falling about 10 years ago, but all groups reported that a sharp decline in the water table is being observed for the past three to six years. Residents of different villages reported the current water table to be at different levels, ranging from 70 feet to 120 feet. Groups of farmers pointed out that four years ago, the water table stood at a depth of 60 feet, while 10 years ago, it was at a depth of 45–55 feet. It was also perceived that the water level continues to fall at rates ranging from 3 feet to 10 feet a year, depending on location.

All the stakeholder groups reported that open wells have dried over time. Panchayat members in Mehndiganj and Bhikaripur informed that till six years back, the use of open wells was prevalent in the villages, but now most have dried. Mehndiganj panchayat cited that of the 200 wells in the village, only 10 have water in them, while the rest have dried. Similarly, the Kachnar panchayat observed that 50 percent of the wells in their gram panchayat villages have dried in the past three years.

All groups of women reported of having wells in their village but their dependence on them was low. In Khajuri, Bhikaripur, and Kachnar, women claimed that most of the wells in their village were dry. While in Mehndiganj they said that the water level in the open wells was very low and the wells dried up in the summer.

Drying of handpumps was also reported. Panchayat members said that several handpumps have dried in the past three to four years.

Because of declining groundwater levels, farmers reported that they needed to upgrade their pumps from 5 HP (horsepower) to 7.5/10 HP to draw the required amount of water for irrigation. They also pointed out that in the past three to four years, the water level had further declined to such levels that the *pulley patta* pumps with stronger motors were unable to draw requisite water. A rating of water availability in the region by different stakeholders across various villages has been indicated in Table 4B.3.

Table 4B.3 Rating of water availability

Village	*Panchayats*					*Women*					*Farmers*					*Weaker sections*				
Scale	*1*	*2*	*3*	*4*	*5*	*1*	*2*	*3*	*4*	*5*	*1*	*2*	*3*	*4*	*5*	*1*	*2*	*3*	*4*	*5*
Khajuri	X[a]	X[b]	X[c]					X					X					X		
Bhikaripur			X					X						X					X	
Mehndiganj				X						X				X				X[ab]		X[c]
Kachnar					X				X					X					X	
Karnadadi									X				X					X		

a – Rating for monsoon

b – Rating for winter

c – Rating for summer

Scale: 1 – no scarcity; 5 – very high scarcity

Reasons

A number of reasons were cited by the different stakeholders for the decrease in groundwater level. The reasons stated were similar across different groups, though the priority accorded to them differed by villages and even between different groups in the same village. The key reasons cited are as follows.

- Lack of sufficient rainfall in the last three to four years
- Excessive use of water by the HCCBPL, Mehndiganj
- Increased number of bore wells in the region
- Increased pressure on groundwater due to drying up of surface water bodies like ponds
- Increasing population

All groups reported that over the last three to four years, the Varanasi region had experienced less than normal rainfall. Consequently, farmers reported that ground was not getting adequately recharged. Some of the key persons pointed out that the problem of dropping groundwater level was not unique to the study area; it was in fact a problem faced in the region, in general. A few other key persons reported that the falling groundwater level was indeed a common problem, but the drop in the water table and the rate at which it is falling are sharper in villages around the plant than in the rest of the district.

Panchayat members reported that there has been an increase in the number of bore wells in the area, which were contributing to the decreased availability of water in the region. Interestingly, some groups of farmers had a different take on the same issue. They said that because existing bore wells and handpumps were failing, they were installing new bore wells. In their opinion, the installation of several new bore wells was the result of groundwater shortage, and not the cause of it.

Another commonly held belief was the role of the HCCBPL, Mehndiganj, in depleting the groundwater. Farmers' and women's groups believed that the HCCBPL, Mehndiganj, has between 4 and 15 '*maha*' (large) tube wells, that is, one tube well within the plant was the equivalent of several tube wells from the village. They also pointed out that since the HCCBPL, Mehndiganj, had 24 hours of power, they were able to extract large quantities of water. This, they felt, was a significant contributor to the depleting water resource in their region. While some key persons attributed the depletion in water level primarily to insufficient rainfall over the past three to four years and not to the HCCBPL, Mehndiganj. Other reasons cited included pressures from increasing population, a change towards growing more vegetables than before, usage of water in other industries in the region like the carpet-making industry, carbon and battery-making factory,

and so on. Farmers also pointed out to a problem of water access due to reduced power availability as compared to before.

Impacts

The different stakeholder groups described the various impacts they felt due to water scarcity. Panchayat members identified impacts on both farmers as well as women. Panchayat members said that bore wells needed to be frequently re-bored to ensure water supply. In terms of agriculture, panchayat members reported that the lack of water led to decreased soil moisture, which eventually affected the productivity of the land. This view was expressed by both farmers as well as women engaged in agriculture. Women further pointed out that low yields implied less fodder for cattle. They also said that less water directly affected cattle since there was not enough to meet the drinking and bathing needs of cattle, thus making it difficult to keep cattle.

Farmers pointed out that decreasing productivity of their land meant increasing costs for agriculture in terms of re-boring of wells. As pointed out earlier, some farmers felt that the increase in the number of bore wells installed was an impact of decreasing groundwater level and not the cause.

Members of the panchayat, women's groups, and weaker sections felt that the biggest burden of decreased water was borne by women, who had to spend time travelling longer distances to fetch water, which is an extremely strenuous task. Standing in long queues and waiting for their turns to fill buckets also wore down the patience of women, resulting in short fuses and quarrels. Further, there was insufficient water to wash and bathe.

Notably, in the village of Kachnar, women described how not having access to adequate water was a source of humiliation since women had to ask private bore owners for water. Women reported that they were often refused, and that they had to swallow their pride and keep going back, and plead for water. Women also reported apprehensions about the future since they felt they would have to travel to farther distances to collect water in the next 8 to 10 years, as they expected the situation to get worse.

Stakeholder perceptions on water quality

Reports on the quality of groundwater were consistent across the different villages. In the extreme upstream and downstream villages of Khajuri and Karnadadi (respectively), there were no reports of water quality problems. However, in one FGD with a weaker section in village Khajuri, it was reported that water had different taste and was

thus not used for cooking. In the villages of Mehndiganj, Bhikaripur and Kachnar, there were reports of problems with groundwater quality. However, one of the key persons reported that there was no perceptible change in groundwater, though he added that actual tests were not done to confirm this.

Farmers from Bhikaripur reported that water has acquired yellowish colour and was salty in taste, a change they had noticed in the last three to four years. Women from this village reported that when their handpumps were used continuously, they threw up sand and mud, especially in the summer.

Panchayat members from Mehndiganj reported muddy water from a few handpumps, while women reported that an open well in their village had dirty water that smelled foul and was unfit for consumption. Farmers reported that the bore wells they used had started yielding yellowish water with a salty taste in the last 3 to 4 years, though they did not link decreased productivity to the change in water quality.

Women from the village of Kachnar reported that in the last three to four years, water in their village has got a salty taste, while farmers brought to notice that the water had turned reddish and yellowish over this period. Members of the panchayat reported that water quality in general was fine, except in a couple of places.

One of the key issues pertaining to water quality was related to effluent discharge by the HCCBPL, Mehndiganj, and the consequent pollution of surface water. Members of the GBSS and the Lok Samiti reported that around the year 2000, wastewater from the HCCBPL, Mehndiganj, was being discharged in a *nullah* close to it and near the GT road. Women and panchayat members also corroborated this. The representatives of the HCCBPL, Mehndiganj, also acknowledged this fact, reporting that there was also an enquiry report by the district magistrate on the issue. They added that they were releasing the water into the *nullah* after acquiring due permissions from the concerned government departments.

Eventually, this water entered the fields situated close to the plant and the GT road, adversely impacting the crops as well as the overall fertility of their soil. According to the HCCBPL, Mehndiganj, construction activities related to the GT road caused the *nullah* to get blocked due to which the wastewater spread in the region. The GBSS and Lok Samiti reported having approached the district magistrate who passed an order that restricted the HCCBPL, Mehndiganj, from discharging the wastewater in the *nullah*. Consequently, the company said that it laid a pipe that carried the wastewater for a distance of 1.5

km, discharging it in another *nallah* near the village of Bhikaripur. Members of the panchayat, farmers, and women from Bhikaripur also reported that the current discharge point located in their village is posing a problem for agriculture. Some farmers said that if they used this water for irrigation, they suffered losses in crops. One of the key persons reported that when there was a shortage of water, the farmers in the vicinity of the *nullah* used this water for irrigation, and the yields were better. The representatives of HCCBPL, Mehndiganj, said that they would not recommend using the wastewater for irrigation.

Another incident pointed out by the Lok Samiti pertained to the distribution of sludge from the HCCBPL, Mehndiganj, to farmers in the vicinity of the plant, as fertilizer. Members of the GBSS also brought this forward, but none of the farmers who participated in the FGDs reported having used the sludge. The staff from the HCCBPL, Mehndiganj, denied ever having distributed any sludge to the farmers. They claim that the sludge is stored within the plant premises. They are awaiting a centrally approved disposal site for the same.

A commonly held belief by groups of farmers and women, as well as a few key persons was that currently the wastewater was being stored in wells or large underground tanks dug for the purpose of storage. Farmers felt this water was seeping into the groundwater, changing its colour in the process.

Protests and agitations

In the Mehndiganj region, protests and agitations against the HCCBPL, Mehndiganj, have been related to several issues, including that of water scarcity. The other issues that drive the protests are related to land acquisition, improper disposal of effluents, adverse impacts to agriculture, and employment.

Civil society actions have been reported as far back as 1996/97, related to a land dispute. Since 2000, civil society has raised issues relating to both water scarcity and water quality. Protest marches asking for closure of the HCCBPL, Mehndiganj, have gained momentum since early 2006 and the movement has found support from external groups and prominent activists. Some of the civil society organizations involved in the protests have beliefs grounded in Gandhian principles of *swadeshi* and their opposition to the Coca-Cola operations goes beyond their stance that the HCCBPL, Mehndiganj, is exploiting water resources in the area. For instance, members of the Lok Samiti, the key group leading the protests also oppose the plant because Coca-Cola is a multinational company. Interestingly, there are also organizations like Sarva Dalit Kshetriya Vikas Morcha and the Adarsh Janjagaran Samiti (the HCCBPL, Mehndiganj, supports the latter in

terms of providing livelihood training, incentives to run the group, and so on) that are found to be actively opposing the Lok Samiti and reportedly supporting the HCCBPL, Mehndiganj, through campaigns and protests against the activities conducted by this pro-*swadeshi* group.

According to the representatives of the HCCBPL, Mehndiganj, the protest marches are baseless, and are instigated by 'outsiders'. Consequently they do not have the support of the community and have been losing steam. The plant staff felt that most of the participants in the protest marches are unemployed youth who are paid for participating in these marches. Thus the protest marches had become a source of income and even a 'business' for people.

Conversely, panchayat members from Mehndiganj, Khajuri, and Bhikaripur claimed to have participated in these marches at some point. Several women from Mehndiganj also claimed to have participated in these protests. Some farmers from Bhikaripur stated that they felt the protests were justified, as the people in the area were facing several impacts due to the operations of the plant. Yet they also felt that prominent people involved in sloganeering and carrying out the marches were driven by concerns that went beyond the good of the local people. They felt that there was an intention of seeking material rewards by people who, after being on the frontlines, suddenly vanished from the movement. They felt that there was a pattern where people would be vociferous in their opposition to the operations of the HCCBPL, Mehndiganj, and then they would suddenly become silent.

Members of the Lok Samiti and GBSS claimed that the protest marches were a direct result of the dire situation faced by the people of the village. According to them, the local community supported their cause and participated willingly. They alleged that those opposing the protest marches were unemployed youth hired from neighbouring villages to intimidate them and make their cause seem insignificant, and these youth were in no way affected by the problems faced by the community residing around the plant. They stated their intentions to intensify agitations against the operations of the plant and eventually they wanted to see the plant stop operations so that they could have control over the water resources in their area.

Regulatory and governance structures and compliance

The Coca-Cola facility in the Mehndiganj village[6] was acquired from M/s Kejriwal Beverages Private Limited, a Parle franchisee, in 1999. The plant draws groundwater through two bore wells in the factory

[6] The village of Mehndiganj is located in the Varanasi district of the state of Uttar Pradesh.

complex. The state has not yet put into effect an Act on groundwater although a draft bill on groundwater regulation has been prepared on the lines of the Model Bill, drafted by the Ministry of Water Resources.[7] Governance issues in the context of the establishment and operation of the bottling unit by Coca-Cola at Mehndiganj include the requirement for approvals from regulatory bodies; the management of water withdrawal and usage, and wastewater disposal at the HCCBPL, Mehndiganj; and the bottling operation's adherence to regulatory requirements. Following parameters have been reviewed in the context of the HCCBPL, Mehndiganj.

- The water policy in Uttar Pradesh.
- Compliance of the HCCBPL, Mehndiganj, with state legal and administrative requirements governing the plant's establishment and operations, with a focus on water resources management and wastewater disposal.
- Compliance of the HCCBPL, Mehndiganj, with TCCC (The Coca-Cola Company) corporate requirements on water resources management and wastewater disposal.

Uttar Pradesh State Water Policy: a review

The UP SWP (State Water Policy), 1999, acknowledges the increasing scarcity of water in the state, characterized by regional imbalances of water resources endowments, as well as seasonal fluctuations in water availability. The SWP emphasizes on the optimal management and allocation of water resources in a socially equitable manner, along with the necessity to conserve and recharge them for the future. By 2025, the SWP indicates, the drinking water and domestic needs of all urban and rural consumers should be fully met, and the means to reconcile conflicts between competing water needs should be enunciated; the state should also consider the transfer of water from surplus to scarce areas. The SWP specifies that in the planning and operation of water resources systems, the state's priorities should be accorded in the order: (i) drinking water; (ii) irrigation; (iii) hydro and thermal power; (iv) agro-based industries and non agricultural industries; and (v) navigation and other uses. In addition to the above, while planning water resource development projects, the needs of drought-prone areas should be given priority, and environmental and ecological balances should be maintained.

Some of the other relevant objectives of UP SWP are: water resource management should include user's participation and decentralization of authority; maintain the quality of both surface and groundwater

[7] The Model Bill was initially drafted in 1970 by the Ministry of Water Resources, and has been amended in 1992, 1996, and 2005. Refer Chapter 3.

according to established norms and standards; conjunctively treat both surface and groundwater from one basin or sub-basin as a unitary resource; and encourage private sector participation. The SWP also proposes a substantive legal framework for the management of water resources; legislation for this should include the restriction of groundwater exploitation in regions where it is depleting at a fast rate, keeping other constraints in view. With respect to groundwater specifically, the UP SWP highlights that the conjunctive use and recharge of groundwater should be central to groundwater management, and lays down various ways in which this can be accomplished.[8] However, while undertaking any recharge project, it must be ensured that such projects do not pollute the groundwater aquifer.

In the context of industrial development, the SWP prescribes that selected industries should be required to bear the development and maintenance costs of water resources, along with the cost of water, to reflect the scarcity value of this resource. The cost of water would be fixed from time to time. Also, industries should implement extensive water conservation and pollution control measures to keep the requirement for water low and prevent pollution of both groundwater and surface water. In the context of water pricing, the SWP makes a generic statement about making efforts such that water supplies become self-sustaining and cover at least operations and maintenance costs, with the caveat that the above should be attempted keeping in context the socio-economic conditions of the population to be served.

On balance, and in the context of this study, although the UP SWP policy is ambiguous about introducing incentives and disincentives for efficient utilization of water, it emphasizes that industrial consumption of water should not be costless. It also makes a strong case for water-consuming industries to take on the onus of water resources management in their areas of operation, in line with the guidelines laid down in the SWP. There, however, does not appear to be any clarity with respect to a framework for the imposition of water user charges for irrigation or domestic purposes.

State legal and administrative framework

The Mehndiganj plant is a brownfield acquisition by Coca-Cola in India, having originally been established as Kejriwal Beverages Private Limited, a Parle franchisee. Located in an agricultural area, the plant was established under a licence issued in April 1996 under the IDR

[8]For example, the construction of recharge ponds/percolation tank and desiltation of existing ponds, construction of recharge basins, and so on in dark and gray blocks.

(Industries Development and Regulation) Act, 1951.[9] A letter of intent dated 7 June 1999, issued under the IDR Act, formalized the transfer of ownership to Coca-Cola, India.[10]

The establishment of an industry in an agrarian area requires a sanction from the district authorities so that the land acquired can be used for non-agricultural purposes. This is largely an administrative procedure with implications for the revenue department. Therefore, the land conversion process does not include an assessment of the potential water usage by the applicant, whether industrial or otherwise. However, every gram panchayat in India is empowered to levy a tax upon buildings and land that are not subject to agricultural assessment but fall within the limits of the panchayat area.[11] The HCCBPL, Mehndiganj, accordingly pays the gram panchayat annual taxes amounting to Rs 6000 per annum, and licence (to operate) fees of Rs 2500 per annum; receipts of these were obtained. According to Coca-Cola, no agreement exists between Coca-Cola and the Mehndiganj gram panchayat with respect to the drawal and usage of groundwater.

Records show the existence of a land dispute between M/s Kejriwal Beverages Pvt. Ltd, the original owners of the bottling operation, and the gram panchayat in the initial years of the plant's establishment; M/s Kejriwal Beverages Pvt. Ltd were accused of occupying a portion of land belonging to the gram sabha. The issue purportedly settled before the acquisition of the property by Coca-Cola, however, resurfaced subsequently and, as per records, is yet to find a final settlement. The Mehndiganj plant has also encountered improper wastewater or effluent-disposal-related allegations in the area; these do not appear to have been substantiated by an UPPCB enquiry, a copy of which was obtained from UPPCB. While the land dispute issue lies outside the purview of this assessment, the improper wastewater disposal issue will be discussed in the context of the plant's compliance with legal and TCCC requirements on water resources management and wastewater disposal.

[9] Licence number 242, dated 4 July 1996 (information from Mr Ramji Singh, General Manager, District Industries Centre, on 25 January 2007. No photocopies were given to TERI).
[10] Consultations as to why the plant was registered under the IDR (Industries Development and Regulation) Act in 1996 despite the commencement of the liberalization of Indian economic policies in 1991 did not yield any specific answers; Coca-Cola too was asked by TERI as to why the plant was registered under the IDR Act (Questionnaire sent on 18 June 2007); however, the company too is not aware and states that in all likelihood, the previous owners did not share the information with them.
[11] As per the State Panchayat Act in respective states.

Categorization, consent, and water cess

TERI has not received a copy of the Consent to Establish, originally issued to M/s Kejriwal Beverages Pvt. Ltd, although Coca-Cola India has shared a copy of the first CtO issued by the UPPCB to the bottling facility. The initial CtO was issued for a trial period of two months to M/s Kejriwal Beverages Pvt. Ltd, renewable thereafter for a period of three years. As mentioned in Chapter 3, the validity of an industrial unit's CtO is determined by the categorization of the industry as red, orange or green. HCCBPL, Mehndiganj has been categorized as an orange industry; the validity period of its CtO, as per UPPCB norms, is three years.[12]

As mentioned in Chapter 3, the Water Cess Act, 1977, and its amendments require industrial units that consume 10 KLD (kilolitres per day) or more of water, to file water cess returns to the respective state pollution control boards. In this context, HCCBPL, Mehndiganj, pays water cess at differential rates depending on the purpose for which water is consumed,[13] to the UPPCB. As per the documents received from Coca-Cola, the plant has paid as cess of Rs 31 573.00 to the UPPCB for 2005/06.

Compliance with regulatory and The Coca-Cola Company requirements

The first CtO issued by the UPPCB to the plant in 1998, when it operated as a Parle franchisee, as mentioned above, prescribes conditions necessary for wastewater disposal but does not lay down any norms for drawing or using water for the industrial process. These conditions and compliance against them by HCCBPL, Mehndiganj, are presented in Table 4B.4.

Table 4B.4 Compliance by HCCBPL, Mehndiganj with conditions specified in the first CtO issued by UPPCB, in 1998

Requirements	*Compliance in Mehndiganj plant; remarks, if any*
General	CtO issued to M/s Kejriwal Beverages Private Limited on 4 April 1998 for trial run for two months
Limit on discharge for wastewater	602 KLD (prescribed by CtO) Based on 2006 data and 122 operating days for 2005/06, the daily effluent generation figure is approximately 169 KLD. This is well within the limits permitted by the CtO issued on 4 April 1998
Mode of discharge of wastewater	In permitted natural drain as per the terms of the CtO

[12] All state pollution control boards in India are required to categorize industries as Red, Orange or Green, depending on their air and water pollution causing potential, with red being the most polluting and green the least; the grouping of industries under each category and compliance provisions may differ among states.

[13] Water cess rates are: 20 paise/kl (kilolitre) for water used for industrial processing; 10 p/kl for water used for cooling and spraying; 3 p/kl for water used for domestic purposes. Refer Chapter 3.

Requirements	*Compliance in Mehndiganj plant; remarks, if any*
Compliance with discharge standards	Limits for two parameters (suspended solids and BOD) Analysis reports enclosed suggest compliance with these parameters
Requirement of sampling and measurement	Not mentioned in the CtO issued by the UPPCB on 4 April 1998
Interlocking of pollution control devices with process	Applicable (separate power connection to pollution control equipment) Separate log book maintained for pollution control equipment at the plant
Records of all the testing and monitoring should be kept for inspection of PCB; in case of malfunction of treatment system, PCB should be intimated immediately	Copies of the report received Plant in compliance
Hydraulic loading rates suggested for land application of treated effluent	Not mentioned as a requirement in the CtO issued by the UPPCB on 4 April 1998
Environment statement reports	Not mentioned in the CtO issued on 4 April 1998; data on monitoring needs to be maintained and sent to UPPCB Plant in compliance

CtO – Consent to Operate; UPPCB – Uttar Pradesh Pollution Control Board; BOD – biochemical oxygen demand; PCB – pollution control board; KLD – kilolitres per day

Note The compliance of the plant is based on secondary data provided by CCI: results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

The plant is currently operating as per the terms and conditions laid down in the CtO issued to HCCBPL Mehndiganj on 27 December 2005, with a validity period of three years. The terms and conditions mentioned in the CtO issued to the HCCBPL, Mehndiganj, in 2005 do not vary significantly from those in the CtO issued to M/s Kejriwal Beverages Private Limited in 1998, assessed in Table 4B.4. The facility's compliance against the waste-water-related conditions in the CtO issued in 2007, is summarized in Table 4B.5.

Also with regard to community allegations of improper waste disposal, TERI was given a June 2006 report by the UPPCB zonal office in Varanasi on a joint inspection conducted by the Environmental Directorate of UP and the UPPCB to assess allegations against improper effluent disposal by HCCBPL, Mehndiganj. The report also takes cognisance of accusations raised by certain local community members with respect to deteriorating water quantity and quality in the area surrounding the plant. The report notes that samples of

treated effluent taken from the plant as well as from the point of discharge into a drain[14] were tested and found to be within the prescribed standards of the UPPCB. In addition to the above, it acknowledges that the groundwater level in the area has declined since 'the last five years' but ascribes the decline to lower rainfall levels and drought in the region.

Table 4B.5 Compliance with conditions specified in CtO by HCCBPL, Mehndiganj

Requirements	*Compliance in Mehndiganj plant; remarks, if any*
General	Copy of CtO issued to HCCBPL on 27 December 2005 received
Limit on discharge for wastewater	600 KLD No data on daily discharge of effluent, based on annual discharge data for 2006 (from January to October) and number of operating days, the daily discharge comes out to be about 169 KLD
Mode of discharge of wastewater	In permitted drain as suggested by the UPPCB
Compliance with discharge standards	Compliance with IS 2488 (four parameters on routine basis and 33 parameters need to be monitored once a year) The parameters in test report enclosed are in compliance
Requirement of sampling and flow measurement	Mentioned Provision of sampling and flow measurement provided at ETP
Interlocking of pollution control devices with process	Not mentioned, however, in case of malfunction, SPCB should be informed
Environment statements	Not mentioned

HCCBPL – Hindustan Coca-Cola Beverage Pvt. Ltd; CtO – Consent to Operate; ETP – effluent treatment plant; SPCB – state pollution control board; UPPCB – Uttar Pradesh Pollution Control Board

Note: The compliance of the plant is based on secondary data provided by CCI: results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

The Coca-Cola Company requirements

In the absence of the siting report, it was difficult to gauge the level of assessment conducted with respect to water resources availability in the region prior to the establishment of the plant. However, compliance with company practices on water extraction, usage, and

[14] Treated effluent is disposed off through a 1.5-km long pipe to a drain situated in village Bhikaripur

wastewater disposal was conducted against a set of requirements and guidelines provided by TCCC.

Water drawal and usage

Table 4B.6 gauges compliance of the bottling unit with water resources management requirements of the Coca-Cola Company.

Table 4B.6 Compliance with TCCC water resource management requirements by HCCBPL, Mehndiganj

Requirements	*Compliance in Mehndiganj plant; remarks, if any*
Environmental due diligence to be conducted prior to siting of the plant	Conducted, EDD report not shared since, as per TCCC, it may contain "sensitive information of both a business and legal nature".
Water availability assessment	Not conducted as a pre-existing bottling plant was acquired by Coca-Cola, India
Initial and periodic water utilization assessments	Carried out as evident in dropping WUR over the years
Implement and maintain a process for water utilization	Process of water balance/audit is maintained, data shared
Establish a continuous improvement process for water utilization	WUR was 7.1 in 2000 decreased to 3.7 in 2006
Define water utilization objectives and goals in annual business plans	Optimization of water utilization per litre of the beverage produced remains the annual objective for which the water resource management group at the plant level works closely with the group at corporate level
Develop and execute internal and external water contingency plans	Various rainwater harvesting initiatives have been undertaken. No new water sources have been tapped as per the information provided by the plant

Note: Based on information provided by TCCC and CCI and site visits by the project team

As stated in Chapter 3, Coca-Cola, India, has certain guidelines on water resources management. These, and their implementation in the HCCBPL, Mehndiganj, are summarized in Table 4B.7.

Table 4B.7 Compliance with TCCC water resource management guidelines by HCCBPL, Mehndiganj

Guideline	*Observation in the Hindustan Coca-Cola Beverages Pvt. Ltd, Mehndiganj*
Self-assessment: water utilization	A plant-level water distribution/balance is maintained and water use is optimized at each level of the process based on in-plant trials and suggestions from the corporate office. As a result, the WUR has declined over the years. A water usage self-assessment is done annually at the plant in TCCC (The Coca-Cola Company) format; the document was shown to TERI by the plant management but a copy of the responses by the plant was not shared by Coca-Cola for reasons of legal and business confidentiality
Self-assessment: water supply	As per the documents received, a safe yield of the water supply source is assessed at the time of establishment of the plant. Quality of raw water is checked on a daily basis for selected parameters at the plant and once in a year by an accredited laboratory. A water supply self-assessment is done annually at the plant in TCCC format; the document was shown to TERI by the plant management but a copy of the responses by the plant was not shared by Coca-Cola company. Yield of the water source at the plant was not checked initially as this was a brownfield plant acquired from M/s Kejriwal Beverages Pvt. Ltd
The data collected during self assessments to be used to build a water conservation plan	Since self-assessment responses were not shared, it is difficult to ascertain how information collated during self-assessments is used to build a water conservation plan.
The establishment of a cross-functional team for water resources management	As intimated during the plant visit, a cross-functional team has been established at Varanasi for water resources management. This includes the Factory Manager and the Quality Assurance Manager apart from other executives; the WRM programme focuses on 4 Rs for water conservation: Reduce; Reuse; Recycle; Recharge. The various initiatives undertaken include technological interventions, e.g. those which treat wastewater such that it can be re-used in applications like gardening and shop-floor cleaning. The plant also has a programme for training employees and creating awareness on water conservation

Note: Based on information provided by TCCC and CCI and site visits by the project team

Wastewater discharge

Coca-Cola corporate policy lays down company standards for effluent disposal, as noted in Chapter 3. The regulatory standards applicable for the Mehndiganj plant are specified in the CtO issued by the UPPCB. The CtO specifies limits for two pollutants.

- Total suspended solids: not to exceed 100 mg/l.
- BOD at 270 °C, three days: not to exceed 30 mg/l.

As per the corporate requirements, the plant needs to get its treated effluent analysed once a year by an accredited laboratory and send the results to the corporate office. Table 4B.8 gives the compliance of the HCCBPL plant, Mehndiganj, with these wastewater requirements.

Table 4B.8 Compliance with TCCC wastewater management requirements by HCCBPL, Mehndiganj

Requirements	*Observations in Mehndiganj plant*
Meet applicable regulatory requirements	Yes (as per documents received; UPPCB officials too did not point to any anomaly)
Maintain an effluent quality that will have no adverse effects on fish or other aquatic biota in receiving waters	A fish tank is being maintained at the plant with wastewater treated at the facility's ETP
Maintain and operate treatment facilities in an efficient manner	Yes, as per the documents received
Compliance with wastewater quality requirements developed by TCCC; plant to get its treated effluent analysed annually by an accredited laboratory and send the results to the corporate office	Yes; as per the documents received
A detailed drainage plan of all water and wastewater streams in the facility	Yes, separate plans exist; as per the documents received
Separate wastewater streams for process wastewater, sanitary wastewater, cooling water, and storm water	Yes, Sewage discharged in septic tanks, separate line for storm water and cooling and process wastewater taken to ETP
Prevent the pollution (of) from water and wastewater	Adequate measures provided
Minimize the volume, strength, and hazardous nature of wastewater	No recycling in place at present;
Treatment of process water such that it is	
compliant with TCCC analytical standards compliant with government effluent discharge standards conducive to the long-term survival of fish in the treated effluent	Yes, as per the information provided by HCCBPL, Mehndiganj Yes, as per the information provided by HCCBPL, Mehndiganj Yes, as per the information provided by HCCBPL, Mehndiganj
Sanitary wastewater to be discharged to a sewer connected or a sewage treatment plant	Yes, plant in compliance. Septic tank arrangement at site
Treatment of storm water according to government regulations if applicable; else prevent the pollution of water and wastewater streams due to the run-off	Yes, separate management of stormwater water through dedicated drains.
Non-contact cooling water may be discharged into the local environment unless otherwise dictated by local laws or regulations	Not Applicable

Requirements	*Observations in Mehndiganj plant*
If treated wastewater discharge is through infiltration, prior to infiltration the wastewater must meet TCCC requirements and local regulations	Not Applicable
If treated wastewater is disposed through land application, then	
Groundwater must be monitored quarterly within the application area, as well as up- and down gradient of the application area	Not Applicable
The soil's carrying capacity should not be exceeded such that there is surface run-off	Not Applicable; No monitoring done at present by the plant
water intended for spray fields, should not be discharged into nearby water bodies; nor should excess run-off from spray fields be allowed to enter nearby water bodies	Not Applicable

HCCBPL – Hindustan Coca-Cola Beverage Pvt. Ltd; TCCC – The Coca-Cola Company; UPPCB – Uttar Pradesh Pollution Board; ETP – effluent treatment plant; STP – sewerage treatment plant

Note: The compliance of the plant is based on secondary data provided by CCI: results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

According to the documents received, HCCBPL, Mehndiganj attained the E1 level of compliance in 2007 under the TCCC audit system (refer Chapter 3). Apart from the above, it has also received the ISO 9001 certification for quality in 2003, and the ISO 14001 certification for environmental management standards in 2004.

Water-related corporate social responsibility initiatives

As reported by the representatives of HCCBPL, Mehndiganj, the plant adopted a strategy to address its CSR agenda in 2003. This strategy included the following.

- Addressing issues in three key areas: water (environment), health, and education
- Engaging the local community, senior citizens, women, and youth
- Thinking local and consistent in CSR initiatives

According to the plant management, the 'recharge' component of the 4 R policy (reduce, recycle, reuse, and recharge) with respect to water resources was addressed through community-based initiatives. In this context, new rainwater-harvesting projects were being installed in the campuses of educational institutes with the objective of creating awareness amongst the younger generation and farming communities on the need to conserve and recharge groundwater. Other water-based initiatives reported by the plant include five rainwater-harvesting projects in the city, which is claimed to have the potential to recharge 3000 cubic metres of groundwater annually during the normal monsoons; and three rooftop rain-harvesting projects under the

'Water Recharge Initiatives' launched on World Water Day on 22 March 2007 by Coca-Cola, India, which cover 5500 m² of roof area, reportedly have the capacity to create annual groundwater recharge potential of over 4900 cubic metres. As per plant representatives, the State Ground Water Board has been actively supporting the plant in the project. Table 4B.9 depicts the water-related CSR initiatives of HCCBPL, Mehndiganj, since 2003. The table is based on information provided by the plant during a site visit by the study team.

Table 4B.9 Water-based community initiatives by HCCBPL, Mehndiganj, since 2003

Activity	*2003*	*2004*	*2005*	*2006*	*Total*
Handpump (drinking water)	2	9	6	10	27
Number of Rainwater harvesting structures	1	–	2	6	9
Recharge potential (cubic metres per annum)	5049	–	2090	5857	12 996

Source PowerPoint presentation by HCCBPL, Varanasi during plant visit by TERI

In addition to the above, as noted by CCI, the plant has also initiated a pilot drip irrigation project at Kallipur to create water conservation awareness amongst the farming community; the repairing and cleaning of a well, and the cleaning and deepening of a pond in two villages on the request of their Gram Pradhans (village headmen); and adopted the Dashaswmegh Ghat (river bank) of the Ganga for cleaning in association with an NGO (the Ganga Seva Nidhi) in the city of Varanasi.

Stakeholder perceptions on corporate social responsibility

All groups of participants, including key persons, reported that the Coca-Cola plant was undertaking certain activities for the benefit of the local populations. The commonly reported activities include installing handpumps, conducting health camps, distributing free medicines, constructing a school wall, and distributing blankets, utensils, and clothes to poor and/or old persons. While all participants reported an awareness of these activities, those from the villages of Mehndiganj, Bhikaripur, and Kachnar mainly reported being the beneficiaries of these initiatives. No one from the village Karnadadi reported any activity taken up in, or for their village. Some farmers from the village Khajuri reported the installation of a handpump in their village. Yet, some panchayat members, women, and farmers reported these activities to be one-time activities and not a continuous initiative. Some women from Mehndiganj felt that only those who participated in protests were the beneficiaries of these initiatives. However, farmers pointed out that the choice of activities was such that they did not contribute to any significant development of the villages in question.

Panchayat members and one of the key persons explained the process adopted for undertaking CSR initiatives by HCCBPL, Mehndiganj. According to them, representatives from the plant approached the Sarpanch with a proposal to carry out certain activities in the village. If the Sarpanch wanted the activity to be carried out, he/she wrote a request to HCCBPL, Mehndiganj, asking for the activity to be conducted, based on which the chosen initiative was executed. The representatives of the HCCBPL, Mehndiganj, also reported this process. Additionally, one of the key persons indicated annually appraising the plant staff about the needs of the community, and guiding them about the kind of activities HCCBPL, Mehndiganj should be undertaking.

Technical assessment

Regional assessment of water quality

Water quality assessment for the selected villages has been undertaken with an aim to develop an insight into the quality of groundwater that is sourced and consumed by the HCCBPL, Mehndiganj, and the impact, if any, of the agricultural management practices such as the use of fertilizers and pesticides on the quality of groundwater. The assessment here does not try to relate the regional groundwater quality to the operations of the Coca-Cola plant.

Selection of sampling location

Groundwater sampling was done in the five selected villages. The justification for selection of villages has been discussed in Chapter 2 on approach and methodology.

A total of 11 sampling locations were selected for sample collection and analysis. Table 4B.10 gives the description of sampling location and Figure 4B.18 gives the location of these sampling points on the watershed map of the area.

Table 4B.10 Sampling locations

Village	*Location*	*Source*
(Chhoti) Khajuri	In front of Prathmik Vidyalaya, (Sankul Kachnar)	Handpump
(Badi) Khajuri	Mr. Dashrath Singh's House (backside), (P O Mirja Murad)	Bore well
Mehndiganj	Gram Panchayat Bhawan, Near Shiv Mandir	Handpump
Mehndiganj	In front of Mr. Ramdhari Gaud's House, Mehndiganj Madai	Handpump
Kachnar	In front of Mr. Pappu's House, S/o Sukhia devi (kurmi), Opp. Anganwadi, (Rajatalab)	Handpump
Kachnar	Inside campus of Primary Health Centre, (Rajatalab)	Handpump
Kachnar	Mr. Bacchalal (Babbul), Near Swastha Kendra (Government Hospital), (Rajatalab)	Bore well

Bhikaripur	Rajatalab Peyajal Yojana	Over head tank
Bhikaripur	Opp. Mr. Millu's house, Harijan Basti	Handpump
Karnadadi	Bauli padh, (in front of Mr. Sobhnath's house)	Handpump
Karnadadi	At backside of Mr. Sobhnath's house	Bore well

The samples were collected from the above locations on the following dates.

First round	6 February 2007 and 7 February 2007
Second round	8 May 2007 to 9 May 2007
Third round	29 May 2007 to 30 May 2007

These samples were collected, preserved, and transported to the designated laboratories as per the set protocols, the description of which is discussed in the chapter on approach and methodology.

Test results

Summarized results of the site-specific parameters that have exceeded the prescribed standards are presented in Figures 4B.19 to 4B.27.

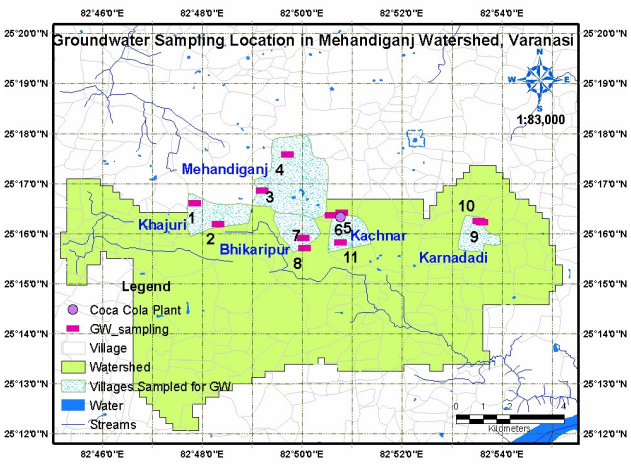


Figure 4B.18 Location of sampling points

The regional groundwater analysis results show that of the various tested parameters and as compared to the drinking water standard BIS (Bureau of Indian Standards): 10500, the total alkalinity exceeds the standard in all the groundwater samples in all the monitored locations in all the villages. This could be of a natural origin. Parameters such as turbidity, iron, lead, faecal coliform, and MPN coliform have also been found in all the villages in 25–35 percent of the all the samples collected.
Thirteen percent of the total samples collected from all the villages showed the presence of *E. coli* except for the extreme downstream village Karnadadi (D 2). In addition to above parameters, parameters in water samples from immediate downstream village namely, Kachnar (D 1),

showed exceedence of additional parameters such as manganese, calcium, TDS, lead, nitrate, and chloride. Of these, nitrate, and chloride were not found in any of the water samples of other villages. Similarly, water samples in another immediate upstream village Bhikaripur (U 1) also showed exceedance for additional parameters such as fluorides, TDS, and calcium. Of these, fluorides were not found in any of the water samples obtained from other villages. Likewise, water samples from Mehndiganj (M 1), village immediate close to the plant, showed exceedance of manganese and barium (as per WHO guidelines).

Overall analysis shows that water samples in villages close to the plant, namely, Kachnar (D 1) and Bhikaripur, (U 1) chapter maximum number of exceeding parameters followed by Mehndiganj (M 1). This study does not investigate into the cause-effect relationships and whether HCCBPL plant is responsible for poor water quality. There is a need to carry out further investigation to determine the causes behind the presence of these additional parameters, which were not found in extreme upstream and downstream villages, namely Khajuri and Karnadadi, respectively. Pesticides were not found in the groundwater of the monitored region. Table 4B.11 presents non-conformity of water samples to WHO (World Health Organization) guidelines and IS 10500 standard for drinking water.

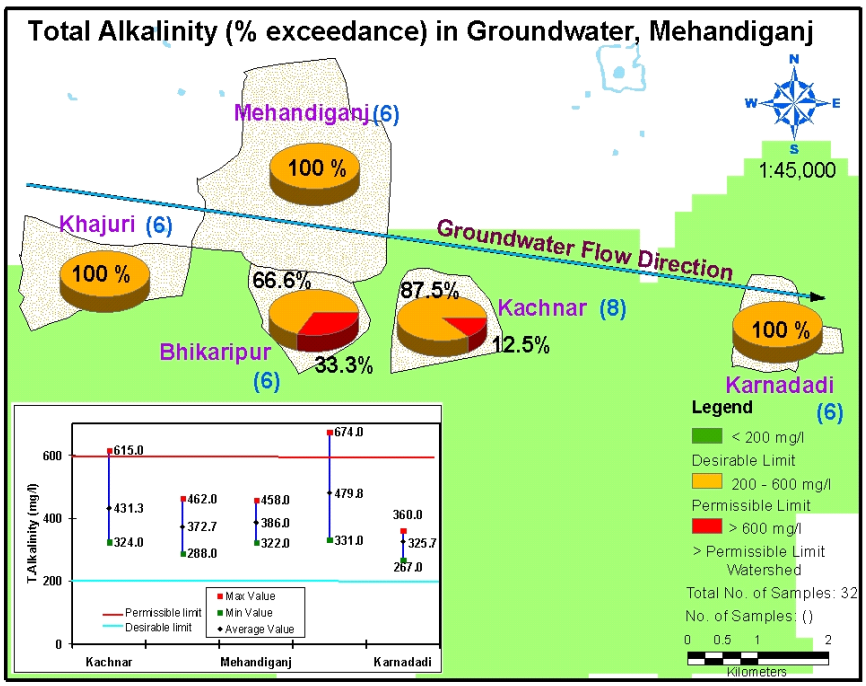


Figure 4B.19 Percent samples in the villages exceeding the desired/maximum permissible limits for alkalinity

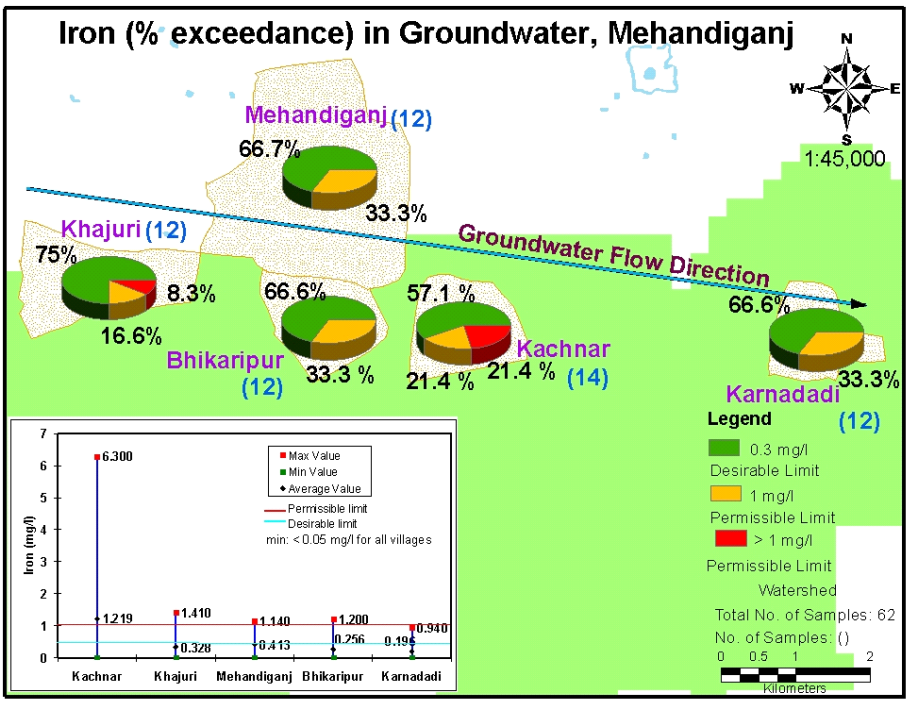


Figure 4B.20 Percent samples in the villages exceeding the limits for total dissolved solid

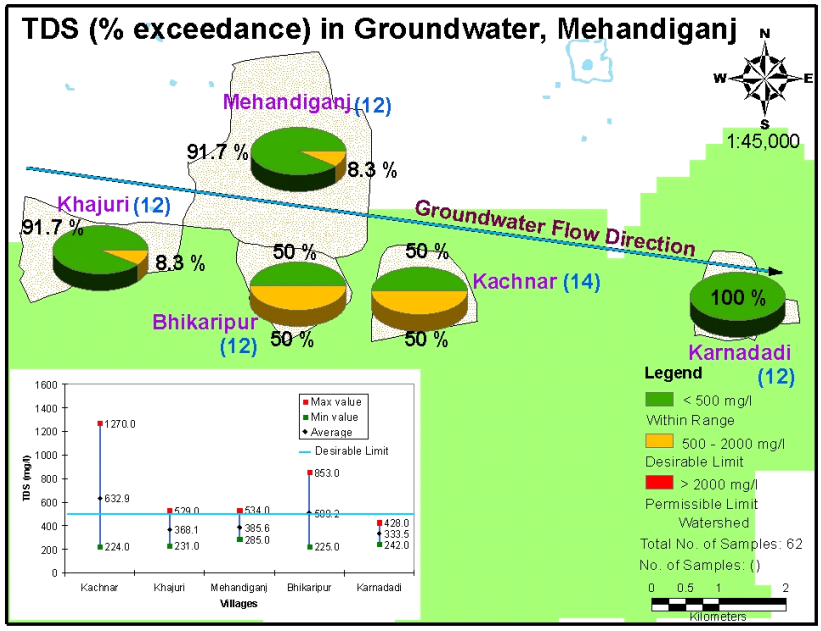


Figure 4B.21 Percent samples in villages exceeding the desired/maximum permissible limits for iron

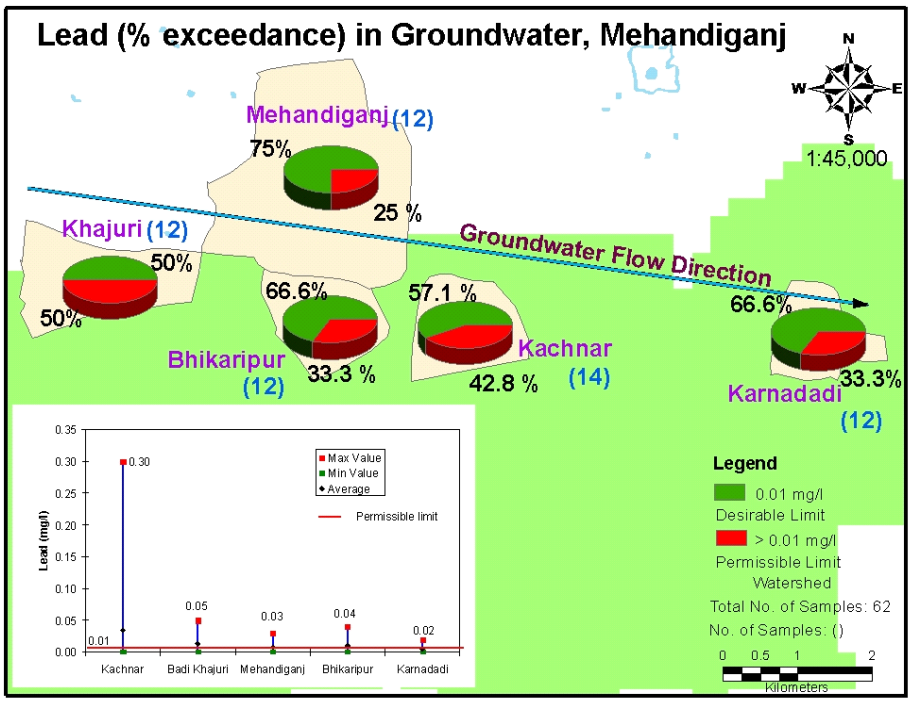


Figure 4B.22 Percent samples in villages exceeding the desired /maximum permissible limits for lead

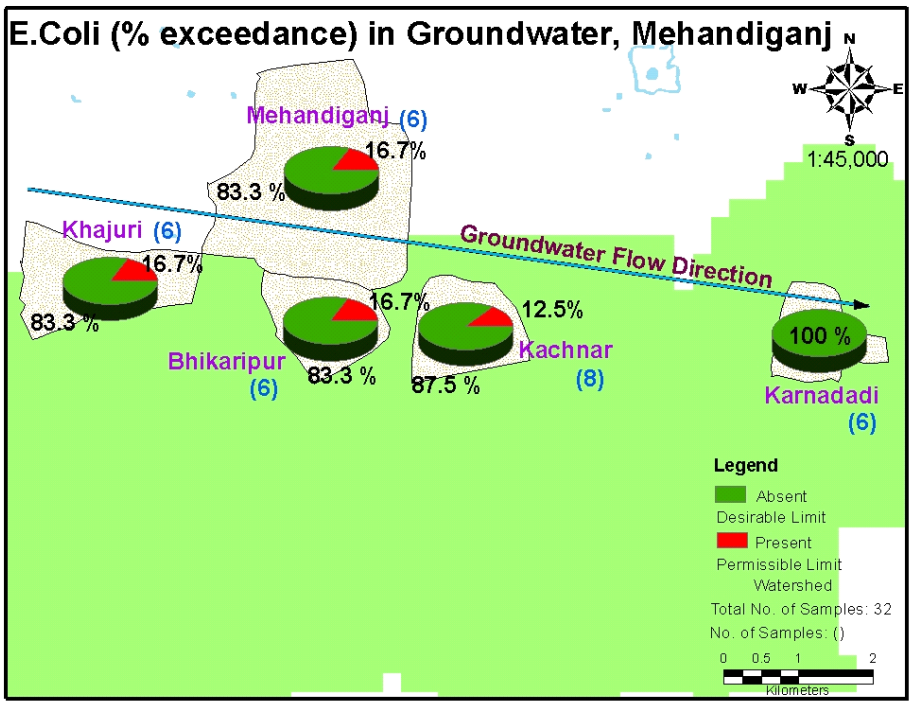


Figure 4B.23 Percent samples in villages exceeding the desired/maximum permissible limits for *Escherichia coli*

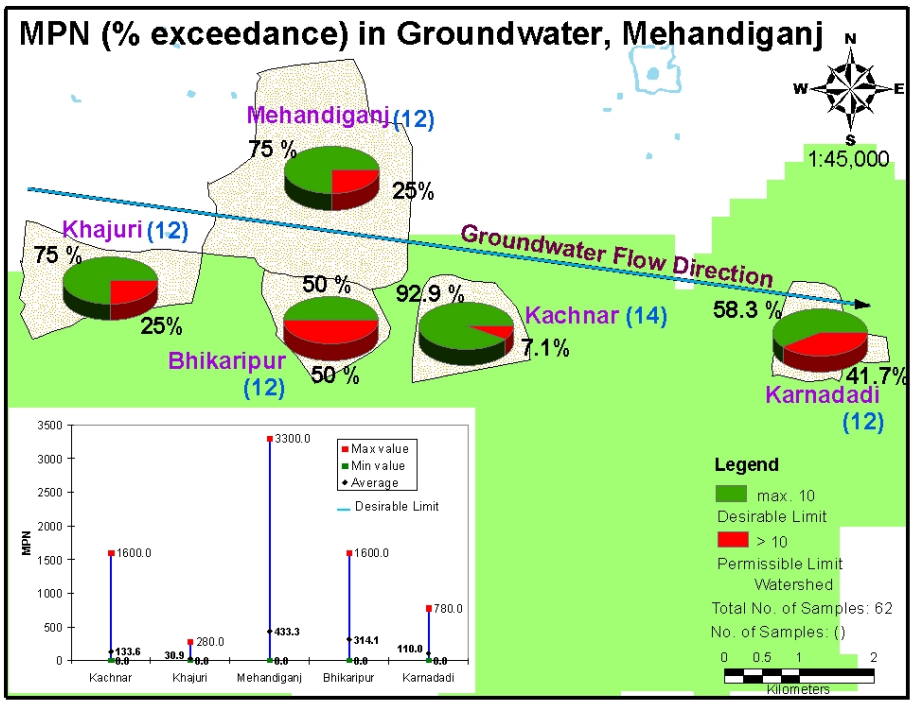


Figure 4B.24 Percent samples in villages exceeding the desired/maximum permissible limits for total coliforms (most probable number)

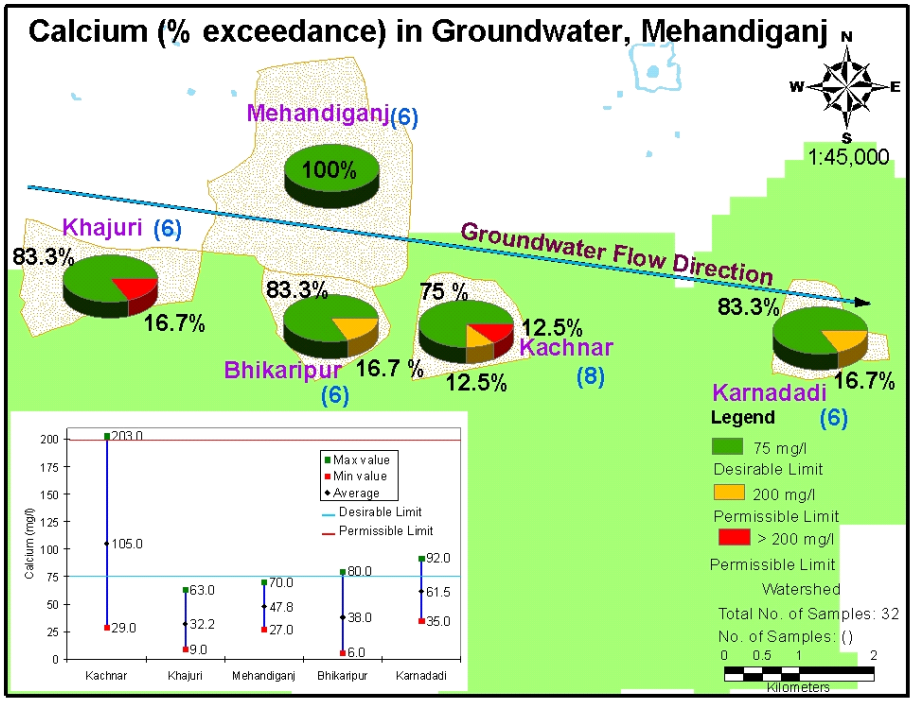


Figure 4B.25 Percent samples in villages exceeding the desired/maximum permissible limits for faecal coliforms

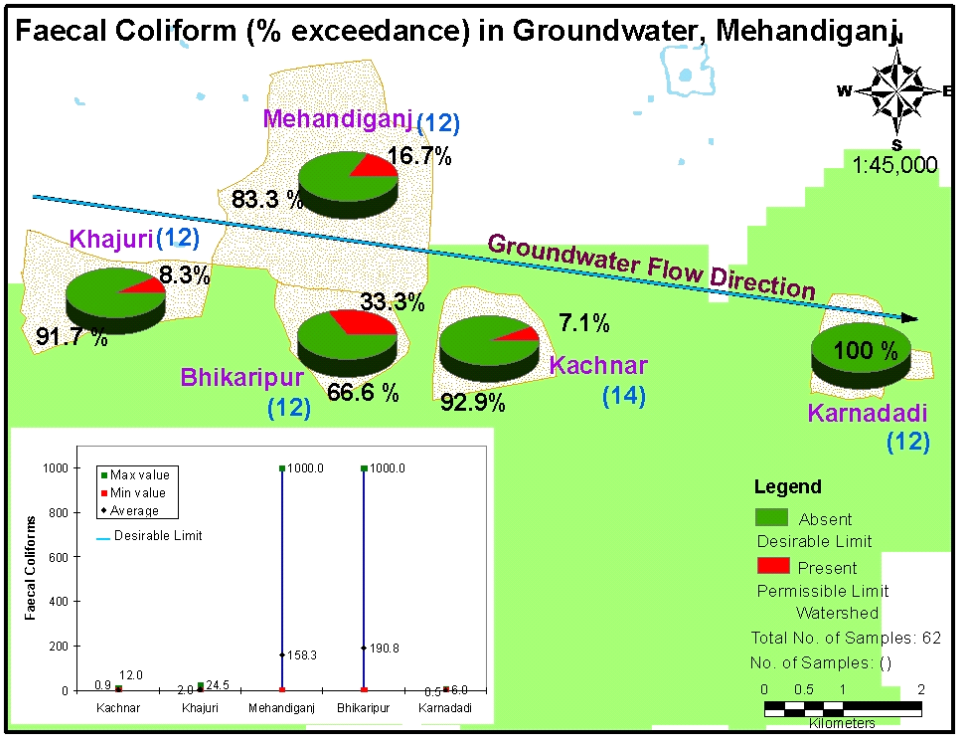


Figure 4B.26 Percent samples in villages exceeding the desired/maximum permissible limits for calcium

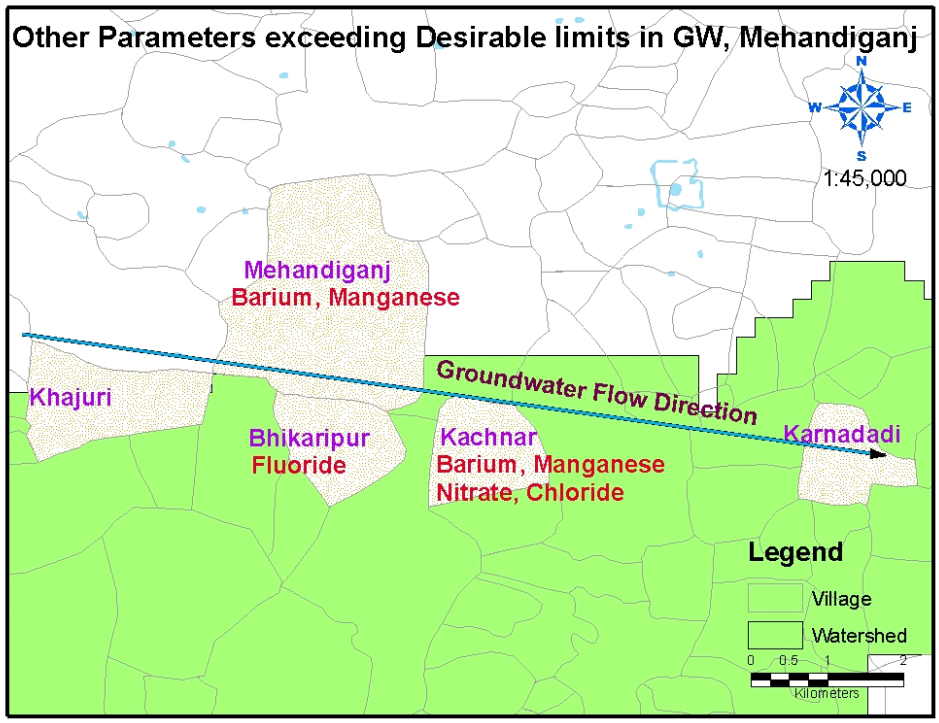


Figure 4B.27 Other parameters marginally exceeding the desired/maximum permissible limits in the watershed

Table 4B.11 Non-conforming test parameters

WHO guidelines	*BIS 10500: 1991 drinking water specifications*
Lead and barium (in addition to non-conforming parameters identified under IS 10500)	*Physiochemical* Total dissolved solid, total alkalinity, fluoride, chloride, turbidity, nitrate, and calcium *Heavy metals* Manganese, iron, and lead *Microbiological* Maximum probable number coliform, *Escherichia coli*, and faecal coliform

Water with the quality mentioned in Table 4B.11 needs to be treated for potable consumption and is not safe for drinking without treatment in the villages.

Plant-level assessment of quality and practice

The Mehndiganj plant sources its water from two bore wells, each of 100 m depth. The water is pumped to a raw water storage tank where it is chlorinated and further sent to different sections and processes for further treatment and usage in the beverage production, domestic use, and the use in the boilers and cooling towers. Wastewater discharges from the production line, boilers and cooling towers, and domestic usages are treated in an ETP (effluent treatment plant, except for domestic sewage), wherefrom it is discharged outside into a drain as well as partly used for green belt maintenance purposes.

Water quality

Table 4B.12 gives the description of points of sample collection and the sampling details.

Table 4B.12 Details of the in situ sampling locations

Sample source	*Location of sampling*	*Quantity of sample*	*Type of sampling*	*Number of samples (from each location in each round)*	*Protocol/ guidelines for sampling & testing*
Raw intake water	Raw water inlet (to treated water)	20 litres	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
	Raw water tank outlet (to soft water)	20 litres	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
Wastewater/ effluent	ETP inlet (before grit chamber)	20 litres	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
	ETP outlet (after clarifier)	20 litres	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
Process water	Plant process ▪ To RGB bottling line (after 5 micron) ▪ To syrup line (after 5 micron) ▪ After soft water tank (after chlorination)	20 litres	Composite (1 hourly for 22 hours)	3	APHA 20th ed. 1998/ IS 3025

ETP – effluent treatment plant; RGB – refillable glass bottle; APHA – American Public Health Association

Seven in situ sampling locations were selected for water quality monitoring. Figure 4B.28 depicts the sampling locations on the process flow diagram of the plant.

The results observed have been compared, for compliance, to the relevant guidelines/ limits/requirements as follows.

- For wastewater discharge: Relevant local regulation by the UPSPCB, CPCB guidelines, and TCCC internal quality guidelines
- For raw water: Relevant national standard for drinking water (BIS 10500: 1991) and an international guideline (WHO guidelines for drinking water)
- For process water: Relevant national standard for drinking water (BIS 10500: 1991, IS 14543: 2004), an international guideline (WHO guidelines for drinking water), and TCCC internal specification for treated water

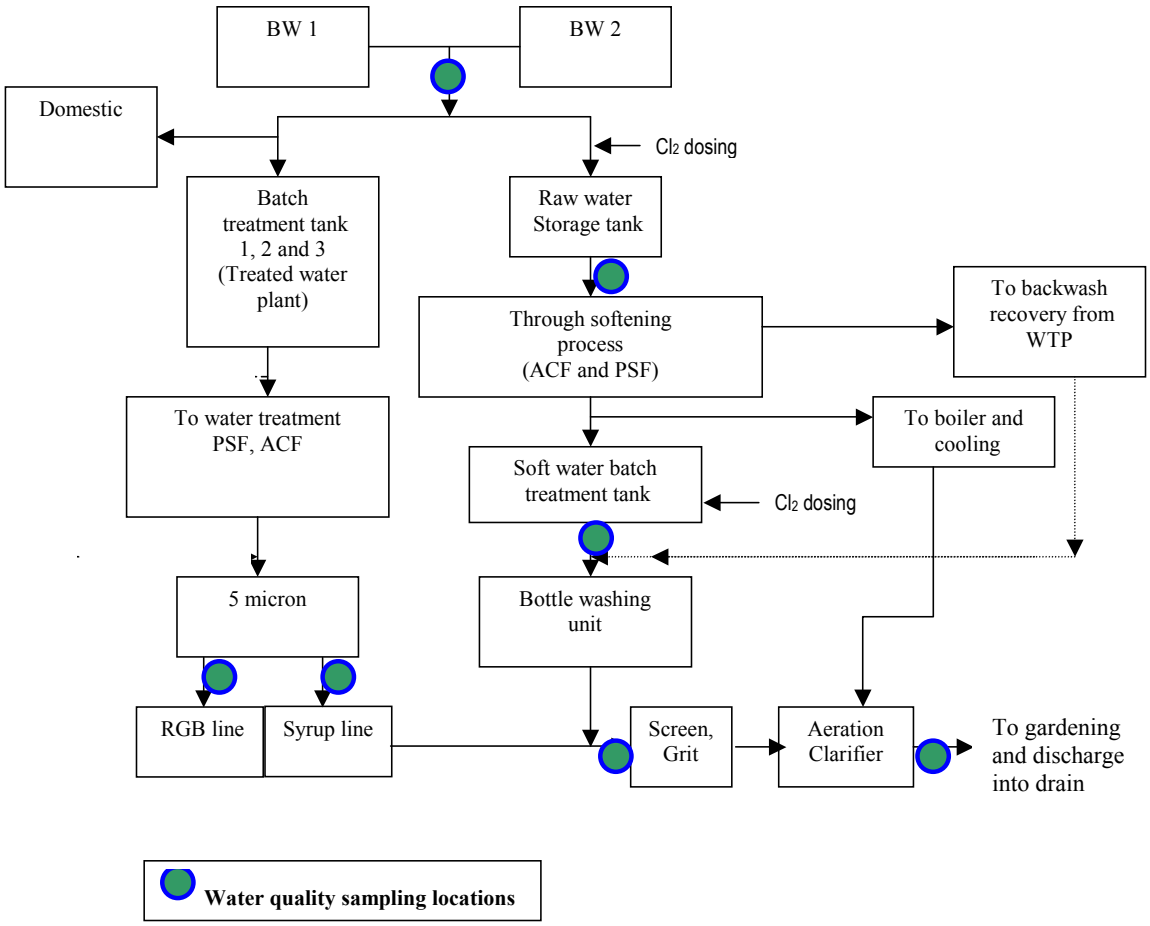


Figure 4B.28 Hindustan Coca-Cola Beverage Pvt. Ltd Mehndiganj plant process flow diagram and sampling locations

Source Developed from data obtained from the HCCBPL plant, Mehndiganj

Sample collection, preservation, and transportation

For all the selected locations, composite sampling was carried out from 6 March 2007 to 7 March 2007 during the first round; 8 May 2007 to 8 May 2007 during the second round; and 29 May 2007 to 30 May 2007 during the third round. Protocols for sample collection, preservation, and transportation to designated laboratories have been discussed in Chapter 2 on approach and methodology.

Test results

The in situ water quality assessment shows that total alkalinity exceeded the desired limits of drinking water specification (BIS: 10500) in the raw water. This is in agreement with the ex situ groundwater sample results that also showed exceedance for alkalinity in all the samples for all the villages.

Alkalinity was found well within the desired limit in the process water (that is, after treatment) that is used for the beverage production (for example, 'after 5 μ to RGB line' and 'after 5 μ to syrup line'). One parameter, namely, nitrite, showed one-time marginal exceedance compared to the guidelines of packaged drinking water (IS 14543:2004) in the process water line after 5 μ filter in one of the sampling rounds. Rest of the parameters including pesticides were found well below the specified standards.

The quality of the ETP discharge water indicates effective treatment for all of the monitored parameters, and was found to be within the specified CPCB limits for land disposal for irrigation.

As compared to TCCC's own wastewater quality guidelines for discharge of treated wastwater into natural water bodies, parameters like TDS, total suspended solids, TKN (total kjeldahl nitrogen), and anionic surfactants were found to exceed the acceptable limit. Of these total suspended solid, TDS, and anionic surfactants showed one-time exceedances.

Other than the ones mentioned above, most of the monitored parameters were found to meet the required CPCB limits for discharge to inland surface water, local UPPCB guideline values, and TCCC's own wastewater quality guidelines. Bioassay test results, for estimating fish survival rate in treated effluent, were found to be conforming to the requirements prescribed by the CPCB.

Pesticides were not detected in any of the monitored in-situ sources for all the rounds at HCCBPL, Mehndiganj.

Plant-level water audit

Water-auditing exercise at the HCCBPL, Mehndiganj, Varanasi, involved an examination of water flows at inlet and outlet of unit processes with the following objectives.

- Establish water balance of the facility for the monitoring period
- Assess ETP/WTP (water treatment plant) inlet and discharge

Details of plant operations

The plant operations with respect to water balance can be divided into four broad segments, namely, RW (raw water), PW (process water), SW (soft water), and effluent. Figure 4B.29 shows the schematic diagram of WTP and locations of meters for three rounds of auditing.

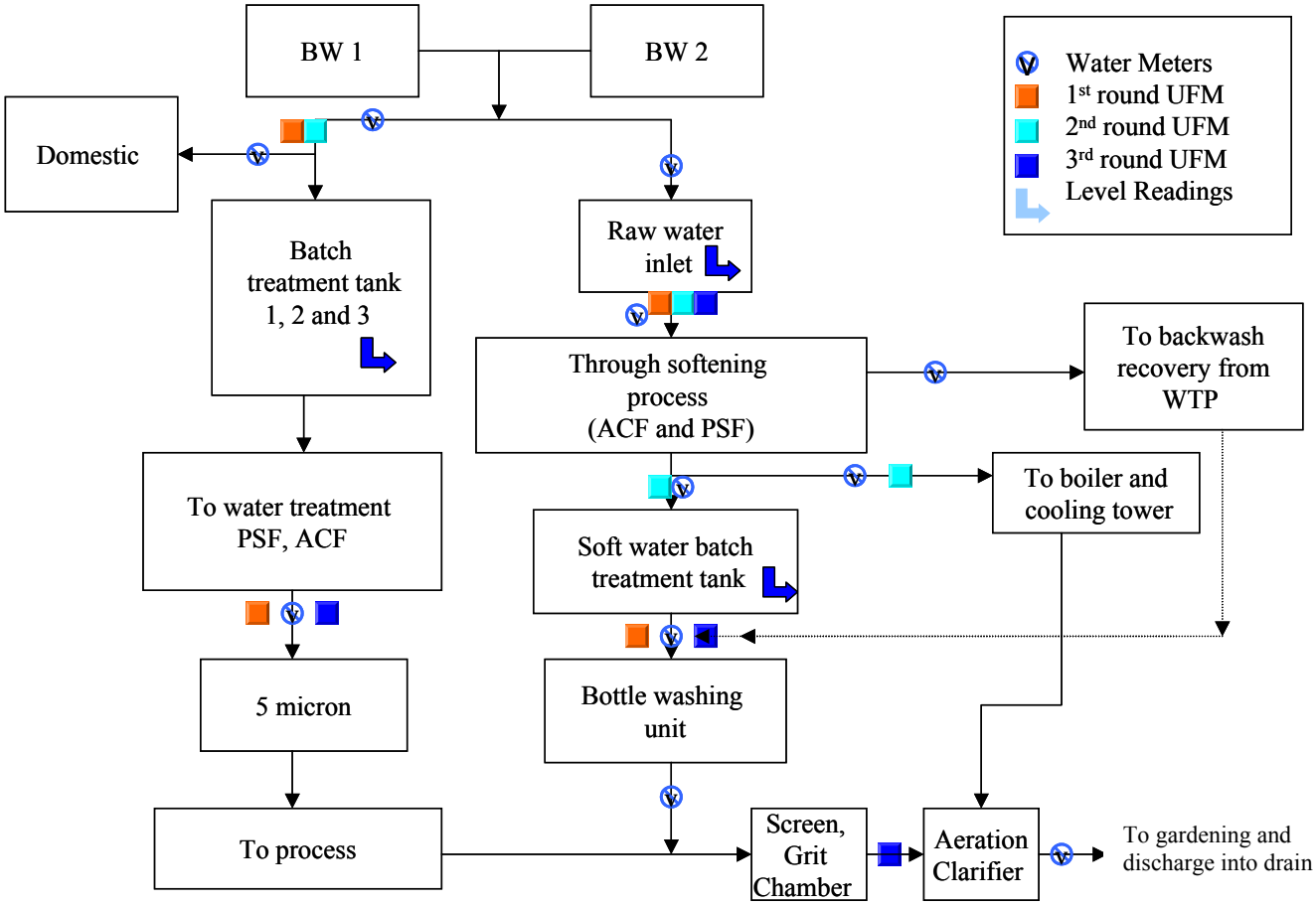


Figure 4B.29 Schematic diagram of the plant showing water meter locations

Water balance

Water balance of individual storage unit for the entire plant was carried out to assess the inflow and outflow of water in the plant and to estimate water usage in process and soft water. Table 4B.13 gives water balance compiled for RW storage tank for three rounds of water auditing.

Table 4B.13 Raw water balance (for soft water) during three rounds of water auditing

Parameter	*First round*	*Second round*	*Third round*
Inlet			
Raw water intake for SW (m^3)	67.8	107.65	106.15
Outlet			
Soft water (m^3)	116	137.9	112.2
Storage			
Measured (inlet–outlet in m^3)[a]	–48.2	–30.25	–6.05
Observed (m^3)[b]	No level gauge	–35.0	–8.5
Percent error in balance (unaccounted for water loses)	Not applicable	4.42	2.31
Percent efficiency with respect to inlet	Not applicable	95.58	97.69

a Measured change in storage is change calculated based on the meter readings at inlet and outlet by applying continuity equation.
b Observed change in storage is storage change based on the difference of tanks water level.
Note Negative tank storage shows net outflow from the tank, that is, reduction in water storage level of tank

The plant water balance derived from the audit shows that the components of the continuity equation (that is, inlet, outlet, and change in storages) are in conformation with each other. The percentage of agreement between observed change (from level indicators installed by the plant) and measured change (from our digital flow meter results) in storage with respect to inflow and outflow is in the range of approximately 95–98 percent.

In addition to water balance, water usages for different unit processes were also estimated. Table 4B.14 presents the results of water usage estimations for three rounds of water auditing.

Table 4B.14 Volume of water used/effluent generated used in various units during three rounds of water auditing

Water use	*First round*	*Second round*	*Third round*
Date of monitoring	6–7 March 2007	8–9 May 2007	29–30 May 2007
Monitoring hours	23	21	22.5
Total inlet (m^3)	209.6	265.02	276.86
Process water (m^3)	144.07	118.25	121.05
Soft water (m^3)	116	121.36	97.6
Domestic water (m^3)	10.37	21.15	24.37
ETP outlet (for gardening) (m^3)	173	No flow	29.5
Production (m^3)	141.53	107.74	109.82
Production	200 ml RGB	200 ml RGB	200 ml RGB

ETP – effluent treatment plant; RGB – refillable glass bottle

The inlet and outlet of ETP could not be linked dynamically as the storage in ETP is very high and pumping is also done at intermittent stages. As a result of this non-continuity in flows, it is not possible to measure pollution load discharged from ETP in relation to the inflow for that day.

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CHAPTER 4C Nabipur

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CHAPTER 4C Nabipur

Executive summary

Franchisee plant is located in a district where groundwater sources are declared to be overexploited by Central Groundwater Board

The Nabipur plant, KBPL (Kandhari Beverages Pvt. Ltd), is located in block Sirhind, district Fatehgarh Sahib, in the state of Punjab in North India, and is one of the franchisee plants of CCI (Coca-Cola India). The plant sources its raw water from deep groundwater aquifers. It has been reported by the CGWB (Central Ground Water Board) that the groundwater table in the block has been steadily declining over the years due to overexploitation of water. This is mainly attributable to water for agriculture purposes, and low rainfall during the period 1998–2003.

Although groundwater is reported as overexploited, water is still available 8–12 m below ground level

During the period 1985–98, the water table in the study area was in the range of 5–8 m below the ground level. Since 1999, the area experienced a decline in water table; water table has dropped by about 3–4 m in the past six years. This decline has been attributed to the rise in water demands from various sectors as well as low rainfall experienced by the area in the period 1998–2003.

Agriculture is the mainstay of the economy

The study region is mostly rural and its economy is mainly dependent on agriculture, although there is a gradual shift to non-agricultural activities. The average cropping intensity of Sirhind for the past eight years was reported to be as high as 1.82, with rice and wheat as the principal crops. With 90 percent of its area under cultivation, of which 100 percent is irrigated, the average yield of paddy and wheat in Fatehgarh Sahib is always higher than that of the rest of the state. The falling groundwater tables have resulted in a shift towards the use of greater number of electric pump sets as compared to diesel ones.

Stakeholder perceptions on water

Perception Those interviewed from the communities largely attributed the decline in water table to paddy cultivation and insufficient rains. However, some groups also indicated that the

water extraction by KBPL was one of the contributing factors for the decline in water table. Impacts of the depleting water resources were felt more on domestic uses and, therefore, on women. Women reported that they spend more time in fetching water from varied and distant sources. In all group discussions, participants reported that the water table had been declining over several years but the problem had become acute in the past four to five years. They reported that during this period, the water table had fallen sharply. The Coca-Cola representatives too pointed out that declining water table levels were of concern to them.

Assessment Land is mainly used for agriculture in the entire block. Rice and wheat are the principal crops grown in the study area. The average cropping intensity in the block for the past eight years was reported to be 1.82, which indicates a close to double cropping of the cultivable land. Rotational rice–wheat cropping pattern and high cropping intensity have put pressure on the groundwater resources of the area. The pressure has been further compounded by scanty rainfall in the area during 1999–2003. Although all potential causes of the drop in groundwater have not been assessed, it is clear that agriculture has a significant impact in this area

Perception Perceptions about water quality varied among the respondents of not only different villages but also same villages. Concerns were related to poor taste of water that had a marked yellowish colour. A common observation made by the respondents of all the four study villages namely, Saidpura, Nabipur, Longo Marji, and Kharodi, was that the water from the shallower bore wells (hand pumps) was of poor quality whereas the water from very deep bore wells was of good quality. There were no reports of effluent discharge from the Coca-Cola factory.

Assessment Laboratory analysis of regional groundwater samples shows that the water quality parameters of groundwater (both for hand pumps and bore wells) such as total alkalinity and TDS (total dissolved solid) along with heavy metals (manganese and aluminium) exceeded the standards set by BIS (Bureau of Indian Standards) 10500 in most of the monitored six villages around the plant. Apart from this, fluoride, calcium, iron, and selenium in few water samples were also found to exceed the BIS 10500 limits. Presence of TDS, alkalinity, and iron might have led to the perception related to poor taste and marked yellowish colour in water.

Plant is in compliance with regulatory requirements

In the absence of laws pertaining to groundwater extraction in Punjab, the Coca-Cola plant is required to be compliant with the conditions specified in the CtE (Consent to Establish) and the renewable CtO (Consent to Operate) issued under the Water (Prevention and Control of Pollution) Act in 1974, which focuses primarily on wastewater. The current CtO was issued by the PPCB (Punjab Pollution Control Board) on 13 September 2006, and is valid until 31 December 2009.

The plant has been placed in the red category, indicating high potential pollution load. However, no norms with respect to specific parameters for treated effluent have been mentioned in the CtO. It only states that the plant is required to fulfil the norms specified for similar industries in the state.

The Coca-Cola Company siting requirements for franchisee-owned bottling operations unclear

Siting exercises are not required by the regulatory framework in designated industrial areas in the state of Punjab. However, a TCCC (The Coca-Cola Company) environmental due diligence exercise, a company requirement applicable to both COBOs (company owned bottling operations) and FOBOs (franchisee-owned bottling operations) prior to the establishment of a plant, was also not conducted. As reported by the plant management, this was not required for a franchisee operation. In this context, the set of EDD (environmental due diligence) requirements shared by the company were issued in November 2004, and amended in June 2006, while construction of the plant was started in 2000.

Process water quality satisfactory; wastewater treatment needs improvement

Process water, after water treatment, was found to be fulfilling norms for all of the parameters except for nitrite that marginally exceeded the norms. Pesticides were not found in the process water samples. The quality of the ETP (effluent treatment plant) outlet water indicates that effective treatment is being carried out for all the parameters except for one sample that failed the bioassay test (for testing fish survival) when compared with the CPCB (Central Pollution Control Board) limits for land discharge for irrigation.

As compared to TCCC's own treated wastewater quality standards, parameters such as BOD, TKN (total Kjeldahl nitrogen), TSS, and iron were found to exceed the prescribed limits.

Corporate social responsibility unstructured but evolving

Most CSR (corporate social responsibility) initiatives have been need-based and responsive to community needs. CSR initiatives are under the charge of the Director General and an assistant manager who also has other responsibilities, for example, water resource management systems, in the plant. Since water scarcity has not been an issue, there was no emphasis on water-related initiatives. The community too did not express any need for water-related interventions during the assessment. The plant now plans to put in place some water-harvesting structures.

Site profile

The Nabipur plant, KBPL (Kandhari Beverages Pvt. Ltd) is located in block Sirhind, district Fatehgarh Sahib, in the north of India in the state of Punjab. This is one of the franchisee plants of CCI (Coca-Cola India). The plant sources its raw water from deep groundwater aquifers. The area for the study was delineated with 1: 50 000 scale base map (toposheet no. 53B/6 and 53B/10) of Survey of India. Figure 4C.1 shows the delineated watershed and the sub-basins.

Geographic

The delineated watershed comprises an area of approximately 76 km² and lies between longitudes 76° 20' E to 76° 28' E and latitudes 30° 30' N to 30° 37' (refer Figure 4C.1). The area is drained by a network of distributaries and minor canals originating from the Bhakra main line canal. I L distributary originating from the Bhakra main canal lies in the north and north-east of the watershed. Sangatpura and Ritkheri minors originate from the I L distributary and lie towards the west and the east of the watershed, respectively. The watershed is a plain agricultural area and lies in the elevation range of 258–268 m amsl (metres above the mean sea level), as shown by the hypsometric curve in Figure 4C.2. The mean elevation is 261 m amsl and standard deviation is 2.6 m.

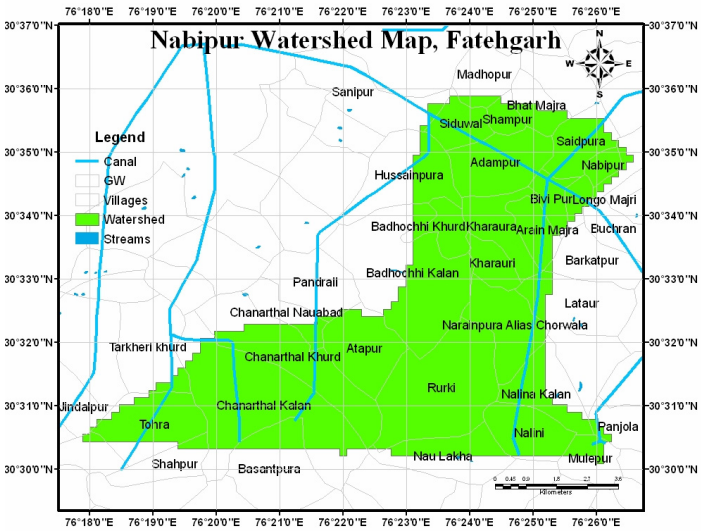
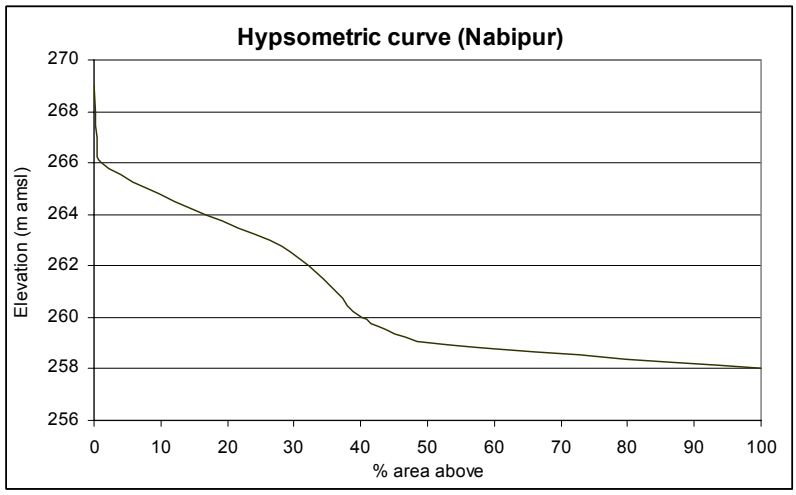


Figure 4C.1 Topography and drainage map of Nabipur watershed

Figure 4C.2 Hypsometric curve of Nabipur watershed



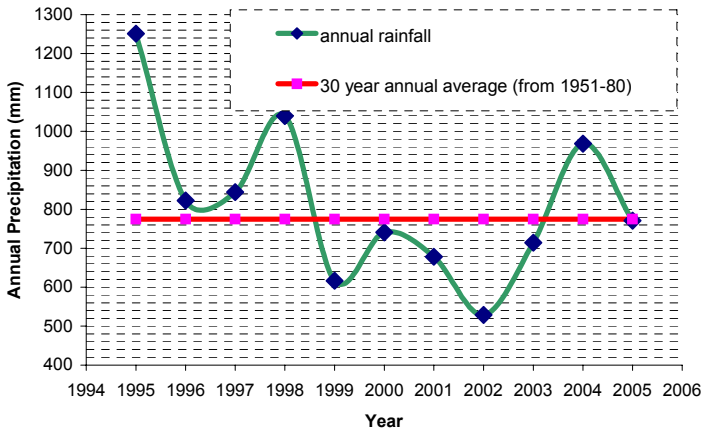
Hydrometeorology

Hydrometeorological details of the watershed have been derived from the data obtained from the Patiala Observatory and climatological tables for the period 1951–80. The observatory is situated at latitude 30° 20' N and longitude 76° 28' E, at an elevation of 251 m amsl.

Rainfall

The analysis indicates that the area witnesses an average annual rainfall of about 775 mm. More than 85% of the rainfall occurs during the monsoons in the months of July, August, and early September. The period from mid-September to November constitutes the post-monsoon period. Figure 4C.3 depicts the annual rainfall recorded by the observatory for the period 1994–2005. The figure shows that the rainfall was below normal during the period 1998–2003.

Figure 4C.3 Annual and monthly rainfall patterns in Nabipur watershed



Temperature

Nabipur experiences sub-tropical continental monsoon climate, with high variation between summer and winter temperatures. The average of daily maximum temperatures in a year is 30.8 °C, going as high as 39.4 °C in June. Similarly, the average of daily minimum temperatures is approximately 17.4 °C, going as low as 6.5 °C in January. Figure 4C.4 shows mean monthly minimum and maximum temperature of Nabipur.

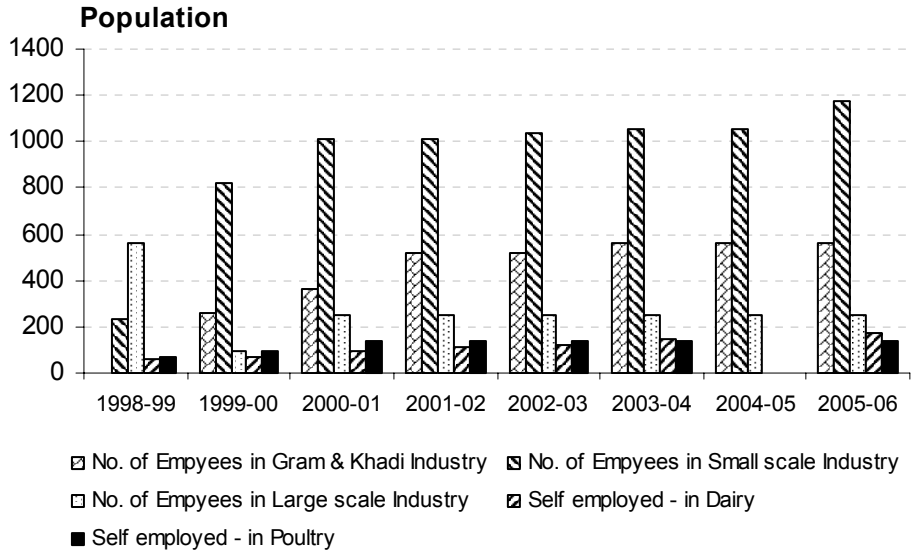


Figure 4C.4 Monthly minimum and maximum temperature of Nabipur

Socio-economic

According to 2001 census, 28% of the population is urban, the rest being rural. More than 60% of the population in Sirhind block is classified as rural. However, it has urbanized rapidly (at a pace of almost 64 percent) between 1991 and 2001.

The study region being mostly a rural area, its economy is mainly dependent on agriculture. However, between 1991 and 2001, the number of cultivators and agricultural labourers in the rural areas has come down, as reported by the officials in the concerned departments. It was also observed that the share of population engaged in non-agricultural activities like gram and khadi industry, small-scale industries, and dairy is increasing (see Figure 4C.5). This highlights a gradual shift towards other economic activities in the rural areas of Sirhind. However, agriculture still remains the predominant activity in the area.

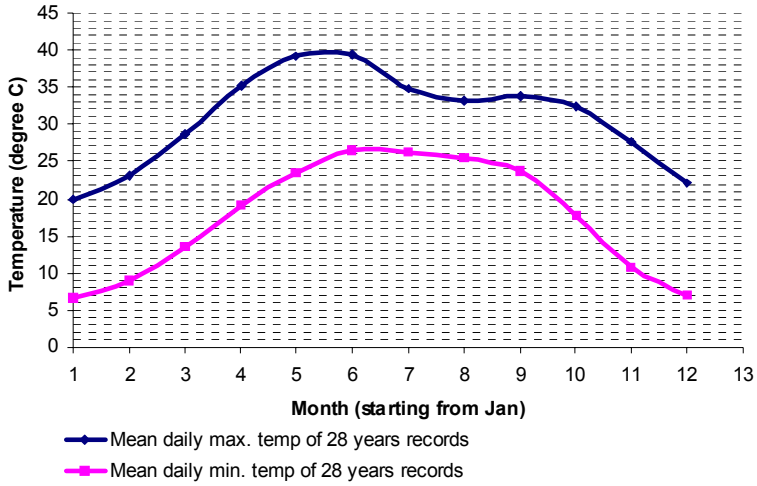


Figure 4C.5 Non-agricultural occupational pattern in the rural region of Sirhind (population in numbers)

Source Office of the Directorate of Economics and Statistics, 2005/06 and past data, Economics and Statistics Department, Fatehgarh Sahib, Government of Punjab

Table 4C.1 gives the details of working population in the urban area of Sirhind in 2001. It is evident from the table that the share of other non-cultivator workers is the highest. This includes populations involved in factories, family businesses, transport and other services, educational services, and so on. The study area is famous for bus and truck body-building as well as for the manufacturing of centrifugal and submersible pumps. It has 10 ancillary units for rubber-manufacturing goods machinery and parts, and 17 units manufacturing centrifugal pumps. There are also 70 units fabricating truck and bus bodies. There are some units of mining machinery and toughened glass as well.[1]

Table 4C.1 Details of working population in the urban area of Sirhind (2001)

			Status of workers			
Main workers	*Marginal workers*	*Non-workers*	*Cultivators*	*Agricultural labourers*	*Household industries*	*Other workers*
16 090	1105	33 593	1054	1024	637	14 480

Total urban population = 50 788

Source Register for posting of Enumeration Block Totals, Municipal Council Office, Sirhind–Fatehgarh Sahib, Government of Punjab

The gradual urbanization phenomena and the prevalence of agriculture as the major occupation imply an increasing demand for water and subsequently, pressure on the existing groundwater resources in the area.

Land use and agriculture

[1] http://fatehgarhsahib.nic.in/Dist_glance_new.htm#sirhind, last accessed on 23 July 2007

The details of the land-use pattern in Sirhind for the period 1998/99–2005/06 were studied. Total geographical area is under cultivation, while there is no area under forests.

Cropping intensity provides an idea of the utilization of the cultivated land. The average cropping intensity of Sirhind for the past eight years was reported to be 1.82, which indicates a close to double cropping of the land. Crop rotation is being carried out on a regular basis. This in turn has a direct bearing on the quantity of water required, as crop cultivation is a water-intensive activity. Table 4C.2 gives the details of the cropping intensity values for the study area over a span of eight years.

Table 4C.2 Land-use pattern (in hectares) and cropping intensity (Sirhind rural)

Land- use pattern	1998/99	1999/2000	2000/01	2001/02	2002-03	2003/04	2004/05	2005/06
Sirhind rural: Total geographical area = 28 183 hectares								
Gross sown area (A)	49 403	48 941	49 626	47 850	47 945	47 689	47 563	47 633
Net sown area (B)	26 611	26 611	26 611	26 611	26 611	26 611	26 411	26 411
Cropping intensity (A/B)	1.86	1.84	1.86	1.80	1.80	1.79	1.80	1.80

Source Office of the Directorate of Economics and Statistics, 2005/06 and past data, Economics and Statistics Department, Fatehgarh Sahib, Government of Punjab

The principal crops grown in the study area are wheat (rabi) and paddy (kharif), followed by fodder, sugar cane, barley, *chholey*, cereals, and vegetables grown in small quantities. Figure 4C.6 shows the cropping pattern of the study area. The area under paddy and wheat cultivation has remained more or less constant between the years 1998/99 and 2005/06. This indicates a consistent availability of water, as paddy requires huge quantities of water.

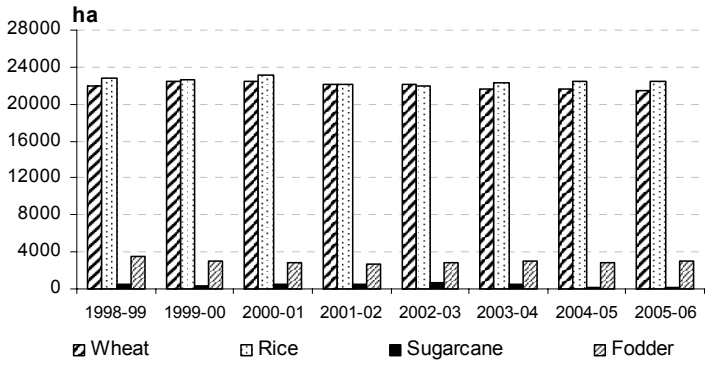


Figure 4C.6 Cropping pattern in Sirhind (hectares)

Source Office of the Directorate of Economics and Statistics, 2005/06 and past data, Economics and Statistics Department, Fatehgarh Sahib, Government of Punjab

The CAO (chief agriculture officer), Fatehgarh Sahib, reported that almost the entire cropped area was irrigated. It is because the area receives abundant rains. Also, the Fatehgarh Sahib district in totality is well irrigated, with tube wells and canals being the main sources of irrigation.

Few facts worth noting about Fatehgarh Sahib district are that 90 percent of its total geographical area is under cultivation, which is 100 percent irrigated. The average yield of paddy and wheat in Fatehgarh Sahib is always higher than the rest of the state. This speaks volume about abundance of water in the region and adequate irrigation facilities along with appropriate production technologies in the region. However, interestingly, the CGWB has identified Sirhind as one of the blocks in Fatehgarh Sahib district where overexploitation of groundwater is taking place. [2]

Irrigation and penetration of pump sets

Irrigation is done mainly through tube wells, which is supplemented by the canal water. A 10-MW (megawatt) power plant, which runs on paddy straw, has been established at village Jalberi[3] in the study area. The present depth of groundwater table is more than 50 feet and typical borings in the area are between 100 feet and 150 feet. The number of pump sets and bores in the study region for the past eight years is given in Figure 4C.7. Even though the number of additional borings made seem to have declined over the years, it was reported by the CAO, Fatehgarh Sahib that the groundwater table has been steadily declining over the years due to overexploitation of water, mainly for agriculture. With falling groundwater tables, there is a shift towards greater use of electric pump sets as compared to diesel pump sets. As is evident from the figure, there has been a greater level of penetration of electric pump sets when compared to diesel pump sets.

[2] http://cgwbchd.nic.in/distpb.htm#d3; last accessed on 23 July 2007
[3] http://cgwbchd.nic.in/distpb.htm#d3; last accessed on 23 July 2007

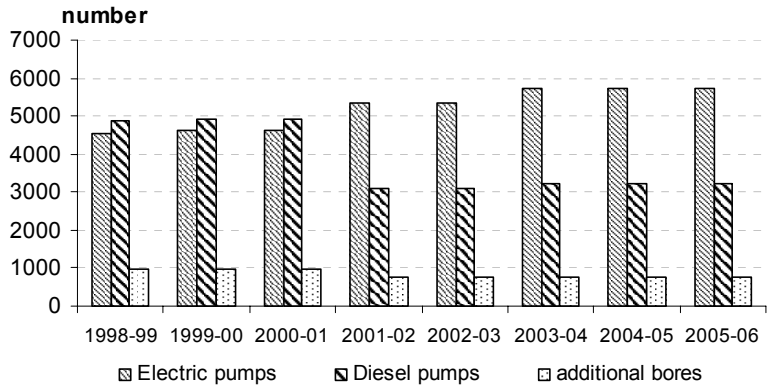


Figure 4C.7 Number of irrigation pump sets and additional bores

Source Office of the Directorate of Economics and Statistics, 2005/06 and past data, Economics and Statistics Department, Fatehgarh Sahib, Government of Punjab

Fertilizer use

The data for block-level fertilizer consumption was not available. However, the CAO, Fatehgarh Sahib, rendered the data at the district level and advised to assume similar trends for the study area. The types of fertilizers used in the area are primarily N, P, and K (nitrogenous, phosphoric, and potassic). Average fertilizer consumption (NPK) in kg/ha has gone up substantially over the past few years as shown in Figure 4C.8. Higher use of fertilizer in the area is due to increasing cropping intensity and gradual depletion of the soil's natural nutrient reserves, not to mention the good irrigation potential in the region.

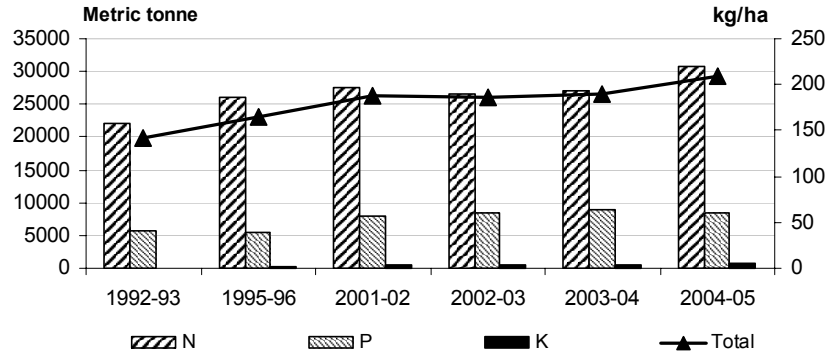


Figure 4C.8 Consumption of fertilizers (in metric tonnes and kg/ha) in district Fatehgarh Sahib

Source Chief Agriculture Officer, Fatehgarh Sahib, Agriculture Department, Punjab, District Fatehgarh Sahib

Groundwater movement

Fatehgarh Sahib district is a part of the Ghaggar drainage system. The watershed area is drained by a network of distributaries and minor canals originating from the Bhakra main line canal. I L distributary originating from the Bhakra main canal lies in the north and north-east of the watershed. Sangatpura and Ritkheri minors originating from the distributary lie towards the west and the east of the watershed, respectively.

Major geological formation is alluvium. According to the CGWB, north-west region, the district is an overexploited zone. In the period 1985–98, the water table in the area ranged between 5 m and 8 m below the ground level. The area has experienced a decline in water tables since 1999. The water tables dropped by about 3–4 m in the past six years. According to the CGWB, this is mainly attributed to rise in water demands by various sectors as well as low rainfall experienced by the area during the period 1998–2003.

The general groundwater flow direction is towards south-west.

Kandhari Beverages Pvt. Ltd, Nabipur

This bottling plant is situated in Nabipur village, in Sirhind block, in Fatehgarh Sahib district. Geographically, the plant is located near the Delhi–Amritsar national highway (Shershah Suri Marg). The plant is not owned and operated by Coca-Cola but is a franchisee-based operation. The plant was first established in December 1999, though it commenced production of CSDs (carbonated soft drinks)[4] only after six months of its inception, that is, June 2000. The plant area lies in the planned industrial area of Fatehgarh Sahib district where the government encouraged industries to be set up. In view of this, a tax holiday was also given for promoting new industries. But, as of now, KBPL, Nabipur, is the only largest industry in this region and no other big industries have come up. The area, in spite of attempts of the government to set up industries, remains primarily an agricultural area.

The plant mainly produces CSDs in RGBs (refillable glass bottles), and PET (polyethylene terephthalate) bottles. The plant uses groundwater for production purposes.

[4] CSD covers products like Coca Cola, Thums up, Fanta, and so on.

Plant capacity

The plant had one RGB line and one PET line during its inception. It installed one additional juice line in February 2004. Potentially, the plant has the capacity to produce 600 RGBs per minute while PET line can produce 120 PET bottles per minute. The juice line, running at full swing, can produce 166 bottles per minute. The annual utilization capacity of the RGB line (50%) and PET line (90%) remained constant in the past three years. However, annual utilization capacity of the juice line was constant (40%) in 2004/05 and 2005/06, though it was only 2% in 2003/04.[5] Installed capacity (bottles per minute) of three lines and their utilization capacity (percent) for past three financial years are shown in Figure 4C.9.

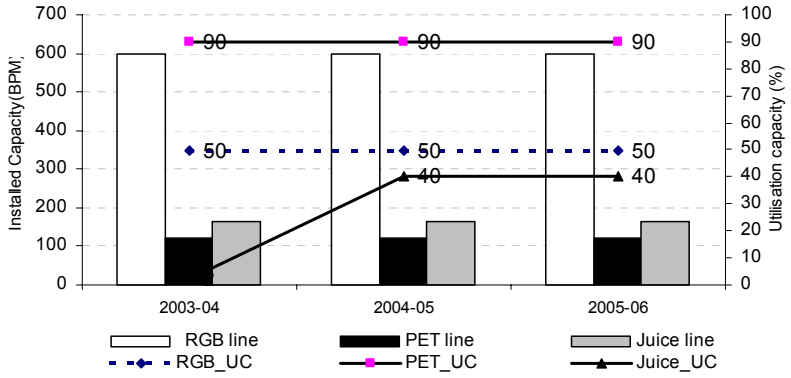


Figure 4C.9 Installed capacity and utilization capacity of the plant

Water intake and production

The Nabipur plant uses only groundwater for its production purposes. Unlike the other plants, this plant has provided daily water intake data only for one year, that is, 2005.

The plant produces RGBs, PET bottles, and juice bottles. The daily production data for different categories of products was provided only for 2005 and not for 2004 and 2006. Figure 4C.10 shows the monthly production of RGBs and PET bottles for 2005.

[5] As the line was commissioned in February 2004, utilization capacity was 2%.

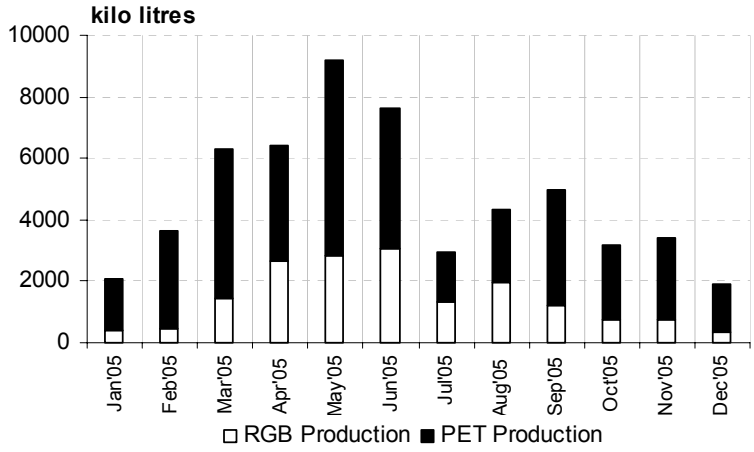


Figure 4C.10 Monthly production (in kl) of RGB (refillable glass bottles) and PET (polyethylene terephthalate) bottles

Because of the availability of only one year's production data, the change in the share of RGBs and PET bottles in total production could not be computed.

The plant produces more PET bottles as compared to RGBs (see Table 4C.3). In the peak months of production, that is, from March to June, average production was substantially higher than the winter months (November to January).

Table 4C.3 Share of RGB (refillable glass bottles) and PET (polyethylene terepthalate) bottles in total production

	Ratio (RGB/PET)	*Total production (kl)*	*RGB share (percent)*	*PET share (percent)*
2005	0.44	55 974.63	30.5	69.4

Water intake and production

Figure 4C.11 shows the monthly groundwater intake by the plant and the corresponding volumes of production in 2005. The peak months of water intake and production had been April–June, while lean months had been November and December.

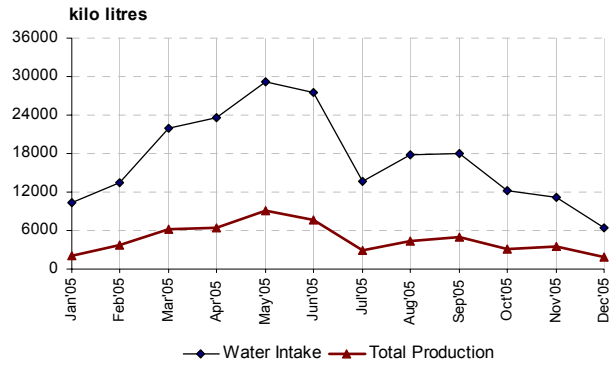


Figure 4C.11 Water consumption and carbonated soft drink production trends

A strong linear correlation (r = 0.978) was observed between monthly groundwater intake and the monthly production over the 12-month period in 2005.[6] This means higher the groundwater intake, greater is the level of production, as depicted through a scatter plot in Figure 4C.12.

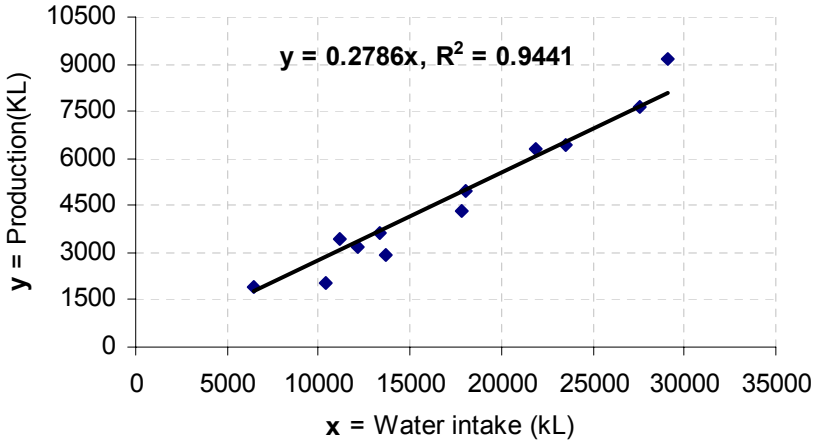


Figure 4C.12 Relationship between monthly groundwater intake and production

Water utilization ratio

Due to non-availability of daily water intake and daily production data for 2004 and 2006, annual WUR (water utilization ratio) could not be computed for these two years. Annual WUR in 2005 computed by TERI is different from the figure that the plant has provided (Table 4C.4).

[6] However, due to limited number of observations (only monthly data for 2005), one cannot expect a robust relationship.

Table 4C.4 Comparative analysis of water utilization ratio

Year	*Plant estimate*	*TERI estimate*
2004	3.44	NA
2005	3.37	3.79
2006	3.14	NA

The monthly average WUR for the period between January 2005 and December 2005 is 3.79, and the standard deviation is 0.55. This means that in 95 out of 100 cases, the average monthly WUR of the plant lies between 2.70 and 4.86.

Selection of villages and stakeholder interaction

Identification of villages for techno-social assessments

The villages identified using the approach as discussed in the Chapter 2 on approach and methodology have been identified as following.

- Village in which the plant is located (M1): Nabipur
- Village immediately upstream of the plant, considering the regional direction of groundwater flow (U1): Jalberi
- Village immediately downstream of the plant, considering the regional direction of groundwater flow (D1): Longo Marji
- Village at the extreme upstream end of the watershed in the direction of groundwater flow (U2): Jalberi
- Village at the extreme downstream end of the watershed in the regional direction of groundwater flow (D2): Kharodi

In addition to above, village Saidpura (M2) was also selected for regional water quality analysis, since this is also an immediate village with respect to the plant location and is situated within the watershed boundary.

Figure 4C.13 gives the location of the selected villages in the watershed (dashed arrow shows the direction of flow).

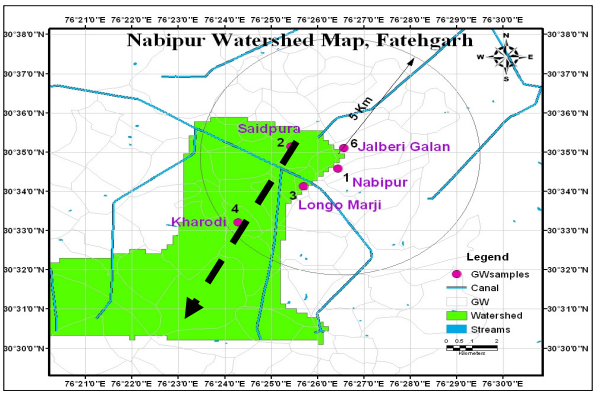


Figure 4C.13 Location of the selected villages in the watershed (dashed arrow shows the direction of flow).

Key stakeholder interaction

Stakeholder perceptions capture the views of different stakeholders on the issues of trends in water availability, quality, utilization, and access across the study villages. The section only records the views as presented by different stakeholders in the course of FGDs (focus group discussions) and key stakeholder interviews. It does not aim to make judgements nor draw conclusions based on these recorded perceptions.
The rationale for selection and relevance of stakeholders has been discussed in detail in Chapter 2 on approach and methodology.

Various groups were interviewed in the Nabipur watershed, including members of the panchayat, key users of water within homes (women) and in agricultural fields (farmers), members of marginal groups, members of NGOs (non-governmental organization), activists, and other persons who had a better understanding of the issues in the area.

Gram panchayats

Each of the four villages namely, Saidpura, Nabipur, Longo Marji, and Kharodi, had its own gram panchayat and thus, four separate meetings were held with members of the panchayats. Each panchayat meeting was mostly attended by elected representatives to the panchayats (men and women). In Saidpura and Kharodi, non-members like ex-sarpanch and other village residents were also present.

Women

There were four meetings held with the groups of women, one each from the four villages.
Besides working in their fields, all women were involved in carrying out household chores.

Farmers

Four FGDs were held with farmers' groups, one in each of the four villages. The key kharif crop was reported to be rice, with corn, *bajra,* and *jowar* grown as fodder crops; other kharif crops reported were *moong daal* and sugar cane. The key rabi crop grown was reported to be wheat, while gram, potato, mustard, *masoor daal,* and sugar cane were also reportedly grown in this season. All the farmers present at the meetings said that they had been growing hybrid varieties of rice and wheat for several years since the Green Revolution, as these varieties gave higher yields.

Weaker sections

Discussions were held with scheduled caste as each village had a separate settlement for scheduled caste. Across all four villages, the common sub-castes found were the Balmikis and Ramdasis. Additionally, Bazigaars, a sub-caste, were the dominant group in Nabipur. The literacy level among these groups was low (in Saidpura, scheduled caste reported 80% illiteracy). In general, the scheduled caste reported not having any landholdings. They were involved in their traditional occupations, as many of them were cobblers, barbers, and so on. Some also worked as daily-wage labourers on agricultural lands and in factories located nearby. Unemployment was reportedly a big problem amongst the weaker sections.

Interviews with key persons

Seven key persons were interviewed. Three were representatives of the Coca-Cola plant. Others interviewed included an Anganwadi teacher, who has residing in one of the study villages for the past 25 years, and has also worked towards preparing village progress reports over the past few years. A college teacher, who has been living in the district for the past 15 years, was also interviewed. A bank official was also interviewed. He has been a resident of a village located close to the study area. A panchayat secretary of the block, who has been in the position since 2001 (barring a period of six months), was also interviewed.

Stakeholder perceptions on water quantity

Sources of water

Discussions with different groups revealed that groundwater was used for both household and agricultural purposes. Members of the various panchayats, women's groups, and

farmers' groups corroborated this. In the villages of Saidpura and Nabipur, bore wells fitted with both hand and motorized pumps were reportedly the means of drawing water. In the villages Longo Marji and Kharodi, bore wells were mostly fitted with hand pumps. There were very few motorized pumps in these two villages for household use. Additionally, the village of Kharodi had access to tapped water supply, courtesy the government, for a flat fee of Rs 60 per month.

As reported by farmers and panchayat members, water for irrigation was sourced through tube wells fitted with motorized pumps. These pumps operated on electricity or diesel. Farmers from all four villages reported that it was common for most farmers to own such motorized pump sets. Besides groundwater, rainwater also used for irrigation during the monsoon season and, to a lesser extent, winter months.

Changes in water availability

In all group discussions, participants reported problems related to water availability. Additionally, farmers and members of the weaker section also reported problems of accessing water due to insufficient and irregular electricity supply, which affected the duration for the motorized pumps could operate.

In all group discussions, participants reported that the water table had been declining over the past several years (between 15 and 20 years) but the problem had become more acute in the past four to five years, as the water table had fallen sharply. Most groups reported that the water table was about 30 feet in the mid-1990s, but had now fallen below 50 feet. The reported depth at which water could be found varied by village and among different groups from the same village. Participants reported seasonal variations in the water table, with water shortage being acute during the summer months. Participants stated that during the monsoons and the winter season, there was sufficient water. Various key persons also corroborated these views. Notably, the Coca-Cola representatives pointed out that declining water table levels was of concern to them. A rating of water availability in the region by different stakeholders across various villages has been indicated in Table 4C.5.

One of the stakeholders mentioned that companies like Coca-Cola use up a lot of water and that the government should think long and hard before giving licences to such companies to operate in areas of water scarcity.

Table 4C.5 Rating of water availability

Village	*Women groups*					*Farmer groups*					*Weaker sections*					*Panchayats*				
Scale	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Saidpura				X				X^{s}	X^{ot}					X				X^{i}	X^{h}	
Nabipur			X					X					X					X^{ab}	X^{c}	
LongoMarji			X^{ab}	X^{c}		X							X^{ab}	X^{ab}				X		
Kharodi			X^{ab}	X^{c}				X					X					X		

a – Rating for monsoon b – Rating for winter c – Rating for summer

i – Irrigation h – Household use s – Submersible pumps ot – other pumps

Scale: 1 = no scarcity 5 = very high scarcity

The perception of women is based primarily on access to drinking water and that of farmers is based on access to irrigation facilities.

Reasons

Several reasons were cited by different groups and key persons for the fall in groundwater levels, the main reason being lack of sufficient rains and cultivation of paddy crop. Most groups stated that they had not received sufficient rainfall over the past several years. Thus, although water was continually being drawn from the aquifers, it was not being sufficiently replenished.

Growing paddy requires a lot of standing water. As reported by several people, including farmers and key persons, farmers tend to sow paddy before the rains. Because of this practice, the water requirement for an already water-intensive crop is very high. It was also reported that the number of bore wells and submersible pumps installed in the area had also increased and they contributed to the increased use of water. Further, the land preparation and the standing water result in the compaction of the soil, which prevents percolation of the water into the ground.

Another commonly reported reason was the use of groundwater by the Coca-Cola factory. Many groups (except those from Kharodi) and the weaker sections from Longo Marji perceived that the plant had a major role in the declining water table in the area. A couple of key persons interviewed also held the same view.

A few farmers and key persons also pointed to the wasteful use of water by households as another cause of decreasing water tables in the area. Another reason given was the spread of the eucalyptus tree, a species known to draw up a lot of water. Some panchayat members also pointed out that

a Bisleri factory in the vicinity was also using large quantities of water.

Impacts

Several groups stated that the worst affected by the water scarcity were women, who had to spend lot of time on collecting water. Women from the marginal groups said that they had to spend at least two hours a day collecting and storing water. Some of the women participants stated that in summer months they had to spend four to six hours a day collecting and storing water. Women also mentioned experiencing increased physical stress (walking long distance) as well as mental stress (not being able to complete household tasks on time).

Farmers from all the four villages said that there was sufficient water for them to cultivate crops, and that nobody left their land fallow for want of water. The main impact that farmers experienced related to the increasing cost of drawing water. They said that in the 1970s they could draw water with a 3-HP (horsepower) pump. Over the years, the power of the pump kept increasing, and today, it is common to have 10-HP pumps. Some farmers, who could afford it, even install submersible pumps.

The main impact felt by the marginal groups was in the form of increased drudgery for women in managing household tasks and collecting water from long distances.

Protests and agitations

There were no protests and/or agitations reported by any of the groups or key persons in this region. The participants of the FGDs, however, mentioned how they coped with the situation. Some said that they would wash and bathe less frequently, especially in summer when the shortage was acute. Others said that they would request owners of submersible pumps to let them use water from these pumps. The participants reported asking their respective panchayats to install a piped water system so that their water needs, especially for household purposes, would be taken care of.

Farmers mentioned the need for more efficient technologies for agriculture and water usage, and stated that scientists could help them out with this. They even expressed a willingness to switch to less-water-intensive crops, if they could get good returns, essentially similar to what they were currently getting.

Stakeholder perceptions on water quality

Perceptions about the water quality varied among the respondents of not only different villages but also same villages. Some of the respondents reported that water quality was good while others were unhappy about the quality. For example, some women in Nabipur were satisfied with the water quality while others reported that the water had poor taste and a yellowish colour and was, therefore, unfit for drinking purposes. In Kharodi and Saidpura, most women were satisfied with the water quality.

Depth of the water influenced the perceptions that various groups had. A common observation made by the respondents in all the four study villages was that the water from shallower bore wells (the ones usually operated with hand pumps) was of poor quality whereas the water from very deep bore wells (usually the ones operated with submersible pumps) is of good quality. This view was also supported by some of the key persons. Respondents also reported that the quality of the water is dependent on the location of the well. They suspected that due to improper sanitation in the villages the water from the hand pumps located near toilets might be contaminated.

Some of the marginal groups and women reported dental and skin diseases and joint pains, though they were not able to confidently link this to water quality in any way.

Across the villages, there were no reports of effluent discharge from the Coca-Cola factory.

State, governance, regulations, and compliance

KBPL, Nabipur[7], a Coca-Cola FOBO, was established in April 2001. The plant draws groundwater for its manufacturing operation through two bore wells in the factory complex.[8] Since the state of Punjab does not have a state water policy or any laws pertaining to groundwater extraction, the components of this assessment are as follows.

- Compliance of KBPL, Nabipur, with legal and administrative requirements governing the plant's

[7] Located in the Fatehgarh sahib district in the state of Punjab
[8] The powers of the pump sets used to draw water from the bore wells are 15 HP and 12.5 HP.

establishment and operations, with a focus on water resources management and wastewater disposal.
- Compliance of KBPL, Nabipur, with TCCC corporate requirements on water resources management and wastewater disposal.

Regulatory framework governing the plants establishment and operations

As mentioned above, Punjab does not have a state water policy. However, a draft water policy was reportedly prepared two years ago, based largely on the National Water Policy, discussed in Chapter 3.[9] The state does not have a groundwater act either, and there are no prescribed policies on groundwater use.[10]

The PPCB's (Punjab Pollution Control Board) general siting guidelines allow industrial units to be located in industrial areas, industrial estates, industrial focal points, or FEZ (free economic zone) areas, as demarcated by the Town and Country Planning Department of the Government of Punjab. The plant is situated in an area declared as a focal point for industries by the Punjab government. As a result of this declaration, the plant obtained a sales tax concession for 120 months for a maximum amount of Rs 909 million.[11] However, a no-objection certificate was also required from PUDA (Punjab Urban Development Association) for the establishment of an industrial unit in an agrarian area, since the land for the plant was purchased from farmers. As per discussions with the district collector, PUDA is a land development agency and does not have any role to play beyond certifying the conversion of land. It was further informed that there are no provisions for taxes to be paid to the gram panchayat for conducting non-agricultural activities in a panchayat area in Punjab.

PPCB 2005 states that site clearances from the SAC (Site Appraisal Committee) are required for industries involving hazardous process. CSD manufacturing operations are not included in the list of industries requiring site clearances, nor are they included in the list of industries requiring environmental clearances from the state. The plant management also conveyed that prevalent regulatory requirements did not require the conducting of siting reports and EIAs (environmental impact assessments) prior to the establishment of the plant.

[9] http://www.countercurrents.org/en-dutt120207.htm
[10] As per a discussion between TERI team and officials at the District Commissioner's Office in Fatehgarh Sahib on 12 March 2007.

[11] As per the documents shown to TERI during site visit.

Given the above, the main regulatory requirements with respect to water resources management and wastewater disposal governing the establishment and operations of KBPL, Nabipur, are those implemented by the PPCB under the provisions of the Water (Prevention and Control of Pollution) Act, 1974, and the Water Cess (Prevention and Control of Pollution) Act 1977, and their amendments thereof.

Categorization and consent

The CtE issued by the PPCB to KBPL, Nabipur, at the time of the plant's establishment was not shared with TERI.[12] The latest CtO issued by the PPCB was issued on 13 September 2006, and is valid until 31 December 2009. The PPCB categorizes industries as green or red, taking into consideration their potential pollution loads. KBPL, Nabipur is in the red category (signifying a polluting industry).

Compliance with regulatory and The Coca-Cola Company requirements

Regulatory requirements

Compliance against the conditions laid down in the CtE cannot be assessed since, as mentioned above, TERI was not given access to it. The CtO does not lay down any norms for drawing or using water for the industrial process. However, it does mention that meters have to be affixed according to the standards laid down by the regional environmental engineer of the PPCB, and at locations advised by him, to measure and record the amount of water consumed by the plant. The PPCB has not mentioned any norm for effluent disposal in the extension of the CtO granted in 2006, and notes that the conditions imposed remain the same as in the CtO granted by the board in December 2004. In this context, the CtO issued in December 2004 also does not contain any standards with respect to the quality of the effluent disposed. However, as per the information provided by the plant, the samples of effluent from the plant were analysed by the PPCB with respect to six parameters namely: pH, TSS, TDS, COD (chemical oxygen demand), BOD, and oil and grease, and compared with standards laid down for other similar industries. The conditions mentioned in the CtO, and compliance against them by KBPL, Nabipur, are presented in Table 4C.6.

[12] A written request for a copy of the Consent to Establish issued by the Punjab pollution Control Board to Kandhari Beverages Pvt. Ltd, Nabipur, after a site visit by TERI was responded to with a copy of the currently valid Consent to Operate for the plant (documents received on 02 April 2007).

Table 4C.6 Compliance with conditions specified in CtO by KBPL, Nabipur

Requirements	*Compliance in Nabipur Plant; remarks if any*
General	CtO issued on 13 September 2006, valid until 31 December 2009
Limit on discharge for wastewater	740 KLD (kilolitres per day) for trade effluent and 35 KLD for domestic effluent 442 KLD as estimated for 2005/06. This is well within the limits permitted as per CtO (Consent to Operate)
Mode of discharge of wastewater	Plant does not discharge wastewater outside the factory premises Zero discharge plant; however, no standard for land application mentioned in CtO
Compliance with discharge standards	Parameters as applicable to other similar industries in the state need to be monitored. As reported by the plant, the PPCB (Punjab Pollution Control Board) monitors six parameters: pH, TSS, TDS, COD, BOD, and oil and grease Analysis of reports enclosed for 20 parameters suggests compliance with respect to these parameters
Affix meters of such standard and at locations approved by the PPCB, to measure and record the quantity of water consumed	The CtO issued on 13 September 2006 notes that the plant is already compliant with this requirement
Requirement of sampling and measurement	Provision for sampling and flow measurement for the treated wastewater at the terminal end of treatment facility
Interlocking of pollution control devices with process	Applicable Industry has installed separate energy meters for ETP (effluent treatment plants), monthly readings are sent to the PPCB
Annual environment statement	Not mentioned as a requirement in the CtO provided
Any other issues	The CtO requires the factory to ensure the plantation of trees at a density of not less than 1000 trees/hectare all along the boundary of its premises Plantation present and seen by the study team. According to Coca-Cola, more than 3600 tress have been planted; this has also been noted in the Environment Statement submitted to the PPCB by the plant

TSS – total suspended solid; TDS – total dissolved solid; COD – chemical oxygen demand; BOD – biochemical oxygen demand

Note: The compliance of the plant is based on secondary data provided by Coca-Cola India): results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

According to the documents received from KBPL, Nabipur, the plant has paid cess of Rs 14 030.00 to the PPCB for the period January 2003 to January 2004, under the provisions of the Water cess Act, 1977.

The Coca-Cola Company requirements and guidelines

The plant was constructed in the year 2000. As per the EDD documents received that were issued in 2004, EDD is required to be conducted both for COBOs and FOBOs before constructing the plant. It is not clear whether this was required in year 2000 when KBPL, Nabipur was constructed.

Water withdrawal and usage

As noted, KBPL, Nabipur, extracts groundwater for its manufacturing activities from pump sets installed in two bore wells. Table 4C.7 gauges compliance of the bottling unit with water resource management requirements of TCCC.

Table 4C.7 Compliance with TCCC water resource management requirements by KBPL, Nabipur

Requirements	*Compliance in Nabipur plant; remarks if any*
EDD (environmental due diligence) to be conducted prior to siting of the plant	As conveyed by the plant management, this was not a requirement for a franchisee operation. According to the EDD requirements shared by CCI (Coca-Cola India), an EDD is required even 'where real estate is being acquired by an entity in which the company has equity ownership, interest or partnership of less than 15% but where the company controls and manages the operation'. However, the set of EDD guidelines shared were issued in November 2004 and amended in June 2006; therefore, these were not applicable when KBPL, Nabipur, was established.
Documented water availability assessment	Not conducted, as this is franchisee operation. The plant is located in the area that was declared as focal point for industrial development by the state.
Initial and periodic water utilization assessments	Carried out as appears in dropping WUR (water utilization ratio) over the years
Implement and maintain a process for water utilization	Process of water balance and audit is maintained as per the details provided by the plant
Establish a continuous improvement process for water utilization	WUR was 3.2 in 2003; decreased to 3.14 in 2006; potential unknown
Define water utilization objectives and goals in annual business plans	Optimization of water utilization per litre of the beverage produced remains the annual objective; water conservation targets are defined each year in consultation with corporate office.
Develop and execute internal and external water contingency plans	In-plant rainwater-harvesting assignments have been initiated as the response to contingency measures

Note: Based on information provided by TCCC and CCI and site visits by the project team

Table 4C.8 notes the adoption of TCCC guidelines on water resources management by KBPL, Nabipur.

Table 4C.8 Compliance with TCCC water resource management guidelines by KBPL, Nabipur

Guideline	Observation in KBPL, Nabipur
A self-assessment on water utilization	A plant-level water distribution/balance is maintained and water use is optimized at each level of the process based on in-plant trials and suggestions from the corporate office. As a result, the water use ratio has declined over the years. No self assessment documents (in TCCC format) shown during plant visit
A self-assessment on water supply	A safe yield of the water supply source was assessed at the time of establishment of plant. Quality of raw water is checked on a daily basis for selected parameters at the plant and once in a year by accredited laboratory. However, the plant does not monitor groundwater levels in its vicinity, although the Punjab Agriculture University reportedly monitors groundwater levels in the area of the plant. CGWA (Central Ground Water Authority) reports suggest that the water table has fallen by 2 metres since 2003 all over Punjab as mentioned by the Coca-Cola company in plant-level details. No self assessment documents (in TCCC format) shown during plant visit
The data collected during self assessments to be used to build a water conservation plan	Since self-assessment responses were not shared, it is difficult to ascertain how information collated during self-assessments are used to build a water conservation plan
The establishment of a cross-functional team for water resources management	As intimated during the plant visit, a five-member cross-functional team has been established at Nabipur for water resources management. Apart from a coordinator, this includes executives from the maintenance, production, and engineering units of the plant; the WRM (water resource management) programme focuses on 4 Rs for water conservation: Reduce; Re-use; Recycle; Recharge. The various initiatives undertaken include creating awareness amongst employees and technological interventions to enable the reduction of water used during bottle washing , and so on, and recycling of water. Additionally, wastewater is re-used in applications like gardening and shop-floor cleaning

Note: Based on information provided by TCCC and CCI and site visits by the project team

Wastewater discharge

As per the corporate requirements, the plant needs to get its treated effluent analysed once a year by an accredited laboratory and send the results to the corporate office. There are a total of 20 parameters listed in the documents provided by the Coca-Cola plant, including heavy metals. Table 4C.9 checks the compliance of the KBPL, Nabipur, with TCCC wastewater requirements.

According to the documents received, KBPL, Nabipur attained the E1 level of compliance in 2005 under the TCCC audit system (refer Chapter 3). Apart from the above, it has also received the ISO 9001 certification for quality in 2006; however, it has not yet received the ISO 14001 certification for environmental management standards. As per the documents received from the Coca-Cola plant, the plant was also a recipient of the Golden Peacock Award for Environment Management in 2002 conferred by Institute of Directors, New Delhi.

Table 4C.9 Compliance with TCCC wastewater management requirements by KBPL, Nabipur

Requirements	*Observations in Nabipur plant*
Meet applicable regulatory requirements	Compliant (as per the monitoring data provided by the plant)
Maintain an effluent quality that will have no adverse effects on fish or other aquatic biota in receiving waters	Compliant (as per the monitoring data provided by the plant)
Maintain and operate treatment facilities in an efficient manner	Compliant, as per the documents received and the assessment of the technical team
Compliance with wastewater quality requirements developed by the TCCC	Documents received provided details on 20 parameters; compliant with the standards for all 20 parameters.
A detailed drainage plan of all water and wastewater streams in the facility	Separate plans exist, verified during the field visit
Separate wastewater streams for process wastewater, sanitary wastewater, cooling water, and storm water	Sewage discharged in septic tanks, separate line for storm water, and cooling and process wastewater taken to ETP (effluent treatment plant)
Prevent the pollution (of) from water and wastewater	Adequate measures provided
Minimize the volume, strength, and hazardous nature of wastewater	No recycling in place at present, effluent used for gardening purpose, the plant is zero discharge
Treatment of process water such that it is	
Compliant with TCCC analytical standards Compliant with government effluent discharge standards Conducive to the long term survival of fish in the treated effluent	Compliant, as per the analytical reports provided Compliant, as per the analytical reports provided Compliant as per the analytical reports provided
Sanitary wastewater to be discharged to a sewer connected or a sewage treatment or a septic tank system	Yes, plant in compliance. Septic tank arrangement at site
Treatment of storm water according to the government regulations if applicable; else prevent the pollution of water and wastewater streams due to the run-off	Yes, separate management of storm water through dedicated drains

Requirements	*Observations in Nabipur plant*
Non-contact cooling water may be discharged into the local environment unless otherwise dictated by local laws or regulations	Not applicable
If treated wastewater discharge is through infiltration, prior to infiltration the wastewater must meet TCCC requirements and local regulations	Not applicable
If treated wastewater is disposed through land application, then	
Groundwater must be monitored quarterly within the application area, as well as up- and down gradient of the application area	No monitoring by plant
The soil's carrying capacity should not be exceeded such that there is surface run-off	No monitoring done at present by the plant
Water intended for spray fields should not be discharged into nearby water bodies; nor should excess run-off from spray fields be allowed to enter the nearby water bodies	Not applicable. The treated wastewater meets the local regulatory requirements for land disposal. No separate TCCC standards exist for treated wastewater to be applied on land

Note: The compliance of the plant is based on secondary data provided by CCI: results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

Water-related corporate social responsibility initiatives

Representatives of the plant informed that the CSR (corporate social responsibility) initiatives largely focus on community welfare and the maintenance of good neighbourly relations with the surrounding community. According to the plant, all community initiatives are need based, as identified by the community. The unit reported that a good relationship of the surrounding villages with the plant prevailed from the initial stages. CSR initiatives are under the charge of the Director General and an assistant manager who also has other responsibilities, for example, water resource management systems, in the plant.

Since scarcity of water was not reported in the surrounding villages, the plant did not undertake any water initiatives till 2003. However, the plant management indicated that they plan to construct an overhead tank in Nabipur as well as a few rainwater-harvesting structures in the areas surrounding the plant. As per documents received from the CCI, the company recommended the installation of a rainwater-harvesting scheme at the plant in 2004. However, there were no consultants engaged in this project, and the technical team from CCI guided this initiative.

Technical assessment

Regional assessment of water quality

The ex-situ assessment has been undertaken with an aim to have an insight into the quality of groundwater that is sourced and consumed by the plant and the impact, if any, of the effluent discharged after processing from the plant. As discussed subsequently, the water has been studied by undertaking water quality monitoring in and around the Nabipur village where plant is located. The assessment here does not relate the regional groundwater quality to the operations of the Coca-Cola plant.

Selection of sampling location

Five villages were selected for the groundwater monitoring.

- Nabipur (village immediate to the plant, M1)
- Saidpura (another village immediate to the plant, M2)
- Longo Marji (village immediate downstream to the plant, D1)
- Kharodi (extreme downstream village, D2)
- Jalberi Galan (village immediate upstream to the plant, U1)

Figure 4C.14 and Table 4C.10 provide the details of the sampling locations.

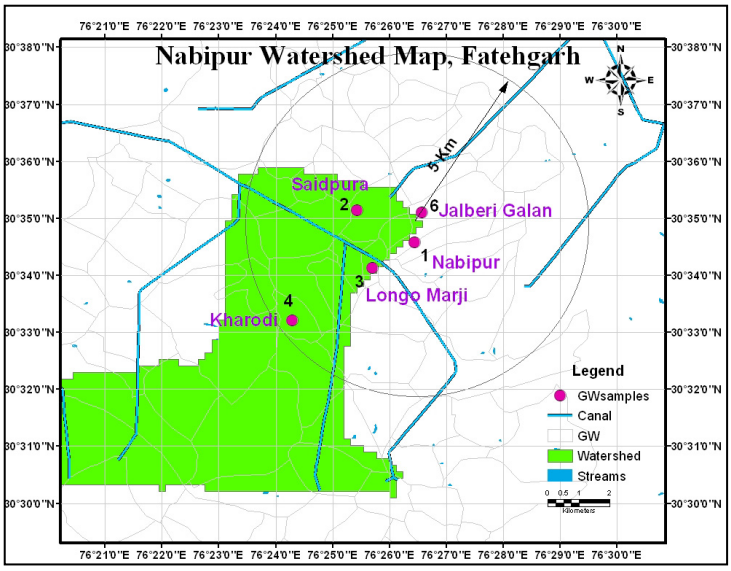


Figure 4C.14 Figure showing groundwater sampling locations at Nabipur region

Table 4C.10 Sampling locations

Village	*Location*	*Source*
Nabipur	Baldeb Singh, P O Nabipur, District Fatehgarh Sahib, Block Sirhind	Bore well
Saidpura	Maruram, P O Saidpur, District Fatehgarh Sahib	Hand pump
	Dharam Pal (alternative to Maruram), P O Saidpur, District Fatehgarh Sahib	Hand pump
Longomajri	Bahadm Singh /Siss-pyra singh, P O Adampur, Block Sirhind, Fatehgarh Sahib	Bore well
Kharodi	Gurmer Singh, P O Rourkee, Block-Sirhind, Zila/Tahsil Fatehgarh Sahib	Bore well
Jalberi Galan	Surjit Singh, s/o Sardar Singh, P O Sadhugarh, GT Road, Dist Fatehgarh Sahib	Bore well

Grab samples of groundwater were collected from the above locations as per the following schedule.

- First round: 12 March 2007 and 13 March 2007
- Second round: 18 April 2007 and 19 April 2007
- Third round: 12 June 2007 and 13 June 2007

These samples were collected, preserved, and transported to the designated laboratories as per the set protocols, the description of which is discussed in the Chapter 2 on approach and methodology.

Test results

Regional assessment shows that of the various tested parameters, total alkalinity exceeded the drinking water standards set by BIS: 10500 in all the sources. TDS is also found to be higher in most of the water samples collected from villages including Nabipur (M1), Kharodi (extreme downstream, D2), and Jalberi Galan (immediate upstream U1). Manganese was found to be marginally higher in water samples of villages such as Nabipur (M1), Kharodi (D2), and Saidpura (M2). While, the above-mentioned parameters exceed the desirable limits specified by the standard (IS 10500), they remain below the maximum permissible limits specified by the standard.

Parameters such as fluoride in the water sample collected from village Kharodi (D2), calcium in the water sample of village Nabipur (M1) and Kharodi (D2), selenium in the water sample collected from village Jalberi Galan (U1), aluminium in the water sample collected from village Kharodi (D2) and Jalberi Galan (U1), and faecal coliform in

the water sample of village Kharodi (D2) showed one-time marginal exceedances as compared to the IS 10500 standard.

When compared to the required WHO (World Health Organization) guidelines, lead and barium were found to exceed the desired limits for all the monitored villages. Pesticides were not found in any sample.

Figures 4C.15–4C.20 show the percent water samples in villages in Nabipur watershed region that exceeded the desired or maximum permissible limits for different water quality parameters.

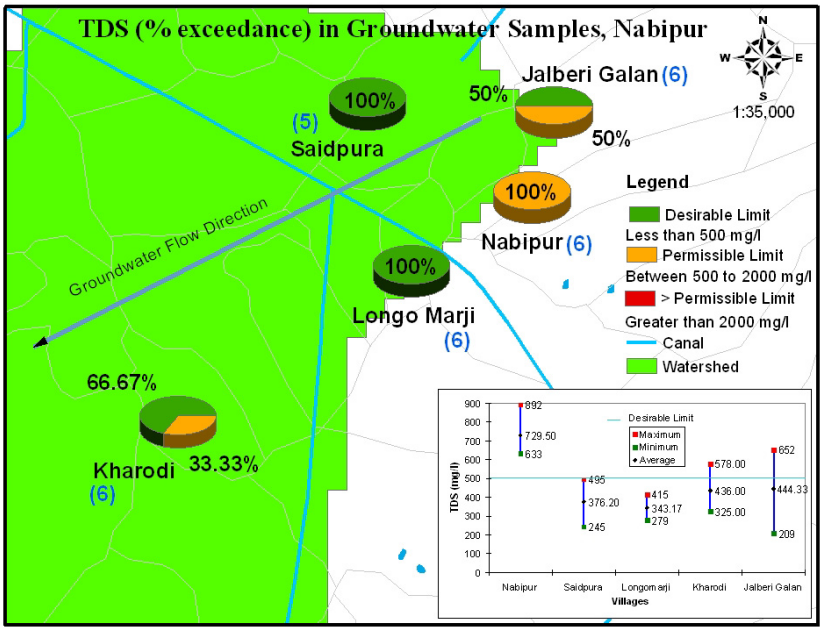


Figure 4C.15 Percent samples that exceeded the limits for TDS (total dissolved solid) in different villages in Nabipur region

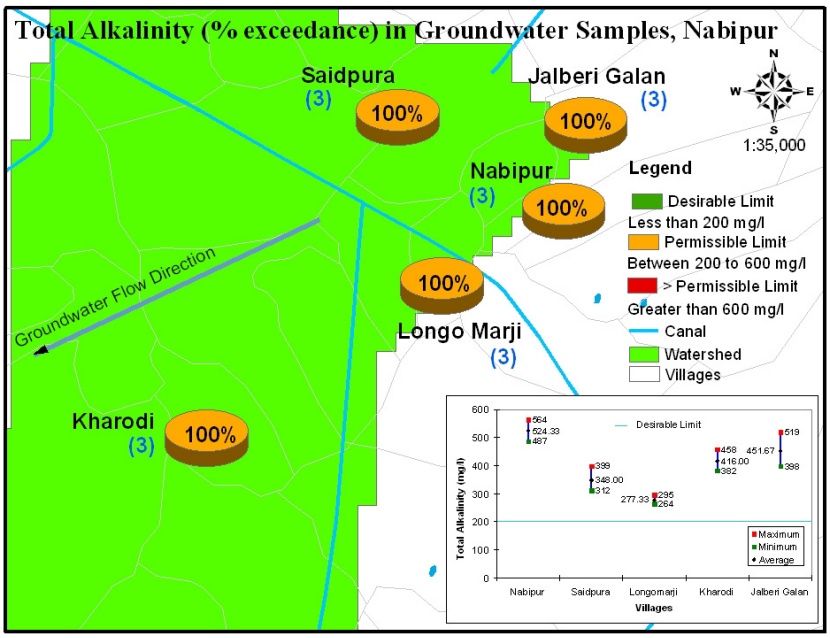


Figure 4C.16 Percent samples that exceeded the limits for total alkalinity in different villages in Nabipur region

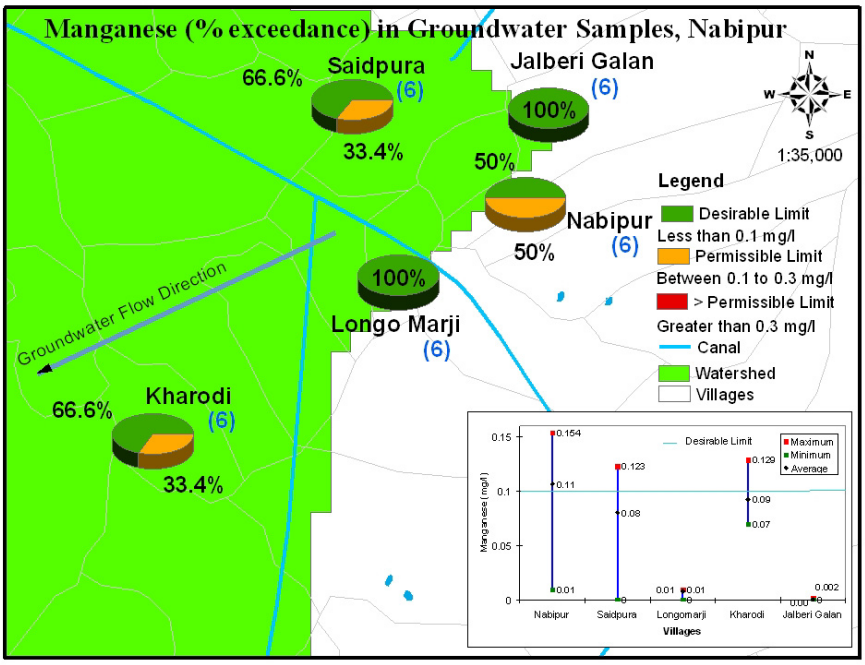


Figure 4C.17 Percent samples that exceeded limits for manganese in different villages in Nabipur region

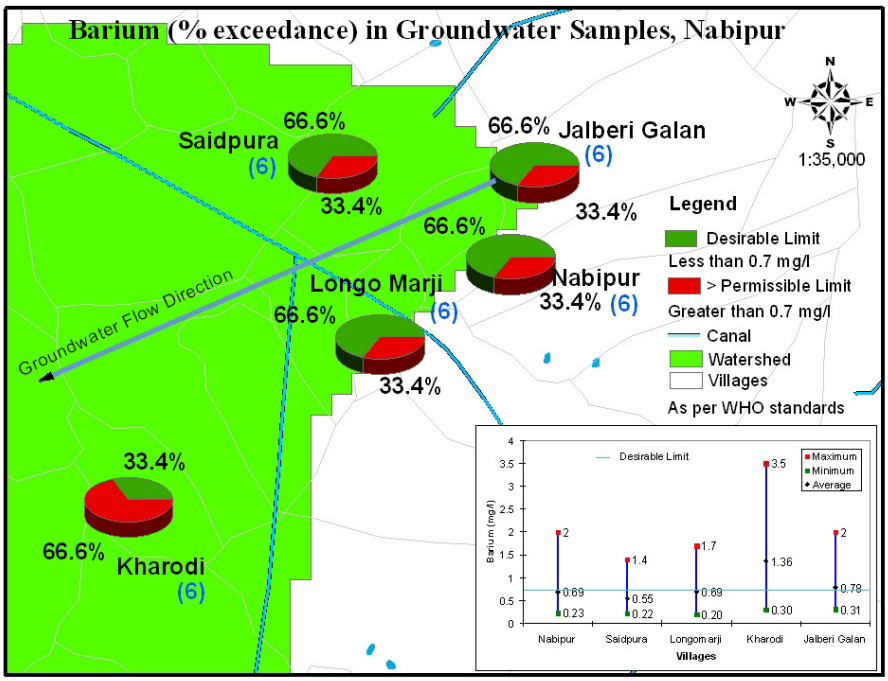


Figure 4C.18 Percent samples that exceeded limits for barium in different villages in Nabipur region

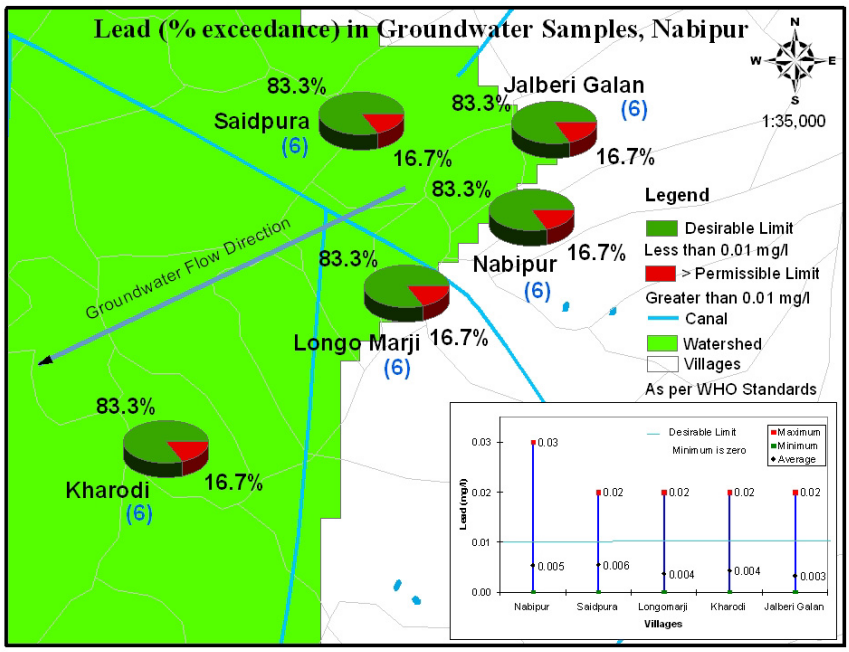


Figure 4C.19 Percent samples that exceeded limits for lead in Nabipur region

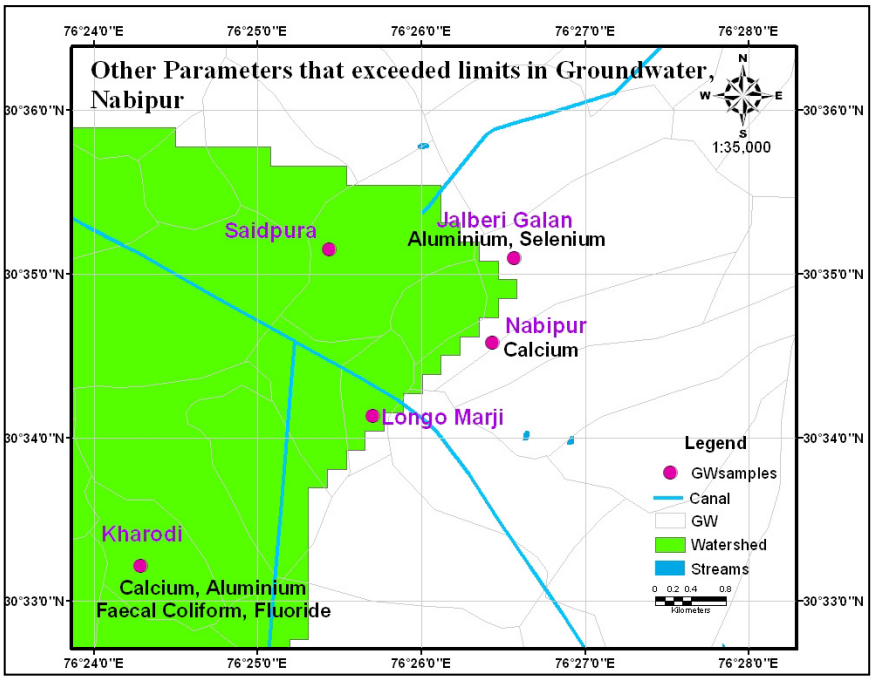


Figure 4C.20 Percent samples that exceeded limits for other water quality parameters in Nabipur region

Overall analysis shows that as compared to the BIS 10500 limits, the groundwater samples show exceedance for total alkalinity and TDS along with heavy metals like manganese and aluminium in almost all the five villages around the plant. Apart from this, fluoride, calcium, iron, and selenium

were also found in one-time marginal exceedances in few sources when compared to the IS 10500 limits. Bacteriologically, the groundwater quality was found to be meeting the desired limits in all the rounds barring one round in which faecal coliform was found to be marginally exceeding the limit in bore well of Kharodi village (D2). Lead and barium were found to exceed the desired limits set by WHO. Pesticides were not found in the groundwater of the monitored region. Table 4C.11 presents non-conformity of parameters in water samples to WHO guidelines and BIS standard for drinking water.

Table 4C.11 Non-conforming test parameters

WHO guidelines	*BIS 10500: 1991 drinking water specifications*
(in addition to non-conforming parameters identified under IS 10500)	Physiochemical TDS (total dissolved solid), total alkalinity
	Physiochemical (marginal exceedance)
Heavy metals barium and lead	fluoride, calcium
	Heavy metals (marginal exceedance) manganese, selenium, aluminium, iron
	Bacteriological parameter (marginal exceedance) Faecal coliform

Water with the above-mentioned non-conforming parameters needs to be treated for potable consumption and is not safe for drinking without treatment in the villages.

Plant-level assessment of quality and practice

The KBPL plant, Nabipur, sources its water from the two bore well sources, each at a depth of 350 feet. Water is pumped to a raw water storage tank where it is chlorinated and further sent to different sections and processes for further treatment and usage in the beverage production, domestic use, and the use in the boilers and cooling towers as shown in Figure 4C.21. Wastewater discharges from the production line, boilers and cooling towers, and domestic usages (except for sewage) finally are collected into a common ETP, wherefrom it is treated and used for horticultural uses.

Water quality

Table 4C.12 gives the description of points of sample collection and the sampling details.

Table 4C.12 Details of the in-situ sampling locations

Sample Source	*Location of sampling*	*Quantity of sample* (in l)	*Type of sampling*	*Number of samples (from each location)*	*Protocol/ guidelines for sampling and testing*
Raw intake water	Bore well no. 1	20	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
	Bore well no. 2	20	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
	Raw water tank outlet	20	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
Wastewater/ effluent	ETP (effluent treatment plant) inlet	20	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
	ETP outlet	20	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
Process water	Plant process Outlet after 1 micron Soft water tank (after chlorination) Before PET (polyethylene terephthalate) paramix	20	Composite (1 hourly for 22 hours)	3	APHA 20th ed. 1998/ IS 3025
	Before RGB (refillable glass bottles) paramix*	20	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025

* Available for third round only.

APHA – American Public Health Association

Thus, nine in-situ sampling locations, shown in Figure 4C.21, were selected for water quality monitoring. These locations are as follows.

- Raw water: Bore well no. 1 (source of water)
- Raw water: Bore well no. 2 (source of water)
- Raw water tank outlet: Water goes to water treatment plant from this section.
- Process water: Outlet after 1 micron—water treatment plant outlet that goes for beverage production.
- Process water: Soft water tank (after chlorination)—this goes as an inlet to bottle/crate washing, rinsing).
- Process water: Before PET paramix (inlet just before final PET bottle filling).

- Process water: Before RGB paramix (inlet just before final RGB bottle filling).
- Wastewater: ETP inlet.
- Wastewater: ETP outlet.

The results observed have been compared, for compliance, to the relevant guidelines/ limits/requirements as follows.

- For wastewater discharge: Relevant local regulation CPCB guidelines and TCCC internal quality guidelines
- For process water: Relevant national standard for drinking water (BIS 10500: 1991, IS 14543: 2004), international guideline (WHO guidelines for drinking water), and TCCC internal specification for treated water
- For raw water: Relevant national standard for drinking water (BIS 10500: 1991) and international guideline (WHO guidelines for drinking water)

Sample collection, preservation, and transportation

For all the selected locations composite sampling was carried out from 12 March 2007 to 13 March 2007 in the first round; 18 April 2007 to 19 April 2007 in the second round; and 12 June 2007 to 13 June 2007 in the third round. Protocols for sample collection, preservation, and transportation to designated laboratories have been discussed in Chapter 2 on approach and methodology.

Test results

The water quality parameters that showed exceedance for the in-situ monitoring locations are discussed below.

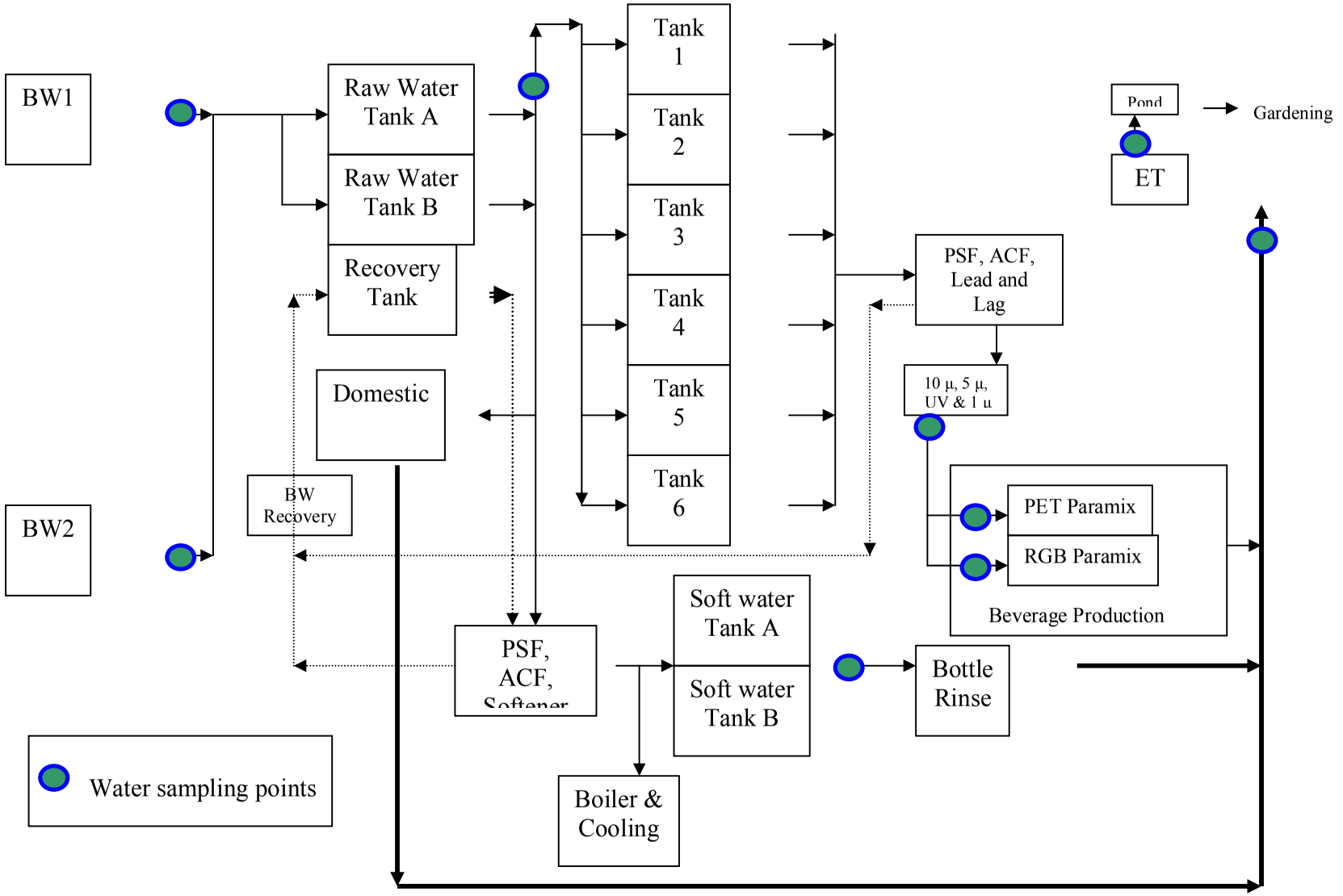


Figure 4C.21 Process flow diagram and sampling locations of KBPL (Kandhari Beverages Pvt. Ltd) plant, Nabipur

In-situ water quality assessment shows that in the raw water, parameters such as total alkalinity and barium exceed the desired limits specified by IS 10500. One-time marginal exceedances of fluoride and aluminium have also been observed.

Process water quality after water treatment showed a one-time marginal exceedance for nitrites.

The quality of the ETP outlet water (that is, after treatment) indicates effective treatment for almost all of the parameters when compared to the CPCB standards for discharge of treated effluent on land for irrigation. One of the samples failed for bioassay test (for testing fish survival), when compared to CPCB limits for land discharge.

As compared to TCCC's own treated wastewater quality standards for discharge into natural waterbodies, parameters such as BOD, TKN (total Kjeldahl nitrogen), TSS, and iron were found to exceed the prescribed limits.

None of the monitored pesticides were detected in the raw and process water as well as treated wastewater in the plant.

Plant-level water audit

Water auditing exercise at KBPL, Nabipur involved examination of water flows at inlet and outlet of unit processes with the following objectives.

- Establish water balance of the facility for the monitoring period
- Assess ETP/WTP (water treatment plant) inlet and discharge

Details of plant operations

The plant operations with respect to water balance can be divided into four broad segments, namely, RW (raw water), PW (process water), SW (soft water), and effluent. Figure 4C.22 shows the schematic diagram of WTP and locations of meters for three rounds of auditing.

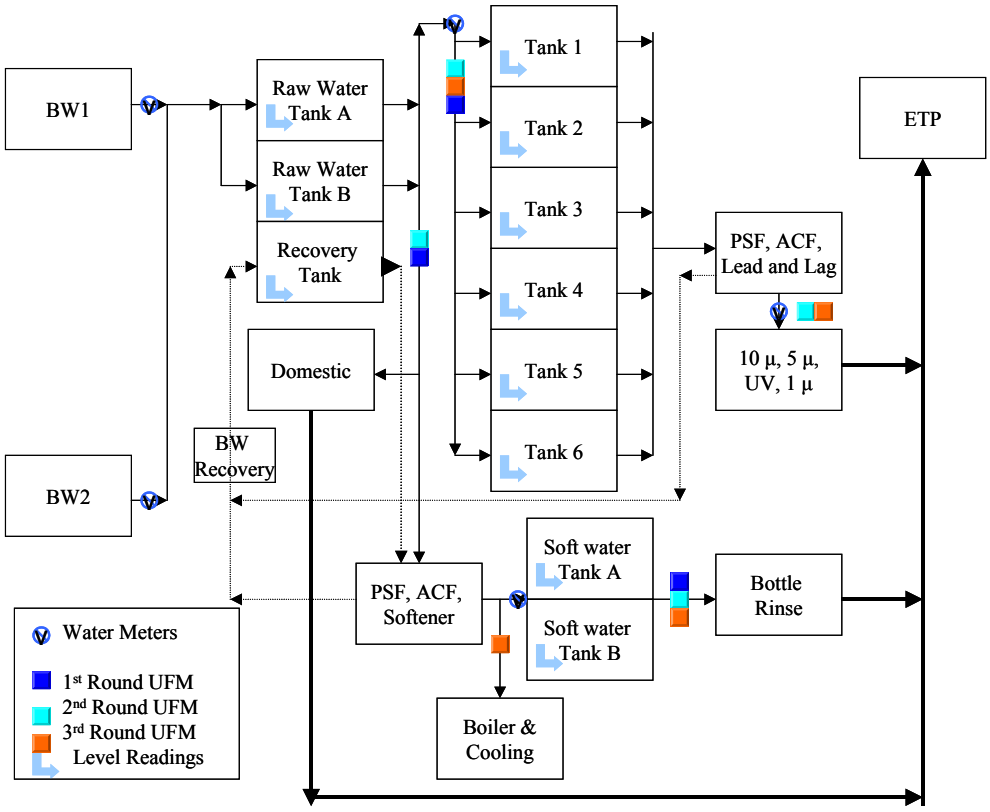


Figure 4C.22 Schematic diagram of the plant showing locations of water meter

Water balance

Water balance of the individual storage unit for the entire plant was carried out to assess the inflow and outflow of water in the plant and to estimate water usage in process and soft water.

Table 4C.13 gives water balance compiled for RW tank for three rounds of water auditing.

Table 4C.13 Raw water balance during three rounds of water auditing

Water balance component	*First round*	*Second round*	*Third round*
Inlet			
Raw water intake (m^3)	174.91	298.06	572.12
Outlet			
Raw water tank (m^3)	211.27	222.34	553.62
Storage			
Measured (inlet–outlet in m^3) [a]	- 36.28	75.72	18.50
Observed (m^3) [b]	- 1.36	51.19	16.6
Percent error in balancing (UWL)	19.9	8.23	0.33

UWL – Unaccounted for water losses

[a] Measured change in storage is change calculated based on the meter readings at inlet and outlet by applying continuity equation.

[b] Observed change in storage is storage change based on the difference of tanks water level.

Note: Negative tank storage shows net outflow from the tank, that is, reduction in water storage level of tank

The raw water balance derived from the water audit shows that during second and third rounds of monitoring exercise, the components of the continuity equation (that is, inlet, outlet, and change in storages) are in conformation with each other, as the UWL obtained for these tanks was less than 10%, reaching a minimum of 0.33%, except for the first round where UWL was more than 10%. This is discussed further in the subsequent paragraph.

During the first round, it was observed that tank level gauges for all the tanks that include RW, PW, and soft water tanks, have a least count of 25 cm. Usually the least count should be in the range of 5–10 mm. As a result of this least count, an error gets introduced when interpolation is done for estimating the level gauge reading value between the two markings 25 cm apart. Balancing of the raw water tanks with the present markings could have introduced a cumulative error as indicated by the estimation of error result (UWL of 19.9 percent) during the first round. To overcome this, the audit team used its own plumb-bob (a mechanical device used for measuring water levels in a tank) and recorded the level of the tanks during second and third rounds of audit. This led to more accurate measurements. The assessment also shows that UFL is within the acceptable limit of less than 10 percent.

In addition to water balance as discussed above, water usages for different unit processes were also calculated. Table 4C.14 presents an overview of observations for three rounds of water auditing.

Table 4C.14 Volume of water used in various units during three rounds of water auditing

Water used	*First round*	*Second round*	*Third round*
Date of monitoring	12–13 March 2007	18–19 April 2007	12–13 June 2007
Monitoring hours	15	20	22
Total inlet (m^3)	174.91	298.06	572.12
Process water (m^3)	151.85	213.89	287.5
Soft water (m^3)	51.53	62.42	450.924
Domestic water (assumed value) (m^3)	5	5	5
Production (m^3)	163.65	227.26	272.89
WUR-treated water	1.382	1.423	2.899
Production	2-litre Limca PET bottles	2-litre Limca PET bottles	600-ml Limca PET bottles and 300-ml Limca and Coke RGB bottles

WUR – water utilization ratio; PET – polyethyelene terephthalate; RGB – refillable glass bottle

Annual WUR reported by the plant is 3.14–3.44 for the past four years while daily WUR calculated from auditing are 1.382, 1.423, and 2.899 for the first, second, and third round, respectively.

It was observed that only PET bottles were produced during the first two rounds. This might have resulted in a low daily WUR. During the third

round a mix of PET bottles and RGB were produced thereby leading to a higher daily WUR. Maaza was not produced during any of the monitoring cycles.

The inlet and outlet of ETP could not be linked dynamically, as the storage in ETP was found to be very high and pumping was also done at intermittent stages. As a result of this non-continuity in flows, it was not possible to measure pollution load discharged from ETP in relation to the inflow for that day.

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CHAPTER 4D Nemam

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CHAPTER 4D Nemam

Executive summary

Part of large river basin but level of groundwater development classified as critical

The Nemam plant of HCCBPL (Hindustan Coca-Cola Beverage Pvt Ltd) is located in Poonamallee block – formed only in 1996, district Thiruvellore, in the state of Tamil Nadu, in South India. The watershed in which it falls forms a part of a river basin, namely, Cooum basin. The normal rainfall is approximately 1300 mm, with the maximum precipitation (more than 50 percent of the total) taking place between October and December, that is, North-East monsoon, followed by the South-West monsoon between June and September.

With regard to the stage of groundwater development, the Central Groundwater Board (CGWB 2005) data shows that Poonamallee block lies in the category of critical blocks, where the stage of groundwater development (use) is 90 percent to 100 percent of the net annual utilizable groundwater availability.

Predominantly urban area

Poonamallee block is a suburb of Chennai (located 20 km away), with a total area of 240 km^2, including roughly 53 villages. The pace of urbanization here has been very rapid and about 81 percent of the population in the block was in urban areas in 2001. As such, dependence on agriculture for livelihood is very small. A mere 20 percent of the area is under agriculture and declining. However, the cropping intensity touched 2.65 in 2005/06 with irrigated rice cultivation being predominant in all three cropping seasons.

General satisfaction with water availability

The panchayat is responsible for supply of water for domestic purposes and for the maintenance of all the physical structures related to drinking water supply. Groups belonging to women and weaker sections indicated that the overall water situation, in terms of water availability, in the villages has improved after the piped supply.

General satisfaction with water quality as well

Stakeholder groups in all the study villages felt that water quality was good and fit for domestic use and also for irrigation. While

minor observations were made on the taste of water, no stakeholder group reported any overall water-related health problem in any of the study locations.

Regional water quality

The assessment of regional groundwater quality shows that all of the monitored villages in the watershed showed exceedance for TDS (total dissolved solids) and aluminium as compared to IS 10500 desirable standards along with heavy metal like barium as compared to WHO (World Health Organization) guidelines. Villages Korattur (M 2) and Nochimedu (U 1) were found to be exceeding the limits for most number of parameters. Korattur (M 2) showed exceedance for MPN coliform, faecal coliform, total alkalinity, calcium, iron, fluoride, and sulphate along with lead (as per WHO guideline). Nochimedu (U 1) showed exceedance for total alkalinity, turbidity, calcium, iron, fluoride, sulphate, and manganese. Village Nemam (M 1) showed exceedance for MPN coliform, along with lead (as per WHO guideline), besides the parameters found commonly exceeding in all the villages.

Plant water quality meets requirements and guidelines

Process water was found to meet the standards of all the parameters under the IS 10500, IS 14543, and WHO guidelines.

The quality of the ETP (effluent treatment plant) discharge water indicates exceedance of fluoride as per specified TNPCB (Tamil Nadu Pollution Control Board) limits. As compared to TCCC's own wastewater quality standards, TKN (total kjeldahl nitrogen) was found to exceed the acceptable limit.

Corporate social responsibility initiatives

The major activities undertaken in relation to water include desilting of ponds; construction of rainwater-harvesting structures; tree or sapling plantation at schools in Nemam and Melmanambedu; donating garbage removing tricycles to Nemam, Vellavedu, and Melmannambedu panchayats; celebrating World Water Day and Environment Day; and organizing public awareness rally involving the students. In addition to these the plant has responded to the needs of the people affected by natural calamities like the tsunami and floods. Groups in other villages had the grievance that the activities of Coca-Cola are centred on Nemam village.

Detailed assessment

Site profile

The Nemam plant of HCCBPL (Hindustan Coca Cola Beverage Pvt Ltd) is located in Poonamallee block, district Thiruvellore in the state of Tamil Nadu, in South India. The area for the study was delineated with 1:50 000 scale base map (toposheet no. 65C/15 and 65C/16) of the Survey of India. Figure 4D.1 shows the delineated watershed and the sub-basins.

Geographic

The delineated Nemam watershed comprises an area of 142 km² and lies between longitudes 790 51' E and 80 o 03 ' E, and latitudes 13 o 00' N and 13 o 07' N. The watershed is plain and approximately 40 km away from the coast along the Bay of Bengal. Elevation is 30–80 m amsl (above mean sea level). The mean elevation is 52 m amsl and standard deviation 11 m amsl, as shown by the hypsometric curve in Figure 4D.2. The watershed forms a part of a river basin, namely, the Cooum basin.

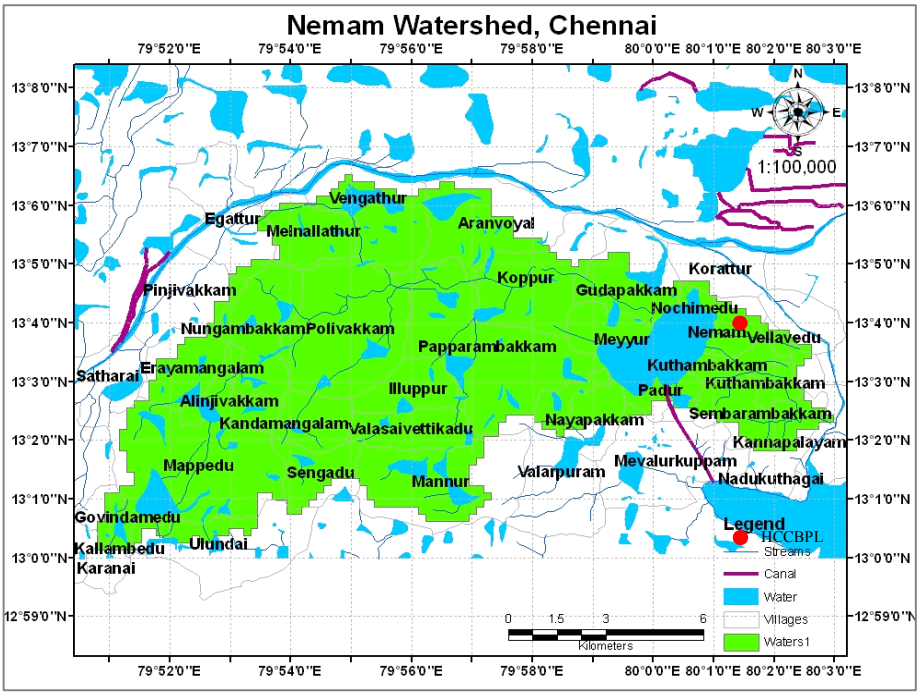


Figure 4D.1 Delineated Nemam watershed and the sub-basins

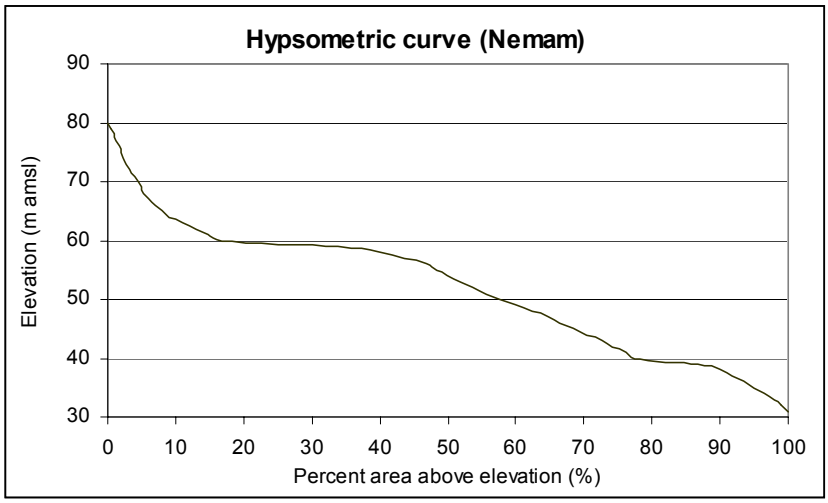


Figure 4D. 2 Hypsometric curve of Nemam watershed

Hydrometeorology

Rainfall

Generally, subtropical climate prevails in the region. The normal rainfall is approximately 1300 mm from four seasons, that is, South-West monsoon, North-East monsoon, winter season, and hot weather period. This is more than the national average rainfall of 1100 mm. The maximum rainfall, that is, more than 50 percent of the total, takes place between October and December from the North-East monsoon, followed by South-West monsoon between June and September. Rainfall pattern data from 1971 to 1998 shows that Poonamallee received more than normal rainfall – almost 55to 58 percent of the time, and less than normal rainfall almost 28 percent of the time (WRO 2000). During this period, 1974 was the most deficient year, when rainfall was less than 50 percent of the normal. On the other hand, years 1976, 1985, and 1997 were years of high rainfall, when rainfall was more than 50 percent of the normal (WRO 2000). In addition to above, monthly rainfall data available for the period 1995 to 2005 depicts that the region experienced rainfall ranging from 840 mm (2003/04) to 2249 mm (1996/97). The rainfall below normal was observed in the years 1997–2000, and 2001–04, as shown in Figure 4D.3.

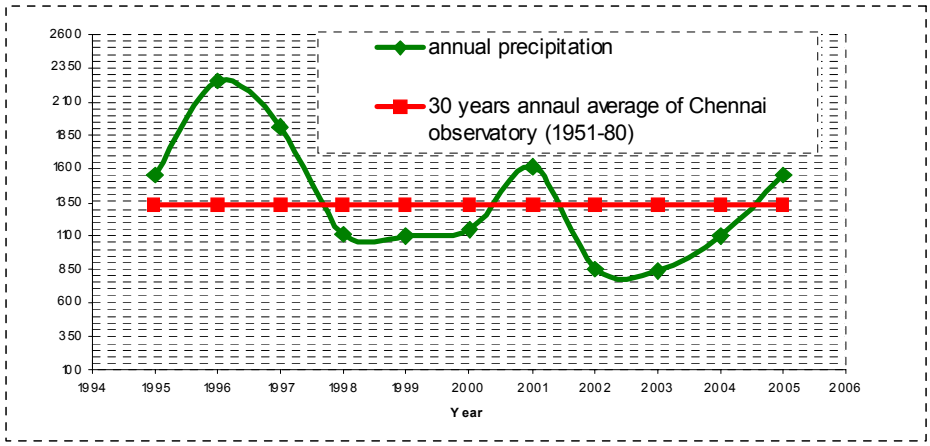


Figure 4D.3 Rainfall pattern (mm) in Neman watershed (1994–2006)

Temperature

The period of April to July is the hot period of the year when mean daily temperature exceeds 35 ºC. Mean daily minimum temperature is approximately 20 ºC. Figure 4D.4 shows the mean minimum and maximum temperatures in the region.

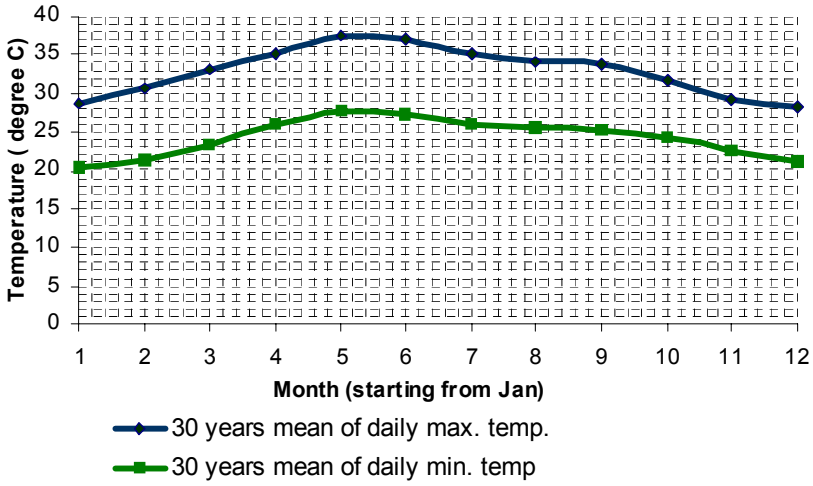


Figure 4D.4 Mean minimum and maximum temperatures in the region

Socio-economic

Poonamallee block is a suburb of Chennai (located 20 km away) in Thiruvellore district. The total area of Poonamallee is 240 km² and it consists of roughly 53 villages and was reclassified as a separate block in 1996. The total population of Poonamallee block was 431 781 in 2001. The pace of urbanization in Poonamallee has been very rapid and about 81 percent of the population in the block

was in urban areas in 2001. The population density was 1799 persons/km² in 2001. The region has been influenced by the rapid developments taking place in Chennai city because of its close proximity.

The occupational pattern in the Poonamallee block in 2001 is shown in Figure 4D.5. Even though agriculture is the major occupation in Thiruvellore district, due to the close proximity of Poonamallee block to Chennai city, the primary occupation in the block is not agriculture. The workers in the block are primarily engaged in non-agricultural activities. In fact, the number of people engaged in agricultural-related activities in the block is very small.

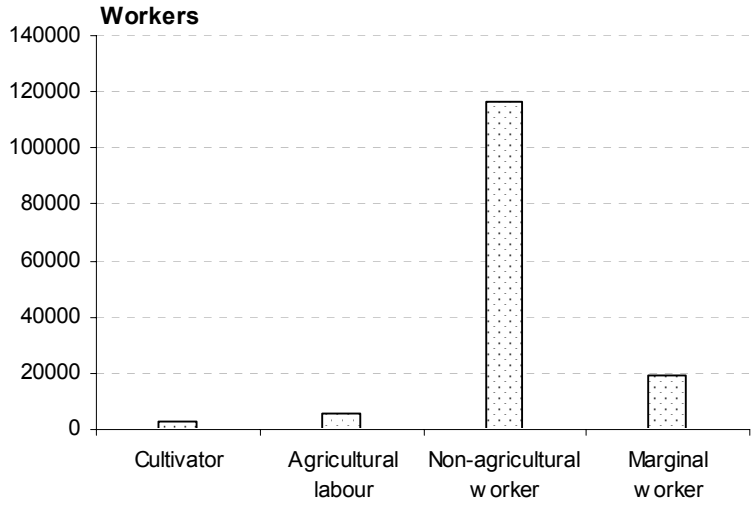


Figure 4D.5 Occupational patterns in the study area

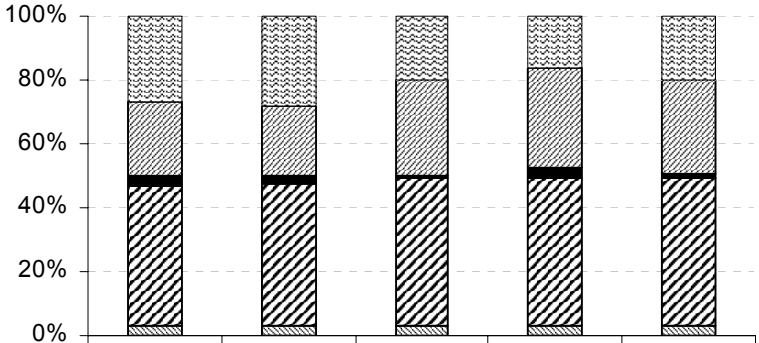
Source District Statistical Handbook of Thiruvellore District for 1999/2000 and 2005/06. Assistant Director of Statistics, Government of Tamil Nadu

Thiruvellore district is one of the fastest developing districts in Tamil Nadu in terms of industrial development. The district has many leading industries like Madras Refineries, Madras Fertilizers, Manali Petro Chemicals, MRF, Ashok Leyland, TI Cycles, Britannia India Ltd, Parry India Ltd, and Hindustan Motors. Also prominent are the Ennore Thermal Power Station and the Avadi Tank Factory. The district has 16 industrial estates, all in operation: 11 developed by the government and five by private organizations. There are also a number of small-scale industries, like food, wood, textile, chemical, engineering, non-metallic, and leather industries. All these are indications of the

study area's economy becoming more and more secondary and tertiary-sector-based.

Land use and agriculture

Land use pattern for a total of 175 54 ha (hectare) in Poonamallee block in the years 1998/1999 and 2005/06 is given in Figure 4D. 6. The maximum share of land was put to use in non-agricultural practices and the share of net sown area shows a declining trend.



	1998-99	1999-00	2000-01	2004-05	2005-06
Net sown area	26.9	27.9	20.3	16.5	19.7
Fallow land	23.4	21.9	29.7	31.2	29.9
Cultivable waste land	2.9	2.8	0.9	3.2	0.9
Non-agriculture	43.8	44.4	46.1	46.1	46.5
Forests	3.0	3.0	3.0	3.0	3.0

Figure 4D.6 Land use pattern in Poonamallee block (percent)

Source Poonamallee Block Handbook: 1999/2000 to 2005/06, Govt. of Tamil Nadu

The average cropping intensity has been increasing and was around 2.7 in 2005/06 (Table 4D.1). The average cropping intensities of over the last 5–7 years have been in the range of 1.8 to 2.7, which at times have used double utilization of the existing land. This has a direct bearing on the quantity of water required as crop cultivation is a water-intensive activity.

Table 4D.1 Land use pattern in hectares and cropping intensity

Land use pattern	*1998/99*	*1999/00*	*2000/01*	*2005/06*
Poonamallee: total geographical area = 17554 ha				
Gross sown area (A)	8682	9454	9125	9125
Net sown area (B)	4724	4905	3565	3439
Cropping Intensity (A or B)	1.84	1.93	2.56	2.65

Source Poonamallee Block Handbook: 1999/2000 to 2005/06, Govt. of Tamil Nadu

The major crops grown in the region are paddy, green gram, black gram, sugar cane, and groundnut. Apart from this, certain horticultural crops like mango, guava, and vegetables are also cultivated. Also, the area around Poonamallee is used extensively for cultivating the flower jasmine.

The major cropping pattern for the years 1999/00 and 2005/06 is given in Figure 4D.7. Paddy is the predominant crop and is grown in all the three cropping seasons.

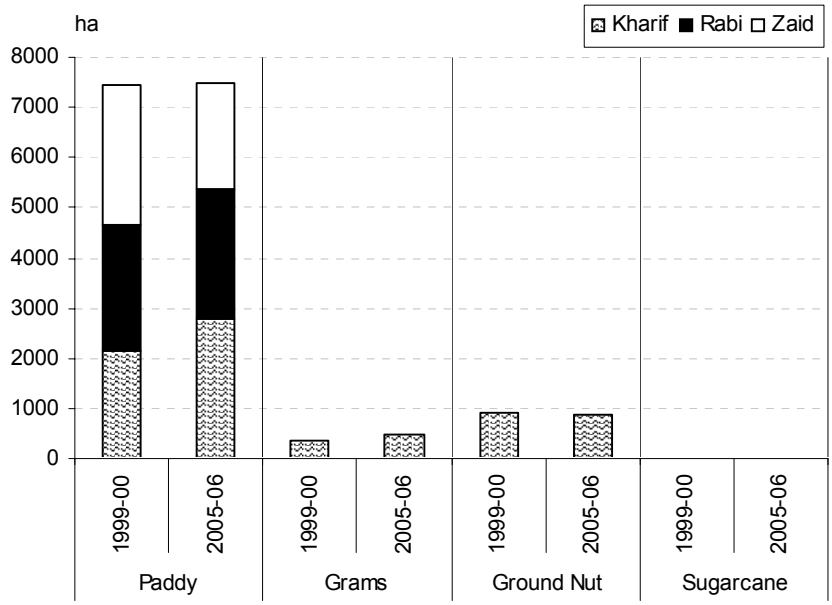


Figure 4D.7 Cropping pattern (hectares)

Source Poonamallee Block Handbook: 1999/2000 to 2005/06, Govt. of Tamil Nadu

The irrigated area under paddy and groundnut is almost equivalent to the cropped area and the area under irrigation for each of the major crops is given in Figure 4D.8.

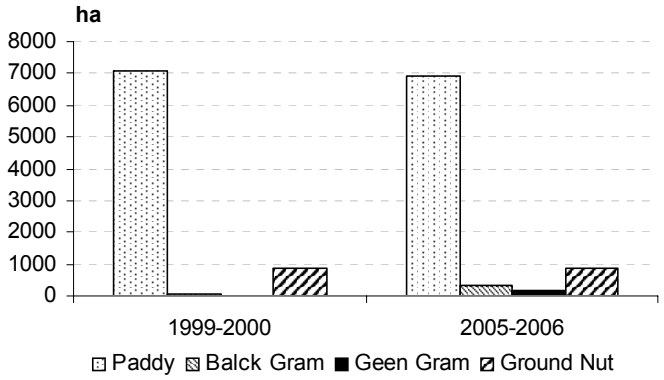


Figure 4D.8 Crop-wise irrigated area (hectares)

Source Poonamallee Block Handbook: 1999/2000 to 2005/06, Govt. of Tamil Nadu

Irrigation and penetration of pump sets

The typical sources used for irrigation in the study area are wells, tube wells, reservoirs, and tanks. Between 1999/2000 and 2005/2006, the trend has reversed, and the number of private tube wells has almost doubled and the number of large surface water tanks has been halved (Figure 4D.9). Also, there has been a greater preference for usage of electric pump sets compared to diesel sets (Figure 4D.10)

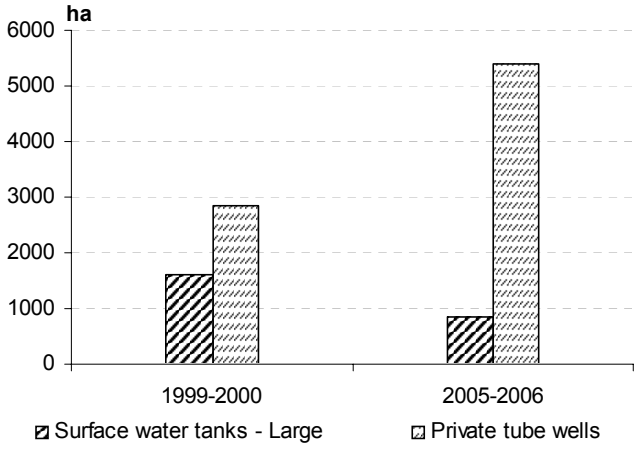


Figure 4D.9 Number of irrigation sources

Source Poonamallee Block Handbook: 1999/2000 to 2005/06, Govt. of Tamil Nadu

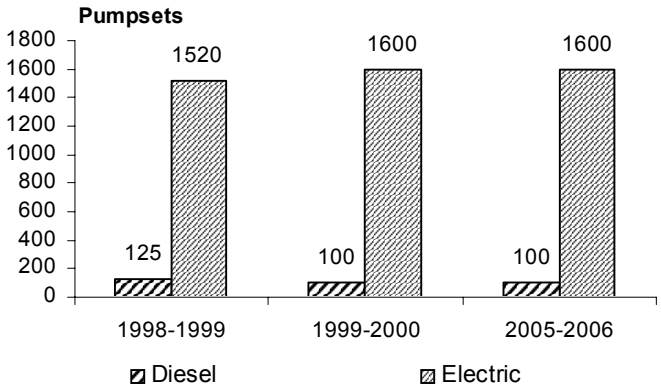


Figure 4D.10 Number of irrigation pump sets

Source Poonamallee Block Handbook: 1999/2000 to 2005/06, Govt. of Tamil Nadu

Fertilizer and pesticide use

Information on fertilizer and pesticide consumption over the years for Poonamallee block was not available. The usage of fertilizer, pesticides, and urea in Thiruvellore district has gone up significantly between 1999/2000 and 2005/06 (Table 4D.2).

Table 4D.2 Consumption of fertilizers and pesticides for Thiruvellore

Year	*Fertilizers* (in '000 tonnes)				Pesticides		*Urea* (in '000 tonnes)
	Nitrogenous (N)	*Phosphatic (P_2O_5)*	*Potassic (K_2O)*	*Total (NPK)*	*Dust* (kg)	*Liquid* (litre)	
1999/2000	17 098	7 100	5 020	29 218	1 684	505	17 323
2005/06	22 217	10 164	8 005	40 386	1 070	21 000	18 500

Source District Statistical Handbook of Thiruvellore District for 1999/2000 and 2005/06, Assistant Director of Statistics, Government of Tamil Nadu

Water situation

The watershed comprises two types of soil categories – aleisols (red sandy to red loamy soils) and inceptisols (red sandy to brown clayey soils).

The geologic formation in the watershed, namely, Jurassic–Crestaceous (part of upper Gondwana), mainly comprises shale and clay. Geomorphologically, these are named as pediplain and alluvial plain units that have moderate to good groundwater potentials and varying rates of infiltration. Water table occurs

under phreatic as well as semi-confined conditions. Depths to water tables in the entire area are found close to the surface and mostly in the range of 2–8 m bgl (below the ground level). Water level contour data for years 1994 and 1997 reported in WRO (2000) indicates that the water tables in general in the watershed have remained in the range of 4–8 m bgl. Figure 4D.11 depicts depths of water tables for some of the observation wells. The watershed experienced decline in water tables during the years 1999/2000 and 2003/04 due to low rainfall as discussed in the section on hydrometeorology above.

Groundwater development data of the Central Ground Water Board (CGWB 2005) at the block level shows that Poonamallee lies in the category of critical blocks where the stage of groundwater development is 90 to 100 percent of the net annual groundwater availability. Tanks, canals, and shallow dugwells serve as main sources of irrigation here.

Dominant flow of groundwater is in the east– south-east direction and follows the topography moving towards the sea.

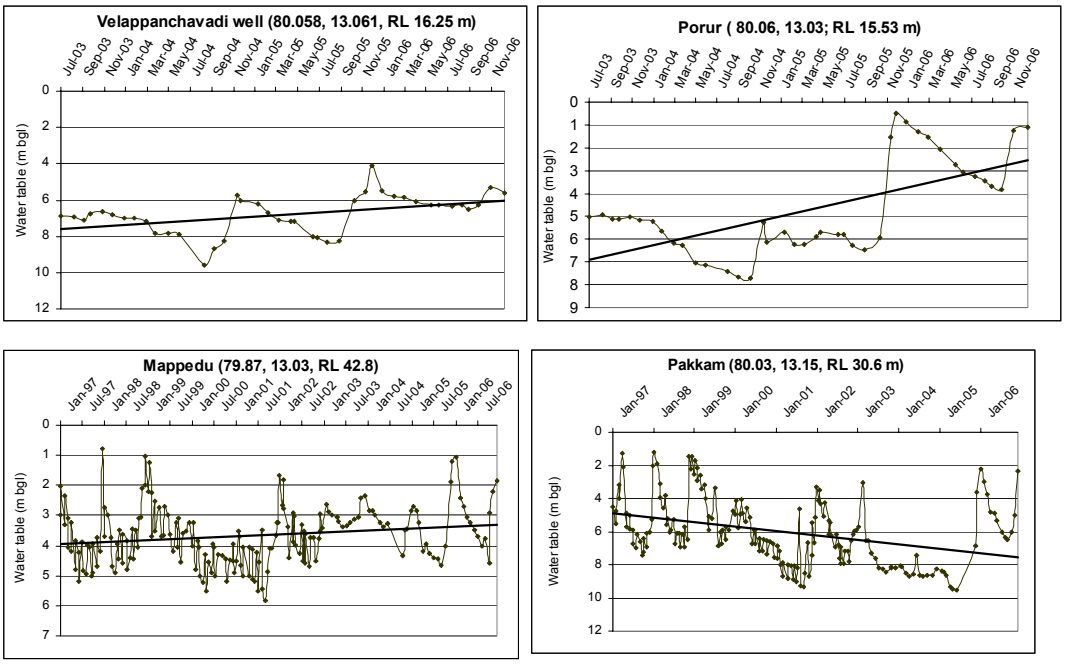


Figure 4D.11 Depth to water tables for some of the observation wells in the watershed

Based on the description of the watershed, including groundwater flow directions, the villages were identified for techno-social assessment. The process related to the identification of the villages

and the stakeholders for the study has been discussed in the chapter on approach and methodology.

Hindustan Coca-Cola Beverages Pvt. Limited, Nemam

HCCBPL plant uses groundwater for the production of RGB (refillable glass bottle) and the drink Maaza.

Plant capacity and utilization

Prior to 2004, the plant had the capacity to produce RGB from two RGB lines (600 bottles per minute each) and Maaza from one juice line (225 bottles per minute) as shown in Figure 4D.12. The plant stopped production from one RGB line in 2005 and this line was shifted to another plant. The plant did not provide the capacity utilization of the existing lines for the last three years. The plant has reported that overall plant capacity utilization in 2006 was 51.26 percent.

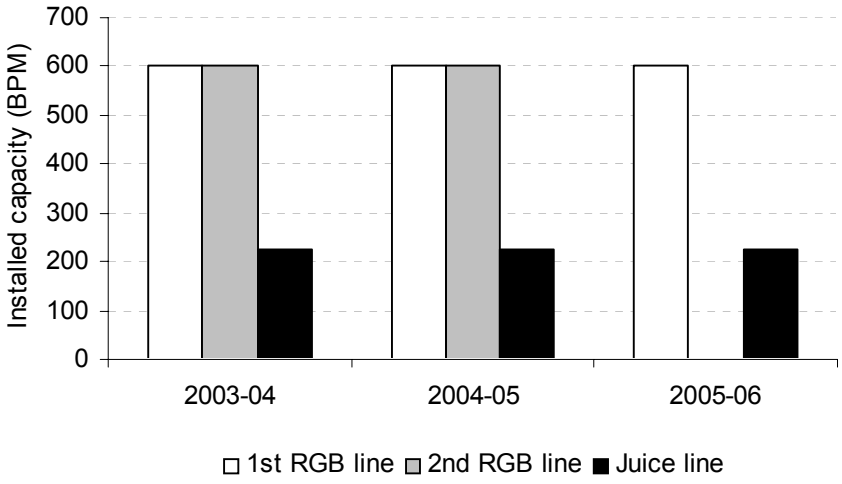


Figure 4D.12 Installed capacity of the plant

Water intake and production

Daily average water intake was about 450 kl (kilolitres)/day in most of the months except for the peak summer months (April–June). During that period, daily average water intake was about 600 kl/day for each the last three financial years. For some days in the summer months, this figure even reached a value of 1000 kl/day. However, the nature of daily water intake for the last three years followed a steady cyclical pattern. Thus, the trend of daily water intake for aggregate 34 months (from January 2003 to October 2006) remained more or less constant (Figure 4D.13).

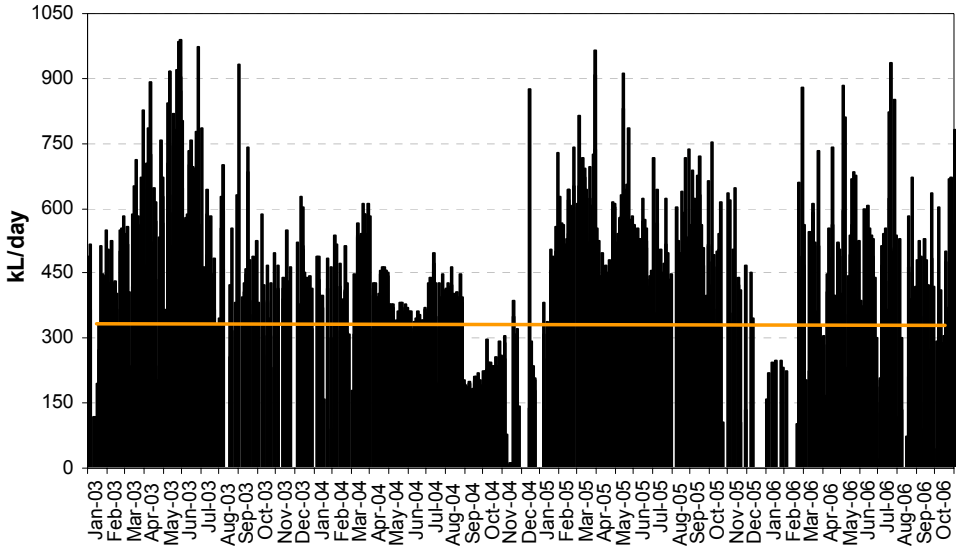


Figure 4D.13 Daily ground water intake

Total annual production of CSDs (carbonated soft drinks) has declined from 2004 to 2006 and the share of production of Maaza bottles went up compared to the CSDs (Table 4D.3 and Figure 4D.14).

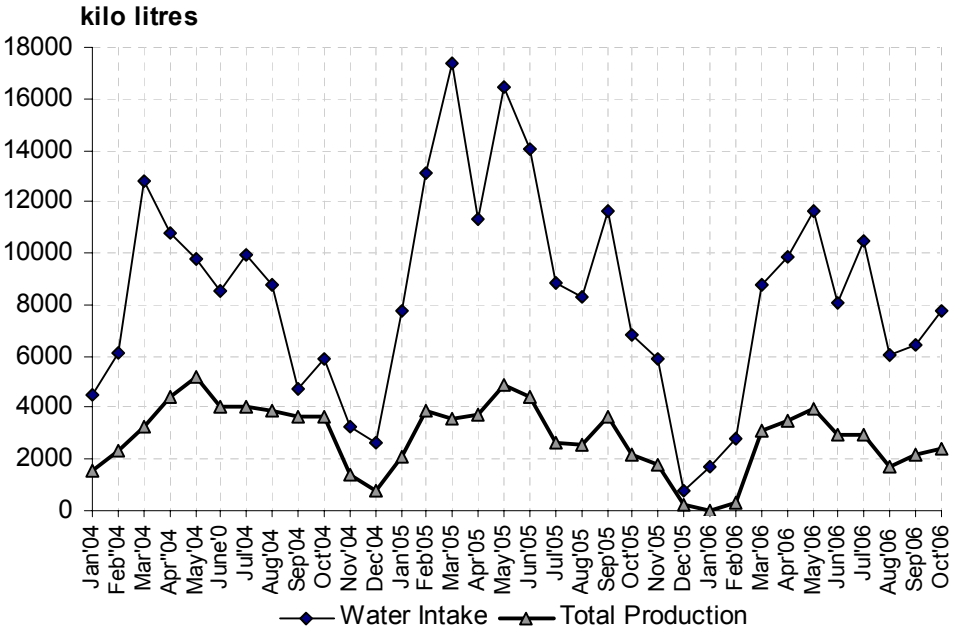


Figure 4D.14 Monthly production of CSD and Maaza

Table 4D.3 Share of RGB and juice bottles in total production

Year	*Ratio* (CSD or juice)	*Total production* (kl)	*CSD share* (percent)	*Juice share* (percent)
2004	5.4	38222	84.4	15.7
2005	4.7	35574	82.4	17.6
2006	4.1	23093	80.7	19.45

Groundwater intake by the plant increases when the product demand in the market goes up. Demand for CSDs is higher in the summer months, and as a result, the products produced by the plants in the peak summer months go up considerably. Figure 4D.14 shows the monthly groundwater intake by the plant and the corresponding volumes of production.

A strong linear relationship was not observed in this plant between the groundwater intake by the plant and its total production over a 33-month period (from January 2004 to October 2006). The correlation coefficient observed is 0.78. Figure 4D.15 shows the relationship between production and water intake on a monthly basis. This plant did not necessarily produce higher volumes of production in months where the water intake was relatively high. For example, water intake in the summer months of 2005 was higher as compared to 2004. However, production in 2005 was lower than 2004, which implies a rise in WUR (water utilization ratio) in 2005. In 2006, both water intake and production declined as compared to 2005. However, the overall trend in the water intake and production pattern of the plant across the years is similar.

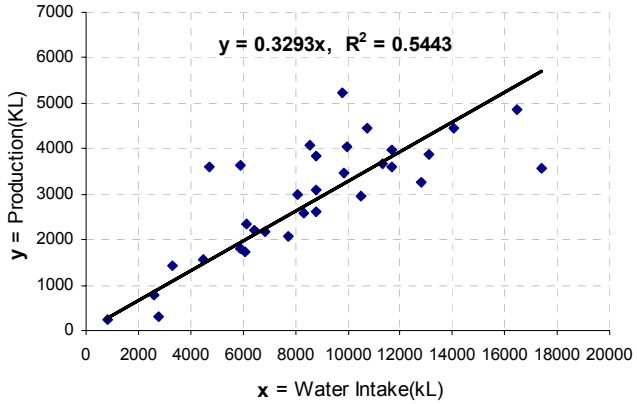


Figure 4D.15 Relationship between monthly groundwater intake and production

Water utilization ratio

The annual WUR values provided by the plant was found to be higher in 2005 compared to its previous and succeeding years (Table 4D. 4). According to the raw data provided by the plant, the value of WUR that was computed and was found to be low in 2004, went up in 2005 and then again declined in 2006. The computed WUR values were different from the annual WUR values provided by the plant but the trend of annual WUR from 2004 to 2006 were found to be similar.

Table 4D.4 Annual water utilization ratio

Year	*Plant estimate*	*TERI estimate*
2004	3.02	2.3
2005	3.32	3.4
2006	3.01	3.1

Selection of villages and stakeholder interaction

Identification of villages

The villages identified using the approach as discussed in the chapter on approach and methodology are the following.
Village in which the plant is located (M 1): Nemam
Village immediately upstream of the plant considering the regional direction of groundwater flow (U1): Nochimedu
Village immediately downstream of the plant considering the regional direction of groundwater flow (D 1): Vellavedu
Village at the extreme upstream end of the watershed in the direction of groundwater flow (U 2): Gudapakkam
Village at the extreme downstream end of the watershed in the regional direction of groundwater flow (D 2): Vellavedu
Village Vellavedu is a large village and therefore its expanse extends across the entire downstream segment till the watershed boundary. In addition to the above an immediate village was also chosen for ex situ water sampling (M 2): Korattur.

Figure 4D.16 indicates the location of the selected villages in the watershed.

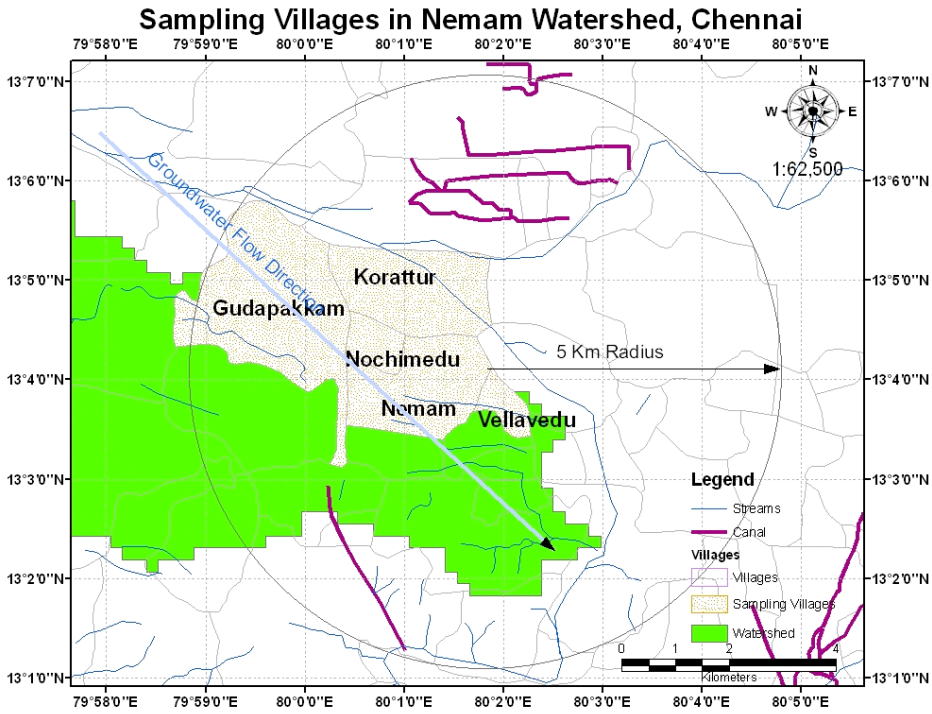


Figure 4D.16 Location of the selected villages in the watershed

Key stakeholder interaction

Stakeholder perceptions capture the views of different stakeholders on the issues of trends in water availability, quality, utilization, and access across the study villages. The section only records the views as presented by different stakeholders in the course of FGDs and key stakeholder interviews. It does not aim to make judgements nor draw conclusions based on these recorded perceptions.

The rationale for selection and relevance of stakeholders has been discussed in detail in chapter 2 on approach and methodology.

In the Poonamallee sub-watershed, four villages were selected for recording of perception to understand the general water scenario in the region around the Coca-Cola plant and the specific water management practices of the community inhabiting the area. This entailed looking at trends in water availability, utilization and access in the region by different stakeholders. FGDs (focused group discussions) were conducted with the key stakeholders. Additionally, key informants who could offer information about the general water quality and quantity scenario in the region were also interviewed.

A description of each of the stakeholders and their importance in the context of the study region is given below.

Gram panchayats

The four villages that were selected based on technical and social criteria for gauging community perceptions come under three gram panchayats. Hence, one FGD was conducted in each of the three panchayats, namely, Nemam (for village Nemam and Nochimedu), Vellavedu (for village Vellavedu), and Gudapakkam (for village Gudapakkam). The participants in the FGD included both male and female elected representatives representing their respective wards. In one of the meetings, the panchayat secretary also attended the meeting and recorded the minutes. Discussion with the panchayat members helped in gathering information related to water management activities undertaken by the gram panchayat.

Women

Four FGDs were held with women across the study villages to assess the changes in availability and quality of water for domestic use. Women who participated in the FGDs belonged to scheduled and backward caste categories. Most of the respondents were living for more than 12 years in the FGD villages. Due to their long stay in the village they were able to discuss the changes in water availability and quality over a period of time. The main source of family income was obtained through wage labour or contract labour or agricultural labour and majority of the respondents supplemented the family income either by working as agricultural labourers or as daily wage labourers in some factories in the nearby area.

Farmers

Three FGDs were held with farmers across the study villages to assess the changes in the availability and quality of water for irrigation. Barring Nochimedu, FGDs were conducted in all the study villages. Nochimedu is a small village under the gram panchayat of Nemam, where the majority of the population earns a living by working as daily wage labourers or agriculture labourers. No one in the village owns any agricultural land and hence there are no farmers in this village.

In Vellavedu and Gudapakkam, the average landholding size was 2 acres, whereas in Nemam it was 5 acres. The farming community in Gudapakkam mainly consisted of small time farmers. Agriculture was the only source of income for most of the participants; nevertheless some of them supplemented their

income either through dairy or by working in factories or companies in the nearby area. Farmers in all the study villages had been growing paddy for more than five decades and there have been no major changes in cropping patterns, despite changes in the varieties of paddy that is grown.

Weaker sections

Four FGDs were held with weaker sections across the study villages to assess the changes in availability and quality of water for agriculture and domestic uses. More importantly issues related to accessibility were discussed. Both men and women participated in the FGDs. The group mainly comprised scheduled and backward caste communities. Most of the respondents earned a living by working as agricultural labourers, while the others worked either as wage labourers or casual labourers. None of the respondents owned agricultural lands. Agriculture being seasonal in nature, the employment pattern was also seasonal and during the lean period most of them were largely unemployed.

Key persons

A number of key persons were interviewed; a brief description of each is presented below.

Representatives of the Coca-Cola plant: Representatives of the Coca-Cola Nemam plant were interviewed to understand the CSR (corporate social responsibility) initiatives undertaken. This was important as it helped understand the perspective of the company on various issues like employment of the local people and water situation in the region.

District official: A senior district official was interviewed to understand the issues related to water supply and sewage, rainfall pattern, and the groundwater status of the area.

Schoolteacher: A local schoolteacher was interviewed to get a broader understanding of the water scenario in the region. The teacher was also a farmer and given his long experience in irrigated agriculture, proved helpful in gauging the changes in water availability and quality in the region over a period of time.

Local person: In Nemam, a local person who had a strong opinion on the water consumption by Coca-Cola plant was interviewed.

Stakeholder perceptions on water quantity

Water sources

The stakeholder groups reported that the panchayat is primarily responsible for the supply of water for domestic purposes in all the study villages. The water supply is done through a combination of the following three modes: piped water supply, syntax OHTs (overhead tanks) and handpumps. In the case of the piped water supply, the groundwater is pumped and stored in high-capacity OHTs and then distributed through private and public taps at designated hours of the day. Syntax tanks and hand pumps are positioned in strategic locations and communities do not have to tread long distances to fetch water. The panchayat is also responsible for the maintenance of all the physical structures related to drinking water supply.

Paddy is the dominant crop in the study villages and farmers indicated that the Sambha (kharif) crop is entirely rain-fed. In Vellavedu and Nemam the farmers are primarily dependent on electrified open wells and bore wells to irrigate Navari (rabi) and Sornavari or Kar (zaid) crops. In these two villages, a few farmers whose fields are located near the *eri* (water tank) divert water from the *eri* through irrigation channels. However, their dependence on the *eri* is decreasing as more and more farmers are switching over to bore wells and dug wells due to sheer convenience. In Gudapakkam, farmers are completely dependent on the *eri* for irrigation. There are four outlets to the Gudapakkam *eri* that are connected to the distribution canals. The PWD (Public Works Department) is responsible for the maintenance of the *eri*. Four representatives known as grama kambukutti vettiyar (village water committee) supervise the water distribution through the canals. The general body of farmers selects them every year from amongst themselves.

Traditionally, open wells (public and private-owned by farmers which were also used for irrigation) had been used as a source for domestic purposes. Surface water sources such as ponds and lakes were also used in the past. Farmer's groups in all the study villages opined that the source of irrigation has not changed over the years although the mode of water extraction has undergone some changes.

Changes in water availability

In Nemam, Vellavedu, and Nochimedu, the stakeholder groups did not report any water shortage or stress, both for domestic and agricultural use. Groups belonging to women and weaker sections indicated that the overall water situation in the villages had

improved after the piped supply. Additional sources like handpumps and syntax tanks are used only when the piped supply is inadequate. Weaker sections did not express any problems related to accessibility. Farmers' groups in Neman and Vellavedu reported that groundwater was available at 20–25 feet. Availability of water, coupled with free supply of electricity, has enabled the farmers to cultivate paddy in all the three seasons.

The stakeholder groups in Nemam, Vellavedu, and Nochimedu noted that with the advent of the piped supply, the dependence on the traditional sources decreased and the traditional sources were used only in case of disruption in electricity supply, which was stated to be rare.

The key persons interviewed also indicated that the Poonamallee block has been traditionally a groundwater rich region. Even during the drought period there has been large-scale water transportation, especially from Neman to Chennai and other places. It was reported that in recent times several companies and in particular water-based industries have been established in the block mainly due to availability of water. A rating of water availability in the region by different stakeholders across various villages is indicated in the Table 4D.5.

The situation in Gudapakkam was entirely different, where all the stakeholder groups reported water shortage. The stakeholder groups were of the opinion that piped supply had not made much difference to the water availability situation. Women's groups indicated that they got water for only half an hour in a day and it was mainly used for drinking and cooking purposes and for bathing and washing, they still had to depend on public wells and the *eri*. The panchayat members and farmers' group mentioned that due to non-availability of sufficient water in the *eri*, the farmers could cultivate only during two seasons.

Table 4D.5 Rating of water availability

Village	*Panchayats*					*Women*					*Farmers*					*Weaker sections*				
Scale	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Nemam	X					X					X					X				
Nochimedu						X										X				
Vellavedu	X					X					X					X				
Gudapakkam				X					X					X					X	

Scale: 1– no scarcity 5 – very high scarcity

Reasons

Gudapakkam is the only village where the stakeholder groups expressed shortage of water. Although the reasons cited by the different groups were similar, the priority accorded to each varied across different stakeholders. The key reasons cited are

- Lack of sufficient rainfall in the last two years
- Increasing dependency on piped supply
- Increasing population
- Topography of the village
- Water flow in the *eri* decreasing
- Barriers to access water

All the stakeholder groups in Gudapakkam spoke about lack of sufficient rain over the last two years. They mentioned that even when the nearby villages experienced good rainfall, this village received less than the normal rainfall. The panchayat members pointed out that with the advent of the piped supply, the dependence on the traditional sources started decreasing and the pressure on the piped supply started increasing. The panchayat supplies water for only half an hour in the day and the women's group pointed out that it was not sufficient to meet their domestic water requirements. Moreover, some of the handpumps were stated to be under repair. One of the key persons interviewed remarked that Gudapakkam was geologically located in an area endowed with limited aquifers. The weaker sections mentioned that the pressure of the water in the public taps was slow as the terrain was uneven. Moreover, fetching water from the public taps was reported to be a tedious task due to the topography of the village. The erratic power supply added to the problem of water access.

The panchayat members and farmers expressed that the water level in the *eri* had been decreasing for the past 6 to 7 years mainly due to factors like sand mining, rise in population and the natural drainage leading towards the *eri* getting blocked. During summer months, the decline was reported to be drastic. According to the panchayat members, groundwater is available in Gudapakkam; however, farmers are not in a position to access it. Installing a bore well would require an investment of Rs 100 000. Hence the problem stated was more of 'infrastructure and resource barriers' to access irrigation water. It should be noted here that the members were not sure at what depth the water would be available. Some opined that water would be available at 50 feet, while the others remarked that it would be available only at 100 feet.

Concerns were raised by the key persons regarding conservation and management of ground water. It was expressed that the present levels of extraction may not be sustainable considering large-scale increase in population, continued intensive groundwater usage and projected industrialization.

Impacts

In Gudapakkam, the different stakeholder groups described the various impacts they felt due to water shortage. The women and weaker sections informed that in the place of two pots of water they used only one pot and instead of taking bath every day they took bath only on alternate days. They also tried to restrict the usage of water as much as possible. The farmers mentioned that they were able to undertake cultivation only in two agricultural seasons due to water shortage and also during stressful years, they left certain parts of the land fallow during the rabi season.

Women and the weaker sections observed that to improve the water situation in the village the panchayat had suggested rainwater harvesting. On the instruction of the panchayat they had dug up certain pits for collecting rainwater. For this no monetary assistance was given by any government agency. These pits became a sort of nuisance because they accumulated dirty water, and children frequently fell into these pits. Therefore, many of them had covered these pits. Also, the stakeholder groups mentioned that as most of the people in the village did not have concrete roofing, rainwater harvesting was not an option. All the stakeholder groups also identified cleaning up of the public wells and ponds as an urgent priority.

Stakeholder perceptions on water quality

Stakeholder groups in all the study villages opined that water quality is good and fit for domestic use and also for irrigation.

Even though stakeholder groups of women, weaker sections, and the panchayat members reported an improvement in the quality of drinking water after the piped supply, some minor complaints were raised during discussions with them. Women's groups in Gudapakkam reported that syntax tanks yielded *uppu thanni* (salty water) and they did not feel fresh even after bathing. The panchayat members also opined that the public wells and hand pumps yielded salty water during the summer months. The saltiness in the water was mainly attributed to high salt content of the groundwater in the village.

In Nochimedu, weaker sections complained that for the last two years, the quality of water supplied through the panchayat piped water supply has deteriorated. According to them the difference in quality is due to the change in the location of the bore well. When the panchayat started water supply, water was pumped from a bore well situated at Sivan Kovil (Siva Temple) in Nemam village. Two years back the panchayat started pumping water from a bore well near Nemam hospital and the water there was sour (metallic taste). The change in location was due to diverting of water from Sivan Kovil to Anderson Pettai, another village coming under the Nemam panchayat.

The key persons interviewed also vouched for the good quality of water in the study villages. Few of the key persons indicated that during summer months the TDS (total dissolved solids) would shoot up to 750 PPM (parts per million), while during non-summer months, the TDS (total dissolved solids) was as little as 150 PPM. However, one key person from Nemam village was of the opinion that in recent times, the water had acquired a foul smell and that was due to the reduction in groundwater level due to the heavy usage by water bottling companies. But this was an isolated opinion not shared in any of the many discussions conducted in the villages under study.

In Nemam and Nochimedu, women's group mentioned that earlier when they were dependant on traditional sources, they were not very happy with the quality. At that time the water from handpumps in Nochimedu smelled of rust and was difficult to drink, while in Nemam, water from public wells was too muddy for domestic purposes. The panchayat members in Gudapakkam observed that earlier water from *eri* was used for drinking, but the community stopped taking water from *eri* as the Spartex tile factory released effluents into the *eri*. In the year 2004 the tile factory was shut due to some labour problems, but still people did not take water from the *eri* for household purposes.

Protests and agitations

The stakeholder groups in all the villages under study are not aware of any protests or dharnas against the Coca-Cola plant. According to the Coca-Cola representative, the local communities have no complaints against them and there are no PILs (public interest litigation) of any kind of complaints filed against the plant.

Regulatory and governance structures and compliance

HCCBPL Nemam was established in 1997 as a FOBO (franchise owned bottling operation) owned by Chennai Bottling Private Limited. It was taken over by Coca-Cola India in 2000 and subsequently became a COBO (company owned bottling operation). The plant meets its industrial water requirements from two bore wells, which may also be used simultaneously, depending on production requirements. As informed by the plant management, the pump sets are on average 7.5 HP (horse power) each. The plant sources the water drawn from the bore wells through a pipeline, the length of which is approximately 2 km. Although the borewells are located on land owned by the Company, a few metres of the pipeline runs through panchayat land; Coca-Cola states that there have been no complaints with respect to this till date.

This section comprises a review of the following.

- A brief review of the policy and laws with respect to groundwater extraction in Tamil Nadu.
- Compliance of HCCBPL Nemam with legal and administrative requirements governing the plant's establishment and operations, with a focus on water resources management and wastewater disposal.
- Compliance of HCCBPL, Nemam, with TCCC corporate requirements on water resources management.

Tamil Nadu State Water Policy

The Government of Tamil Nadu adopted a State Water Policy in 1994 along the lines of the National Water Policy of 1987. Subsequently, when the National Water Policy was revised in 2002, the Tamil Nadu government initiated the process of revising the state policy to include various current concerns. Subsequently, the Tamil Nadu Groundwater (Development and Management) Act 2003, was enacted to ensure the planned development and proper management of ground water resources in the state; however, it is not yet in force as the rules are yet to be framed. When implemented, the Act would apply to the whole state except the CMA (Chennai Metropolitan Area), where the Chennai Metropolitan Area Groundwater (Regulation) Act 1987 is applicable. This section contains overviews of the salient features of the Tamil Nadu water policy under formulation, and provisions of the Chennai Metropolitan Area Groundwater (Regulation) Act 1987 applicable to the establishment and operation of HCCBPL, Nemam.

Some of the major aspects of the new policy being formulated, obtained from a secondary source, are the following.

- Importance of water resources in the development of the state
- Need for considering socio-economic aspects of water resource projects
- Need for basin-wide planning for equitable water use
- Priorities for water use in the state
- Management and development of groundwater resources.
- Watershed management in rain-fed areas
- Increase in demand for non-agricultural uses
- Management of water quality and environmental aspects
- Need for a hydrological database for planning and management
- Stakeholder participation in management, for example, water user associations
- Need for proper pricing of water in different sectors

The apex institution in the state at the policy level for water resources management is the Water Resources Control and Review Council chaired by the chief minister; Metro-water is the implanting agency in the CMA. Given that the reformulation of the policy is based on the amended National Water Policy 2002, it follows that water for human use has been accorded the highest priority in Tamil Nadu as well.

State legal and administrative framework

Chennai Metropolitan Area (Groundwater) Regulation Act, 1987

The Chennai Metropolitan Area Groundwater (Regulation) Act, 27 of 1987, which came into force with effect from February 1988, requires: (i) registration of wells; (ii) issue of licence to extract groundwater for non-domestic purposes, and (iii) issue of licences for transportation of water through goods vehicles. The Act was amended in 2002, when the definition of the scheduled area was expanded; a gazette notification of the amended act was published in October 2002.

According to the Act, free extraction of groundwater is permitted only for domestic purposes. In this context, in granting or refusing a licence for groundwater extraction, the competent authority would have to take cognisance of the following.

- The purpose or purposes for which groundwater is to be used
- The existence of other competitive users
- The availability of groundwater
- Effect on other sources of water supply
- The compatibility with the existing water supply system

- The availability of factors controlling or preventing pollution

Licence fees, payable annually, are determined by the purpose and quantum of extraction. Higher rates apply to groundwater extraction for industrial purposes based on the capacity of the pump sets being used while nominal rates apply to groundwater extraction for agricultural purposes.

As discussed above, registration of borewells under the CMA is applicable to the notified areas as per the Schedule of the Chennai Metropolitan Area Groundwater (Regulation) Act. However, since HCCBPL Nemam is located in the Madura Nemam village, which is not a notified area as per the schedule of the Act, there is no requirement of registration for the registration of its borewells.

Apart from the above, the establishment of the plant, located in an agricultural area within the limits of the CMA, required an NOC from the CMDA for the conversion of agrarian land for industrial purposes, and a licence from the Madura-Nemam village panchayat, which is renewed annually. As per documents received from CCI, HCCBPL Nemam applied for the annual renewal of the panchayat license in February 2007, the license subsequently issued by the panchayat is valid until March 31, 2008. A copy of the license was made available to the project team; the panchayat license however does not contain any provisions with respect to water drawal and usage. It gives the plant permission to manufacture, store, distribute and sell its products under the provisions of the Prevention of Food Adulteration Act, 1954.

Industry category as per TNPCB

The TNPCB (Tamil Nadu Pollution Control Board) issued consent to establish the plant in 1997; consents to operate are renewed every three years subject to the fulfilment of the conditions in the previous consent to operate. The TNPCB has categorized the facility in the orange category of industries.

Compliance with regulatory and TCCC requirements

The CtE (Consent to Establish) was issued by the TNPCB to HCCBPL Nemam in 1997. It prescribes conditions necessary for wastewater disposal; these conditions and compliance against them by HCCBPL, Nemam, are presented in Table 4D.6. The CtE, however, does not lay down any norms for drawing or using water for the industrial process.

Table 4D.6 Compliance with conditions specified in CtE by HCCBPL, Nemam

Requirements	*Compliance in Nemam plant; remarks if any*
General	CtE (Consent to Establish) issued on 3/3/1997
Limit on discharge for wastewater	Not mentioned in the CtE
Mode of discharge of wastewater	Land application *Plant is zero discharge as per the latest consent to operate*
Compliance with discharge standards	Not mentioned in the CtE
Requirement of sampling and measurement	Not mentioned in the CtE
Interlocking of pollution control devices with process	Not mentioned in the CtE
Any other issues (s)	Unit shall provide impervious solar evaporation pan for evaporating wastewater generated from softener plant *Loading rate of treated effluent prescribed at 35 kl/ha/day*

Note: The compliance of the plant is based on secondary data provided by CCI: results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

The last two renewals of the CtO (Consent to Operate) issued to HCCBPL, Nemam, were on 26 October 2005, with its validity extending to 31 March 2007, and the latest extension of CtO has been granted up to 31 March 2008.

The currently applicable CtO (Consent to Operate) issued to HCCBPL Nemam is valid until March 31, 2008. It is an extension of most of the conditions mentioned in the CtO issued to the plant on 26 October 2005, which was valid until March 31, 2007.

The CtO issued in October 2005 maintains the same conditions as mentioned in the CtE with limit of discharge set at 500 KLD (kilolitres per day) (480 KLD trade treated effluent + 20 KLD domestic effluent) and the requirement of a green belt around the plant boundary. Waste-resource-management-related criteria contained in the CtE dated 26 October 2005, and the facility's compliance against them, is summarized in Table 4D.7.

Table 4D.7 Compliance with conditions specified in CtO by HCCBPL, Nemam

Requirements	*Compliance in Nemam plant; remarks if any*
General	CtO (Consent to Operate) issued to HCCBPL Nemam valid 31 March 2008;
Limit on discharge for wastewater	500 KLD (480 KLD trade treated effluent + 20 KLD domestic effluent). No data on daily discharge of effluent, based on annual discharge data for year 2006 (from January to November) and number of operating days, the daily generation comes out to be around 404 KLD, which is well with in the norm
Mode of discharge of wastewater	Zero-discharge plant as per the CtO
Compliance with discharge standards	Limit for 35 parameters The parameters in test report enclosed are in compliance
Any other issues (s)	Plant boundary to be planted with trees @ 1000/ha Plantation present in the plant complex; density and area of plantation was not physically verified during plant visit;

Note: The compliance of the plant is based on secondary data provided by CCI: results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

The CtO issued by TNPCB to HCCBPL Nemam, valid until March 31, 2008 also requires the plant to: (i) ensure that the cooling water shall be kept under close circuit system; (ii) ensure that untreated trade effluent does not gain access, directly or indirectly, to surface water, ground water or on land; (iii) evaporate the high TDS RO rejects in SEP without overflow or seepage.

Compliance with TCCC corporate practices on water management in HCCBPL, Nemam

Water drawal and usage

As noted, HCCBPL, Nemam, extracts groundwater for its manufacturing activities from pump-sets installed in two bore-wells. Table 4D.8 gauges compliance of the bottling unit with water resource management requirements of the Coca-Cola Company.

Table 4D.8 Compliance with TCCC water resource management requirements by HCCBPL, Nemam

Requirements	*Compliance in Nemam plant; remarks if any*
Environmental due diligence to be conducted prior to siting of the plant	Conducted, EDD report not shared since, as per TCCC, it may contain "sensitive information of both a business and legal nature".
Documented water availability assessment	Pump test stated to be conducted at the time of setting up the plant, report not shared with TERI. Report on hydrological surveys conducted for the area around the plant in year 2004 enclosed; report suggests the aquifer which the plant is tapping is deep, has no contamination, is safe for use, and has no influence on pumping in nearby observation wells.
Initial and periodic water utilization assessments	Carried out as evident by reducing water use ratio over the years
Implement and maintain a process for water utilization	Process of water balance or audit is maintained
Establish a continuous improvement process for water utilization	Yes, WUR was 3.70 in 2001 and reduced to 2.25 in 2006, potential unknown
Define water utilization objectives and goals in annual business plans	Optimization of water utilization per litre of the beverage produced remains the annual objective; water conservation targets are defined each year in consultation with corporate office.
Develop and execute internal and external water contingency plans	Not available; details on rainwater-harvesting initiatives undertaken within the plant have been shared.

Note: Based on information provided by TCCC and CCI and site visits by the project team

As stated in Chapter 3, Coca-Cola has certain guidelines on water resources management. These, and their implementation in HCCBPL Nemam, are summarized in Table 4D.9 below.

Table 4D.9 Compliance with TCCC water resource management guidelines by HCCBPL, Nemam

Guideline	*Observation in HCCBPL, Nemam*
A self-assessment on water utilization	A plant level water distribution or balance is maintained and water use is optimized at each level of the process based on in-plant trials and suggestions from the corporate office. As a result, the water use ratio has reduced over the years. A water usage self-assessment is done annually at the plant in TCCC format but a copy of the responses by the plant was not shared by Coca-Cola (India)
A self-assessment on water supply	As per documents received, a safe yield of the water supply source is assessed at the time of establishment of the plant. Quality of raw water is checked on a daily basis for selected parameters at the plant and once in a year by an accredited laboratory. A water supply self-assessment is done annually at the plant in TCCC format but a copy of the responses by the plant was not shared by Coca-Cola (India)
The data collected during self assessments to be used to build a water conservation plan	Since self-assessment responses were not shared, it is difficult to ascertain how information collated during self-assessments is used to build a water conservation plan.
The establishment of a cross-functional team for water resources management	The names, designations and responsibilities of a seven-member cross-functional water resource management team at HCCBPL Nemam have been shared with TERI; the quality assurance manager of the plant heads the team. As intimated by the plant management, the responsibilities include the implementation of WRM systems, calculation of the WUR, monthly water balances, creating awareness to minimize and reduce water usage in the processing, utility, bottle washer, and syrup room areas, monitor the effective operation of all recovery schemes.

Note: Based on information provided by TCCC and CCI and site visits by the project team

Wastewater discharge

Coca-Cola corporate policy lays down company standards for effluent disposal as well, as noted in Chapter 3. The regulatory standards for HCCBPL, Nemam, are specified in the CtO issued by the TNPCB, which specifies limits for 33 pollutants for the treated effluent discharged from the ETP of the plant. The limits are

- pH – 5.5 to 9.0
- Temperature – 40 ºC at the point of discharge
- Total suspended solids – not to exceed 100 mg/l

- Particle size of total suspended solid – shall pass 850 micron IS sieve
- Total dissolved solids – not to exceed 2100 mg/l
- Chloride as Cl – not to exceed 1000 mg/l
- Sulphide – not to exceed 2 mg/l
- Sulphate - not to exceed 1000 mg/l
- Fluoride – not to exceed 2 mg/l
- Ammoniacal nitrogen – not to exceed 50 mg/l
- Copper – not to exceed 3 mg/l
- Zinc – not to exceed 1 mg/l
- Phenolic compounds – not to exceed 1 mg/l
- Boron – not to exceed 2 mg/l
- BOD (biological oxygen demand) at 270 ^{o}C, 5 days – not to exceed 30 mg/l
- COD (chemical oxygen demand) – not to exceed 250 mg/l
- Oil and gas – not to exceed 10 mg/l
- Total residual chlorine – not to exceed 1 mg/l
- Arsenic – not to exceed 0.2 mg/l
- Cadmium – not to exceed 2 mg/l
- Total chromium – not to exceed 2 mg/l
- Chromium (hexavalent) – not to exceed 0.1 mg/l
- Lead – not to exceed 0.1 mg/l
- Selenium – not to exceed 0.05 mg/l
- Mercury – not to exceed 0.01 mg/l
- Pesticides – absent
- Alpha emitters – not to exceed 10-7 micro Curie/ml
- Beta emitters – not to exceed 10-6 micro Curie/ml
- Free ammonia – not to exceed 5 mg/l
- Dissolved phosphate – not to exceed 5 mg/l
- TKN (total kjeldahl nitrogen) – not to exceed 100 mg/l
- CN (cyanide) – not to exceed 0.2 mg/l
- Nickel – not to exceed 3 mg/l

As per the corporate requirements, the plant needs to get its treated effluent analysed once a year by an accredited laboratory and send the results to the corporate office. Table 4D.10 checks the compliance of HCCBPL Nemam plant with these wastewater requirements.

Table 4D.10 Compliance with TCCC wastewater management requirements by HCCBPL, Nemam

Requirements	*Observations in Nemam plant*
Meet applicable regulatory requirements.	Yes (as per documents received; TNPCB officials too did not point to any anomaly)
Maintain an effluent quality that will have no adverse effects on fish or other aquatic biota in receiving waters.	Yes, as per the data sheets provided by the plant
Maintain and operate treatment facilities in an efficient manner.	Yes, as per the documents received
Compliance with wastewater quality requirements developed by TCCC.	Yes, as per the documents received
A detailed drainage plan of all water and wastewater streams in the facility.	Yes, separate plans existing; verified during the plant visit
Separate wastewater streams for process wastewater, sanitary wastewater, cooling water, and storm water.	Yes, Sewage discharged in septic tanks, separate line for storm water and cooling and process wastewater taken to ETP
Prevent the pollution (of) from water and wastewater.	Adequate measures provided
Minimize the volume, strength, and hazardous nature of wastewater.	Around 22 percent of treated wastewater is recycled or reused in the process and 78 percent is used for maintenance of green belt. On an average 250 m^3 of water is recycled every day.
Treatment of process water such that it is	
compliant with TCCC analytical standards compliant with government effluent discharge standards Conducive to the long-term survival of fish in the treated effluent	Yes, as per the information provided by HCCBPL, Nemam Yes, as per the information provided by HCCBPL, Nemam Yes, as per the information provided by HCCBPL, Nemam
Sanitary wastewater to be discharged to a sewer connected or a sewage treatment plant	Yes, plant in compliance. STP (Sewage treatment plant) arrangement at site.
Treatment of storm water according to government regulations if applicable; else prevent the pollution of water and wastewater streams due to the run-off	Yes, separate management for storm water through dedicated drains.
Non-contact cooling water may be discharged into the local environment unless otherwise dictated by local laws or regulations	Not Applicable
If treated wastewater discharge is through infiltration, prior to infiltration the wastewater must meet TCCC requirements and local regulations	Not Applicable

Requirements	*Observations in Nemam plant*
If treated wastewater is disposed through land application, then	
Groundwater must be monitored quarterly within the application area, as well as up- and down-gradient of the application area	No monitoring by the plant
The soil's carrying capacity should not be exceeded such that there is surface run-off	No monitoring done at present by the plant
Water intended for spray fields, should not be discharged into nearby water bodies; nor should excess runoff from sprayfields be allowed to enter nearby water bodies	Not Applicable; The treated wastewater meets the local regulatory requirements for land disposal. No separate TCCC standards exist for treated wastewater to be applied on land

Note: The compliance of the plant is based on secondary data provided by CCI: results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

According to the documents received, HCCBPL, Nemam attained the E1 level of compliance in 2005 under TCCC audit system (refer Chapter 3). Apart from the above, it has also received the ISO 9001 certification for quality in 2003, and the ISO 14001 certification for environmental management standards in 2003.

Water-related CSR (Corporate Social Responsibility) Initiatives

As per information provided by CCI, the CSR initiatives of HCCBPL Nemam focus on three areas: water, health, and education. The company noted that the actual selection of the projects is left to the bottling plant management to ensure flexibility in the undertaking of projects, such that they are relevant to local needs. The plan's CSR initiatives are lead by the Human Resources manager who reports to the Factory Manager. A CSR Coordinator is responsible for the execution of all community initiatives on the advice of the Plant HR Manager. According to the plant, CSR initiatives were identified based on a need analysis exercise conducted in October 2005 and written requests received from relevant stakeholders including village panchayats. Also, the plant participated in tsunami relief initiatives though the distribution of Kinley drinking water bottles, food packets, clothing articles, etc., in tsunami-hit districts of the city of Chennai in 2005

Specific water-related CSR initiatives of HCCBPL Nemam include the following.

- Rainwater-harvesting initiatives in Melmanambedu Panchayat Union Middle School and Vellavedu Police Station during August 2006
- The celebration of World Water Day in Melmanabedu middle school in 2006 in which panchayat presidents and the water

supply maintenance team of the Nemam area participated. A discussion on Swajaldhara rural drinking water scheme was conducted with the presidents of three panchayats during the event. The Swajaldhara scheme is a Government initiated scheme, based on the principle of empowering villagers, and ensuring their full participation in the planning, design, implementation, control of finances, and management of drinking water assets.

Stakeholder perceptions on CSR

In Nochimedu and Nemam the weaker sections acknowledged that during the floods in 2005, Coca-Cola had distributed drinking water and food packets. The panchayat members in Vellavedu mentioned the that the plant had constructed a rainwater-harvesting structure in Vellavedu police station. None of the stakeholder groups mentioned the need for undertaking any water-related CSR activities by the Coca-Cola Company.

Technical assessment

Regional assessment of water quality

Water quality assessment for the selected villages has been undertaken with an aim to develop an insight into the quality of groundwater that is sourced and consumed by HCCBPL plant at Nemam and the impact, if any, of the agricultural management practices such as the use of fertilizers and pesticides on the quality of groundwater. The assessment here does not relate the regional groundwater quality to the operations of the Coca-Cola plant.

Selection of sampling location

Groundwater sampling was done in the five selected villages. The justification for selection of villages has been discussed in the chapter on approach and methodology.

A total of eight sampling locations were selected for sample collection and analysis. Table 4D.11 gives the description of sampling location and Figure 4D.17 gives the location of these sampling points on the watershed map of the area.

Table 4D.11 Sampling locations

Village	*Location*	*Source*
Gudapakkam	Panchayat well	Open well
Korattur	Pillayar Street, Nemam Post,	Handpump
Korattur	Mr. Ram Chandran (respondent) Owner: Narayanan,	Bore well
Nochimedu	Mr. Venkatesan,	Hand pump
Nemam	Mr. Yagamurti	Bore well
Nemam	Mr. V kanaku,	Hand pump
Vellavedu	Mr. V K Sambandham	Bore well
Vellavedu	Common handpump, Mr. Attinkarai Theruvu	Hand pump

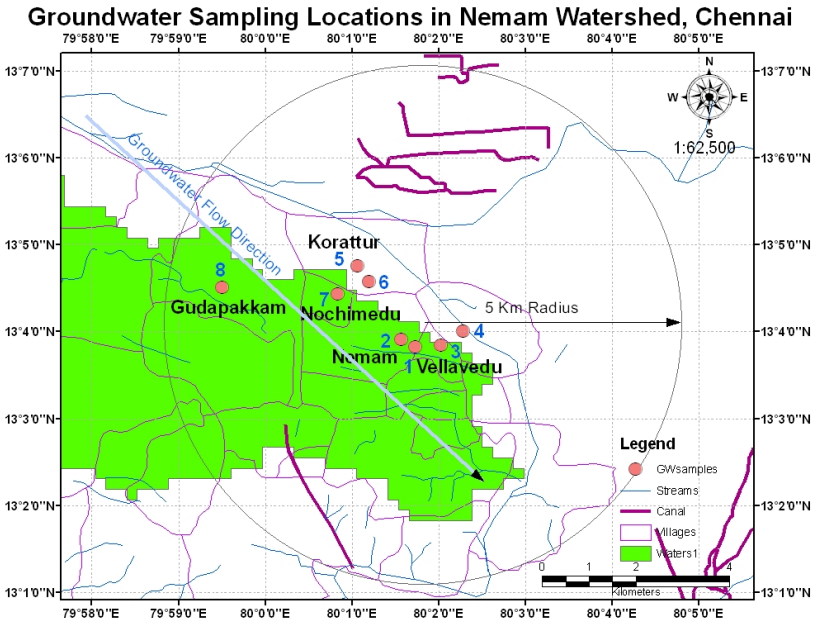


Figure 4D.17 Showing groundwater sampling locations in Nemam region

The samples were collected from the above locations on the following dates:

First round	29 March 2007 to 30 March 2007
Second round	26 April 2007 to 27 April 2007
Third round	17 May 2007 to 18 May 2007

These samples were collected, preserved and transported to the designated laboratories as per the set protocols, the description of which is discussed in the chapter on approach and methodology.

Test results

The regional assessment of groundwater quality shows that all of the monitored villages in the watershed showed exceedance for TDS and aluminium as compared to IS 10500 desirable standards, along with heavy metal like barium as compared to WHO guidelines.

In addition to the above parameters (as compared to IS 10500) the village Gudapakkam (at the extreme upstream village, U 2) showed exceedance for calcium, faecal coliform, chloride, nitrate, MPN (most probable number) coliform, and E. coli, along with nickel and lead (as per WHO guidelines).

Villages, Korattur (village immediate to the plant, M 2) and Nochimedu (immediate upstream village, U1) were found to be exceeding the limits for most number of parameters. Korattur (M 2) showed exceedance for MPN coliform, faecal coliform, total alkalinity, calcium, iron, fluoride, and sulphate, along with lead (as per WHO guidelines). Nochimedu (U 1) showed exceedance for total alkalinity, turbidity, calcium, iron, fluoride, sulphate, and manganese.

Village Nemam (M 1), where the plant is located, showed exceedance for MPN coliform, along with lead (as per WHO guidelines) beside the parameters found commonly exceeding in all the villages. Village Vellavedu (D2), an extreme downstream village, showed exceedance for additional parameters like MPN coliform, faecal coliform, total alkalinity, and iron.

It was also observed that village Gudapakkam (U2) showed exceedance for pesticides endosulfan-1 and endosulfan-2 when compared to the IS 14543 limits. However, no other monitored pesticides were detected in any of the monitored sources for the groundwater.

Summarized results of site-specific parameters that have exceeded the prescribed standards are presented in Figures 4D.18 to 4D.26.

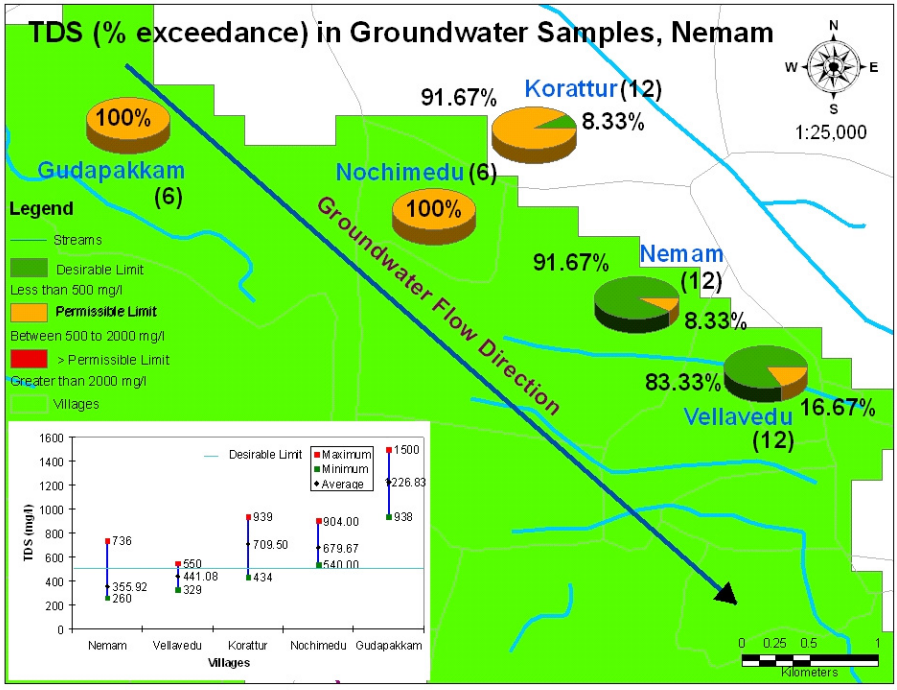


Figure 4D.18 Percent samples that exceeded limits for TDS at different villages at Nemam region

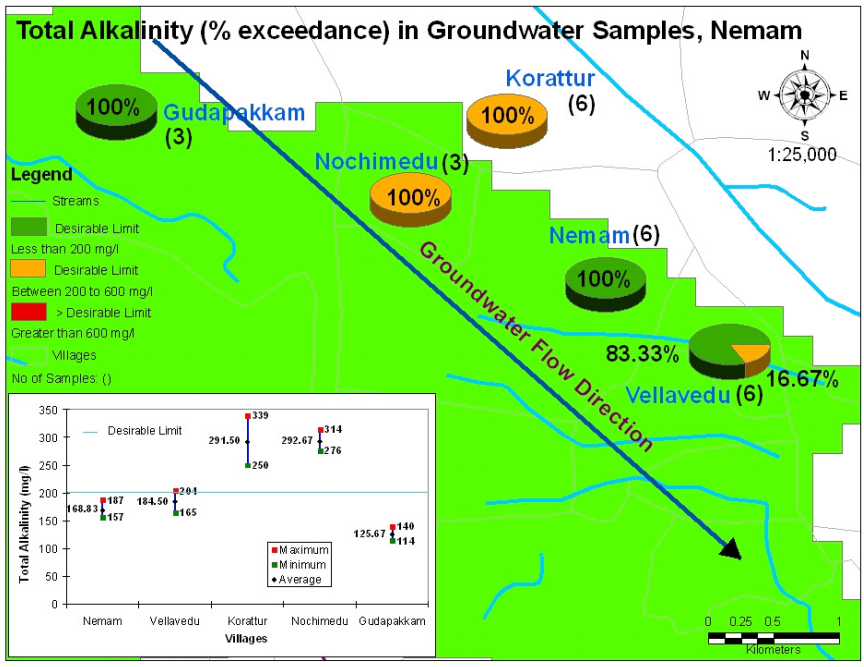


Figure 4D.19 Percent samples that exceeded limits for total alkalinity at different villages at Nemam region

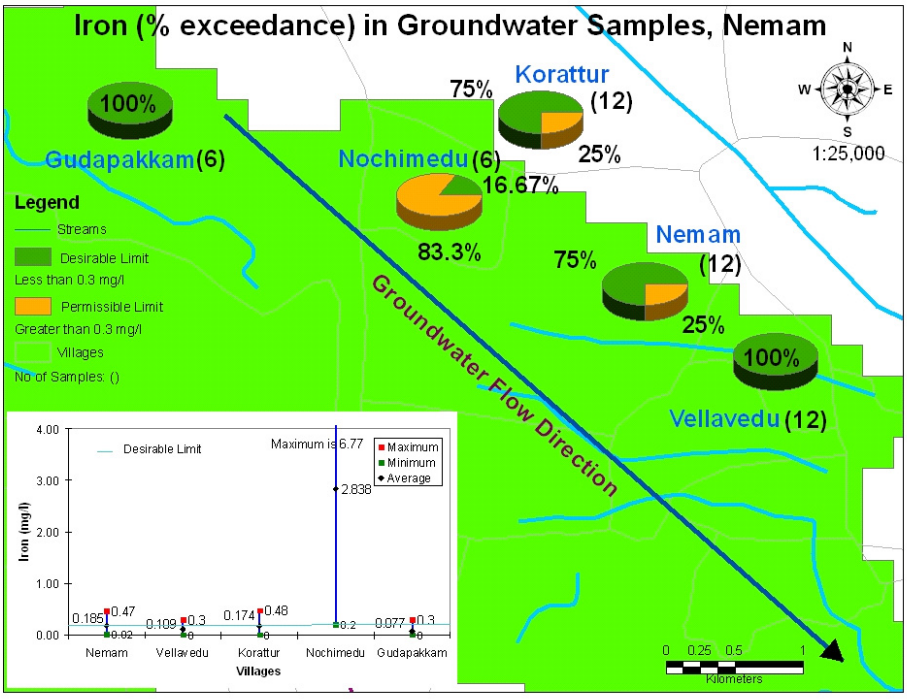


Figure 4D.20 Percent samples that exceeded limits for iron at different villages at Nemam region

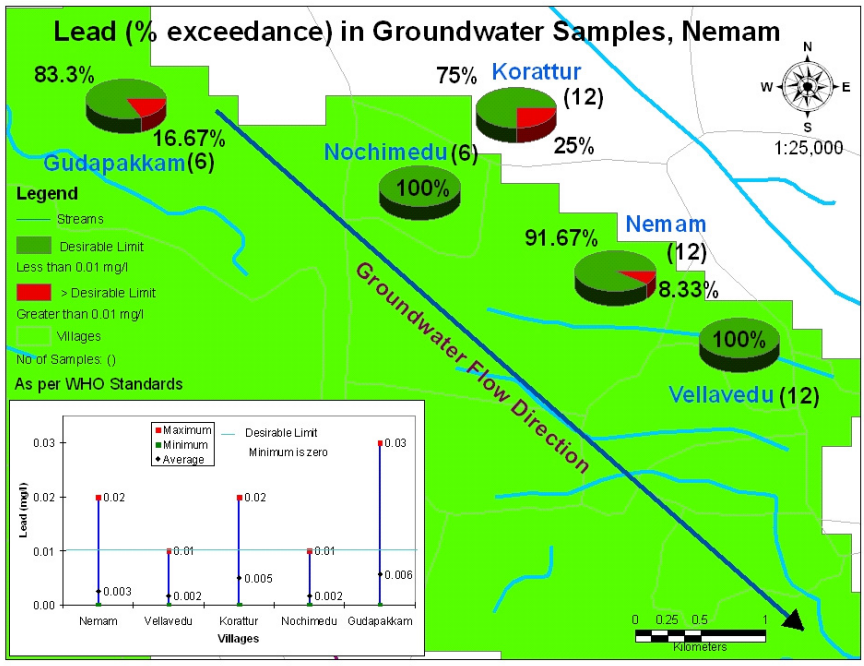


Figure 4D.21 Percent samples that exceeded limits for lead at different villages at Nemam region

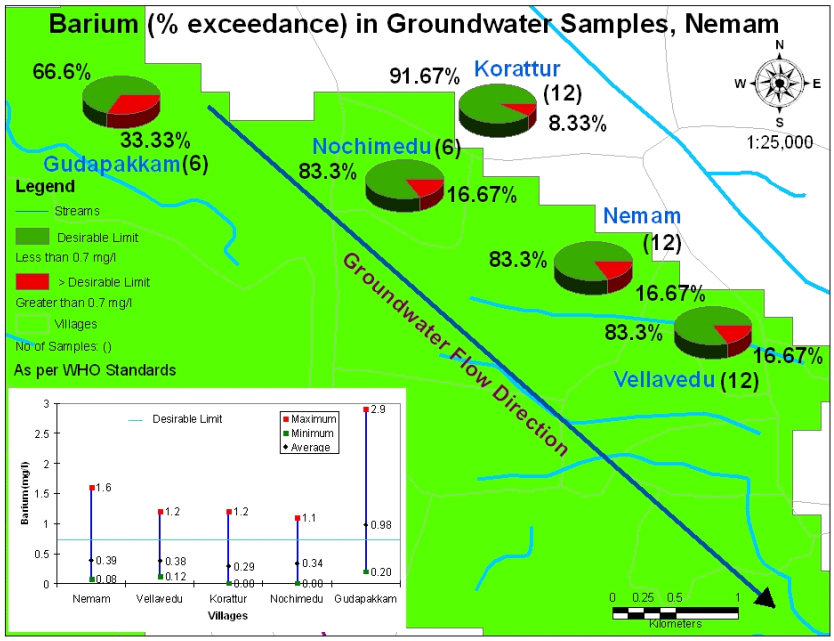


Figure 4D.22 Percent samples that exceeded limits for barium at Nemam region.

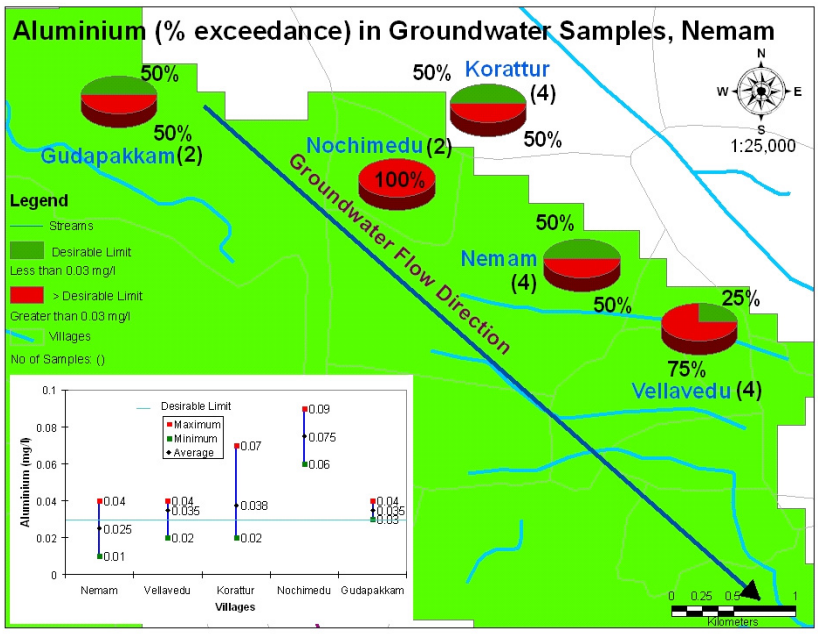


Figure 4D.23 Percent samples that exceeded limits for aluminium at Nemam region

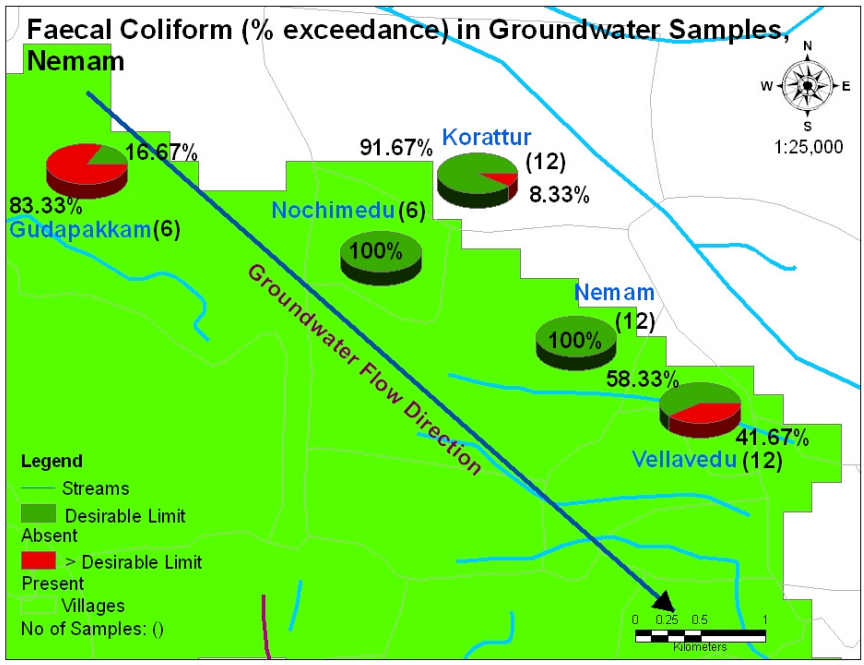


Figure 4D.24 Percent samples that exceeded limits for faecal coliform at Nemam region

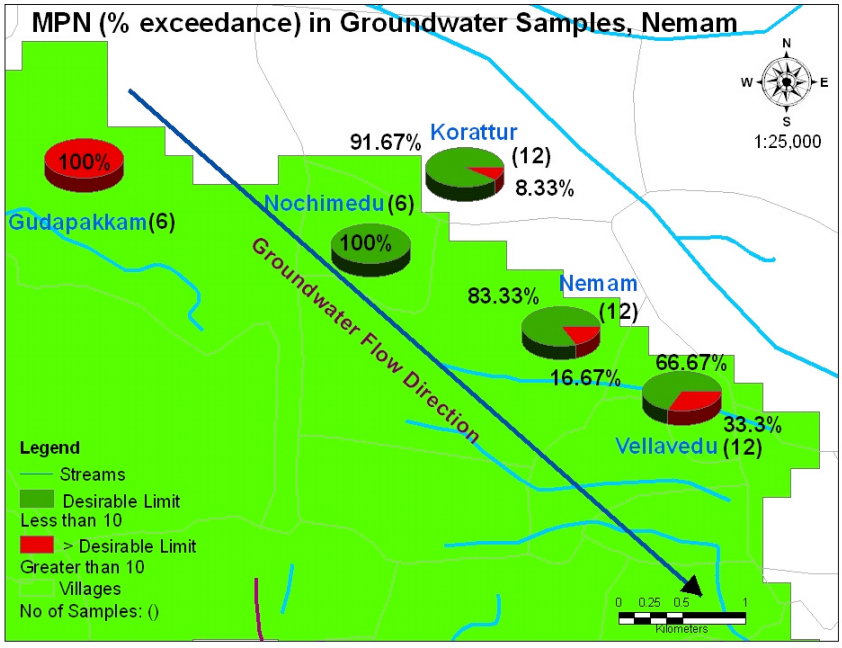


Figure 4D.25 Percent samples that exceeded limits for MPN coliform at Nemam region

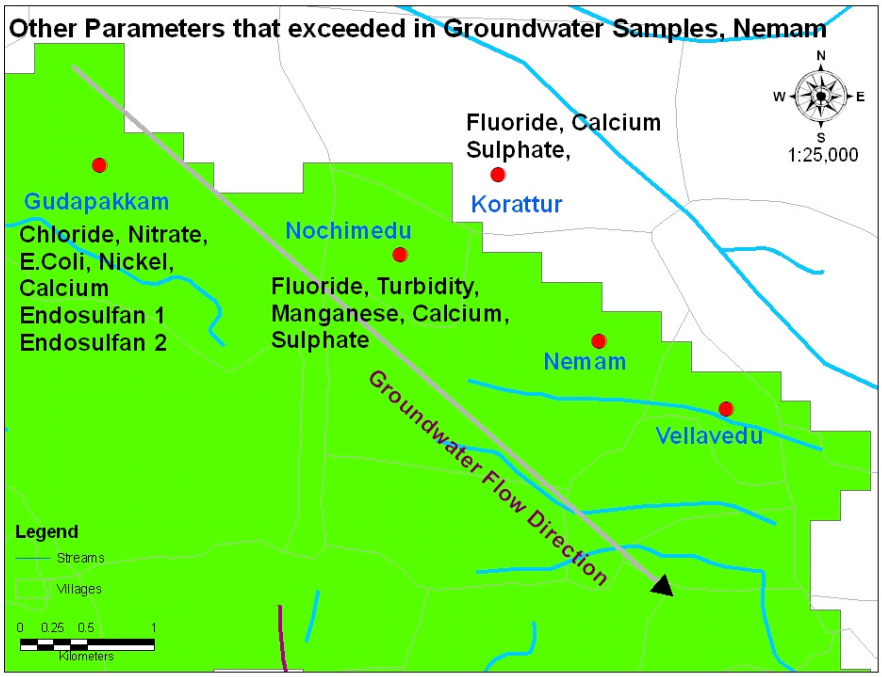


Figure 4D.26 Other parameters that marginally exceeded limits

While most of the monitored parameters were found to meet the required BIS 10500: 1991 drinking water specification and WHO guideline values, the following non-conformity was found for groundwater with respect to drinking water norms (refer Table 4D.12).

Table 4D.12 Non-conforming test parameters

WHO guidelines	*BIS 10500: 1991 drinking water specifications*
(in addition to non-conforming parameters identified under IS 10500) Barium, lead and nickel	Physiochemical: TDS, total alkalinity, turbidity, chloride, fluoride, sulphate, nitrate, calcium Heavy metals: manganese, iron, aluminium Microbiological: MPN coliform, *E. coli* and faecal coliform
Pesticides: Endosulfan-1 and Endosulfan-2 as compared to IS 14543:2004	

Water with this quality needs to be treated for safe drinking water use in the villages.

Plant level assessment of quality and practice

The Nemam plant sources its water from two bore wells. The water is pumped to a raw water storage tank where it is chlorinated and further sent to different sections and processes for respective treatment and usage in the beverage production, domestic use, and the use in the boilers and cooling towers as shown in Figure 4D.27. Wastewater discharges from the production line, boilers and cooling towers, domestic usages finally are collected into a common effluent treatment plant wherefrom it is used for horticultural uses. At the time of visit discharge was being done within the plant premises.

Water quality

Table 4D.13 gives the description of points of sample collection and the sampling details.

Table 4D.13 Details of the in situ sampling locations

Sample source	*Location of sampling*	*Quantity of sample*	*Type of sampling*	*Number of samples (from each location in each round)*	*Protocol or guidelines for sampling and testing*
Raw intake water	Raw water inlet (common header of bore well 1 and 2)	20 litres	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
	After raw water storage tank	20 litres	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
Wastewater or effluent	ETP inlet (after bar screen)	20 litres	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
	ETP outlet (clarified effluent collection tank)	20 litres	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
	(For round III only) • ETP (Treated water after PSF [pressure sand filter]) • RO Permeate (Recycled water to plant)	20 litres	Composite (1 hourly for 22 hours)	*2*	*APHA 20th ed. 1998/ IS 3025*
Sewage treatment pant (Round III only)	STP Inlet	20 litres	Grab	*1*	*APHA 20th ed. 1998/ IS 3025*
	STP Outlet (After ACF (Activated Carbon Filter))	20 litres	Grab	*1*	*APHA 20th ed. 1998/ IS 3025*
Process water	Plant process • Chlorinated soft water (After 5 µ filter) • Treated water (After 5 µ filter) • After 1 µ filter (Inlet to RGB, CSD) • Treated water inlet to Maaza line	20 litres	Composite (1 hourly for 22 hours)	4	APHA 20th ed. 1998/ IS 3025

The details of the sampling locations are as follows.

- Raw water inlet: common header of bore well 1 and 2: This is situated at about 2 km away from the plant in the plant-owned land.
- Raw water outlet: after raw water storage tank.
- Process water: chlorinated soft water (after 5 μ filter)—inlet to bottle or crate washing.
- Process water: treated water (after 5 μ filter) —inlet to beverage production.
- Process water: after 1 μ filter (inlet to RGB, CSD) —inlet just before final bottle filling.
- Process water: treated water inlet to Maaza line—inlet just before final Maaza bottle filling.
- Wastewater: ETP inlet (after bar screen).
- Wastewater: ETP outlet: clarified effluent collection tank.
- Wastewater: ETP (treated water after PSF)
- Treated wastewater: RO (reverse osmosis) permeate—recycled water to plant for use in boilers, etc.
- STP: besides the above sampling locations, two samples from the STP inlet and outlet each.

The results observed have been compared, for compliance, to the relevant guidelines or limits or requirements as follows.

- For wastewater discharge: relevant local regulation CPCB or TNPCB guidelines and TCCC internal quality guidelines
- For process water: relevant national standard for drinking water (BIS 10500: 1991, IS 14543: 2004), international guidelines (WHO guidelines for drinking water) and TCCC internal specification for treated water.
- For raw water: relevant national standard for drinking water (BIS 10500: 1991) and international guideline (WHO guidelines for drinking water).

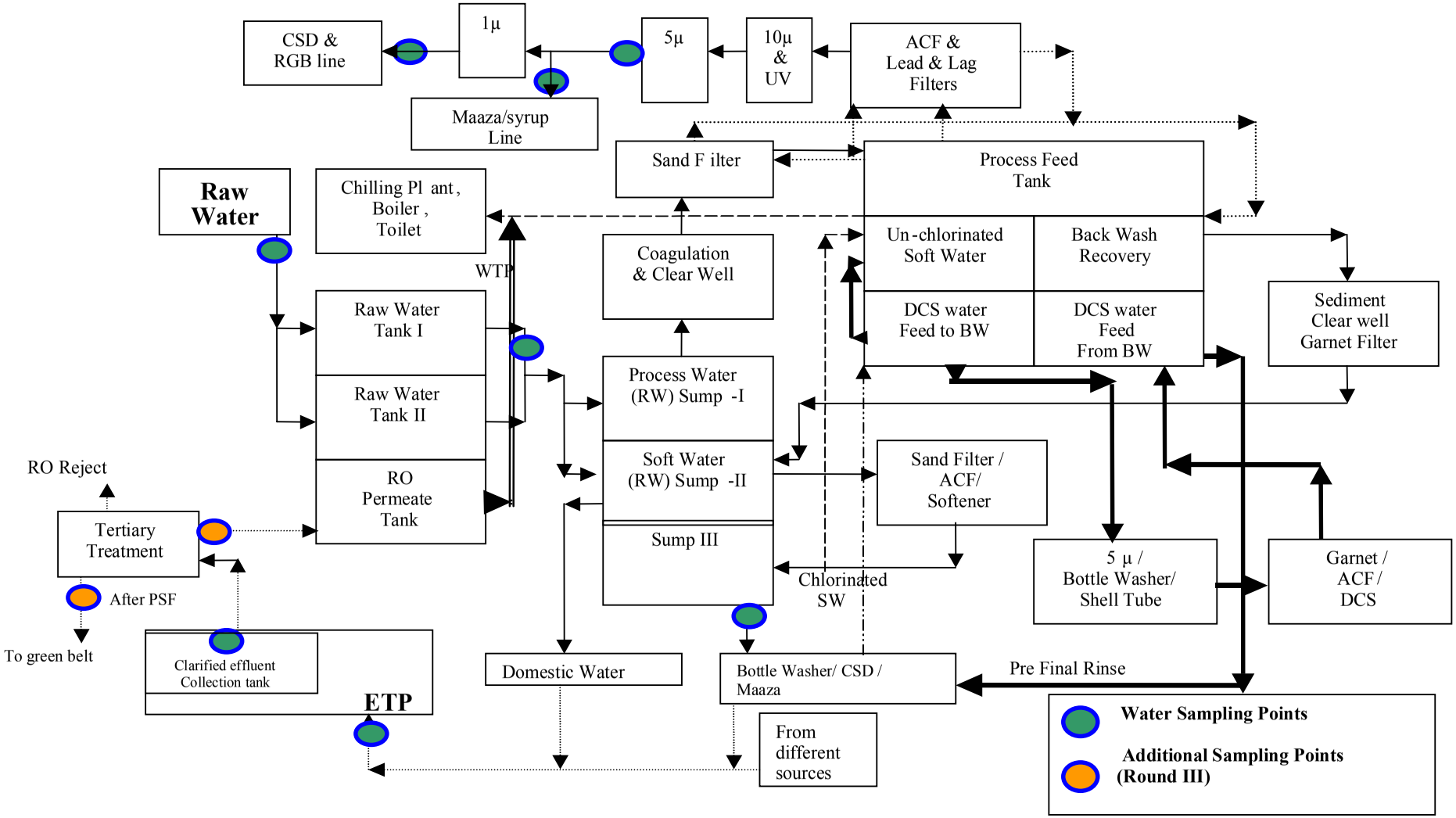


Figure 4D.27 HCCBPL, Nemam; plant process flow diagram and sampling locations

Sample collection, preservation, and transportation

For all the selected locations composite sampling was carried out as follows.
Round I: 29 March 2007 to 30 March 2007
Round II: 26 April 2007 to 27 April 2007
Round III: 17 May 2007 to 18 May 2007

Protocols for sample collection, preservation, and transportation to designated laboratories have been discussed in the chapter on approach and methodology.

Test results

The in situ water quality assessment shows that the source 'raw water inlet (common header of borewell 1 and 2) showed a marginal exceedance for barium when compared to the WHO guideline values. Rest of the monitored parameters were found well below the specified standards or limits or guidelines for raw and process water.

Process water was found to meet the standards of all the parameters under the IS 10500, IS 14543, and WHO guidelines.

The quality of the ETP discharge water indicates one-time marginal exceedance of fluoride as per specified TNPCB (Tamil Nadu Pollution Control Board) limits. As compared to TCCC's own wastewater quality standards for discharge inti natural waterbodies, TKN was found to exceed the acceptable limit.

Rest of the parameters, including the pesticides and bioassay test, for testing fish survival, were found to be within the specified limits for the wastewater discharge from the ETP.

Pesticides were not detected in any of the monitored in situ sources at Nemam plant. This includes raw water to the plant, process water, as well as treated effluent.

Plant level water audit

Water auditing exercise at the HCCBPL, Nemam, Chennai, involved an examination of water flows at inlet and outlet of unit processes with the following objectives.
Establish water balance of the facility for the monitoring period
Assess ETP or WTP inlet and discharge

Details of plant operations

The plant operations with respect to water balance can be divided into four broad segments—RW (raw water), PW (process water), SW (soft water) and effluent. Figure 4D.28 is a schematic diagram of the WTP (water treatment plant) and locations of meters for three rounds of auditing.

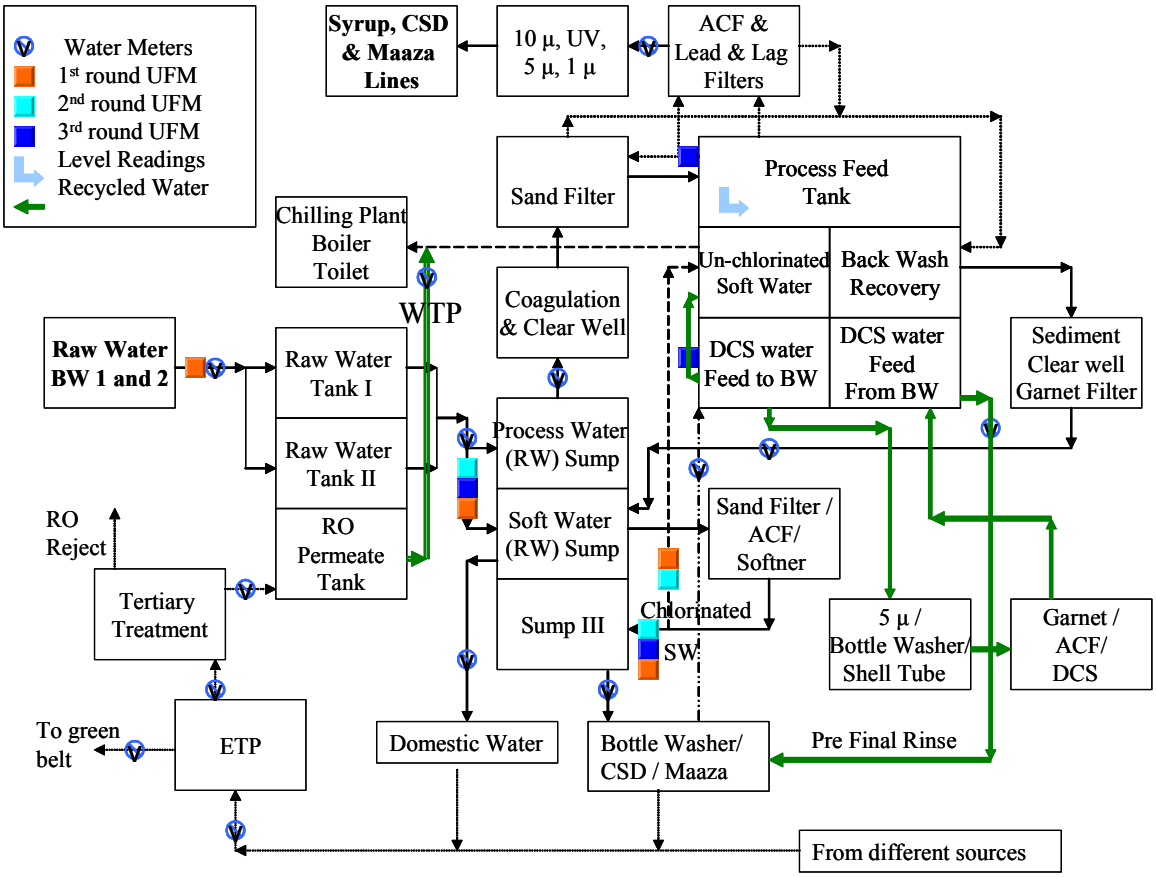


Figure 4D.28 Schematic diagram of the plant showing water meter locations

Water balance

Water balance of individual storage unit for the entire plant was carried out to assess the inflow and out flow of water in the plant and to estimate water usage in process and soft water. Table

4D.14 gives water balance compiled for RW tank for three rounds of water auditing. Level gauges were not installed on raw water tank, hence for the first round water balance for raw water balance was not carried out. Plumb bob and tape were used in second and third round auditing to measure water level changes in the tank to establish water balance of raw water tank.

Table 4D.14 Raw water balance during three rounds of water auditing

Water balance component	*First round*	*Second round*	*Third round*
Inlet			
Raw water intake (m^3)	341.9	133.2	426
Outlet			
Raw water tank (m^3)	321.9	385.7	409.1
Storage			
Measured (inlet–outlet in m^3)*	20	-252.5	14.1
Observed (m^3)**	NA***	-263.37	28.4
Percent error inefficiency with respect to inlet (percent)	NA***	8.17	1

*Measured change in storage is change calculated based on the meter readings at inlet and outlet by applying continuity equation.
** Observed change in storage is storage change based on the difference of tanks water level
Note: Negative tank storage shows net outflow from the tank i.e. reduction in water storage level of tank
*** Reading could not be measured since there were no provisions of water level measurement in the raw water tanks

The raw water balance derived from the water audit shows that during the second and third round of monitoring exercise, the components of the continuity equation (inlet, outlet, and change in storages) are more or less in conformation with each other, as the percentage error in tank balancing (which indicates percent unaccounted flow with respect to inlet) obtained was below 10percent.

In addition to water balance, water usages for different unit processes were also recorded. Table 4D.15 presents an overview of observations for three rounds of water auditing.

Table 4D.15 Volume of water used in various units during three rounds of water auditing

Water use	*First round*	*Second round*	*Third round*
Date of monitoring	29–30 March 2007	26–27 April 2007	17–18 May 2007
Monitoring hours	20	20	22.5
Total inlet (m^3)	341.9	133.2	426
Process water consumed (m^3)	207.3	184.19	231.67
Soft water consumed (m^3)	158.82	236.06	199.79
Domestic water consumed (m^3)	18.37	21.25	35.8
Production (m^3)	126.26	153.88	154.608
WUR treated water	3.04	2.86	3.02
Production	Fanta 200 ml Maaza 200 ml	Sprite 200 ml Limca 200 ml Maaza 250 ml	Limca 200 ml Sprite 200 ml Fanta 200 ml Maaza 200 ml

Annual WUR reported by the plant is 3.01 to 3.32 for the last four years while the daily WUR calculated from auditing are 3.04, 2.86, and 3.02 for the first, second, and third round, respectively.

Few additional observations made during the audits are related to the need for installation of level gauges on every storage tank, and shifting of water meters from their present position of being close to the bends of the pipes to a position as per IS: 2373 – 1981, which states that 'the inlet and outlet of the water meter shall be provided with a straight pipe of internal diameter equal to the nominal size of the meter and having a length equal to at least 10 times its diameter on the upstream or inlet side and a straight length of at least eight times its diameter on the downstream or outlet side free from tees, bends, and valves'.

It was difficult to install flow meters at the inlet of the ETP as the inlet drains were deep and not easily accessible. However, digital metres were installed at the inlet of flow equalisation tank after grit chamber, but since pumping is done intermittently from grit chamber tank, estimation of influent load entering the effluent treatment plant cannot be made. Moreover, the ETP has a designed capacity of 1115 KLD while it receives wastewater approximately half of its capacity most of the time. This increases the residence time of the influent in the

ETP. Thus, inlet and outlet of ETP could not be linked on a simultaneous basis as a result of this non-continuity in flows.

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CHAPTER 4E Pirangut

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CHAPTER 4E Pirangut

Executive summary

Plant sources its water from a reservoir through infiltration wells

The Pirangut plant of HCCBPL (Hindustan Coca-Cola Beverage Pvt. Ltd) is located in taluka Mulshi, district Pune, in the state of Maharashtra in West India. The plant sources its raw water from a surface water source, the Uravade reservoir through infiltration wells. This watershed area witnesses an average annual rainfall of about 3600 mm, which is more than three times the national average of 1100 mm. More than 85 percent of the rainfall occurs during the monsoons that usually come in late June or early July for about two-and-a-half months.

Largely a rural region with stable population characteristics

The study area is largely a rural region, with 6 percent people residing in urban areas. Population growth of the block in which the plant is located has been very slow, and urbanization too is taking place at a very slow pace. Agriculture is the primary occupation in Mulshi block, with more than one-third of the population engaged in crop cultivation. The net sown area has increased at the expense of forestlands. There is a growing dependence on irrigation although the area is still primarily rain-fed. Paddy is the main crop grown and the area under its cultivation has gone up steadily since 1995/96.

Plant uses water drawn from infiltration wells

This plant is owned and operated by HCCBPL since June 1996. The plant produces CSD (carbonated soft drink)[1] in RGBs (refillable glass bottles), PET (polyethylene terephthalate) bottles and cans. It uses only surface water drawn through infiltration wells. The capacity utilisation of the plant is about 40 percent and the months from April through June are the peak production period.

Availability of water is not an issue per se, its access is impacted by inadequate infrastructure and limited financial resources

Perception

- In Ambegaon (D 2) and Marnewadi (another village further downstream of Ambegaon), the members reported an improvement in the availability of water

[1] Carbonated soft drinks cover products like Coca-Cola, Thums up, Fanta, and so on.

over the past 8–13 years. The improved availability was chiefly attributed to the piped supply that had been provided by, and maintained solely by, the panchayat. Earlier, the community had to fetch water directly from the traditional sources such as a *nullah*, well, pond, reservoir, handpump, and so on.

- In Bhilarwade (an hamlet of Ambegaon), the respondents mentioned that there was adequate water for household use during monsoon and winter months. However, they encountered shortages during summer months. In Gadewadi (a hamlet of Uravade, U1) and Ambegaon, however, shortage was felt during monsoons. Shortages, either during summers or monsoons, were mainly attributed to irregular electric supply and undulating terrain (villages at the tail end do not get enough water).

Assessment

- Pirangut district is in the safe category of groundwater development as per Central Ground Water Board.
- Average annual rainfall in Pirangut is 3600 mm, almost three times the national average. Agriculture is mainly rain-fed. In recent years, farmers have shifted towards cash crops such as sugar cane, groundnut, and oilseeds. The net sown area under rice cultivation has also shown an increase since 1995.
- Watershed is highly undulating.
- The Coca-Cola plant sources water from infiltration wells of the irrigation department as well as private sources. The irrigation department allocates water to the plant on the basis of the terms and conditions of a formal agreement.

Regional water quality

- Perception
  - In all the three villages, namely, Ambegaon (D 2), Uravade (U 1) , and Marnewadi (village further downstream of Ambegaon), water quality was reported to be very good, and water was found to be fit for domestic consumption. In Uravade and Marnewadi, the panchayat has formed a committee called Jalrakshan Pani Parothana Samithi, which is responsible for water treatment and distribution to the households.
  - Respondents from Pirangut complained that water supplied through the taps contains a white powder like substance. Respondents further reported that water was not sweet and palatable.

- During rainy season, the Ambegaon panchayat supplies metachlor liquid to the households. This liquid is used to purify the drinking water.

- Assessment
  - Regional water quality assessment shows that turbidity exceeds the drinking water standard IS 10500 in Uravade reservoir, infiltration well number 3, and a private infiltration well in Uravade (U 1).
  - Similarly, total alkalinity exceeded in the water of both the infiltration wells and iron was found to exceed in Uravade reservoir water.
  - In terms of the bacteriological parameters, water in Uravade reservoir showed the presence of MPN (most probable number) coliform, faecal coliform, and *Escherichia coli*. Water from private infiltration wells showed exceedance for MPN coliform.

Effluent water quality mostly meets the existing regulatory requirements

The treated wastewater quality parameters were found to be within the specified MPCB (Maharashtra Pollution Control Board) and CPCB (Central Pollution Control Board) limits (standards) for land application except for chlorides, where a marginal exceedance was observed.

As compared to TCCC's (The Coca-Cola Company) own treated wastewater quality standards, iron, TKN (total kjeldahl nitrogen), cadmium, and BOD (biochemical oxygen demand) have shown one-time exceedance.

Corporate social responsibility activities can be better targeted

A few stakeholders and one key person, an ex-zilla parishad member, expressed dissatisfaction at Coca-Cola's CSR (corporate social responsibility) activities. Stakeholders expressed that the company had not tried to find any long-term solutions to their drinking-water problem. It was suggested that the plant should contribute towards maintaining the Uravade reservoir so that it could store more water.

Detailed assessment

Site profile

The Pirangut plant of HCCBPL is located in taluka Mulshi, district Pune, in the state of Maharashtra in West India. The plant sources its raw water from a surface water source, the Uravade reservoir. The study area was delineated with 1:50 000 scale base map (toposheet number 47F/10 and 47F/11) of Survey of India. Figure 4E.1 shows the delineated watershed and the sub-basins.

Geographic

Delineated watershed comprises an area of about 40 km² and lies between longitude 73° 37' E to 73° 42' 30" E and latitude 18° 31' 30" N to 18° 27' N. Two rivers lie in the north and south of the delineated watershed.

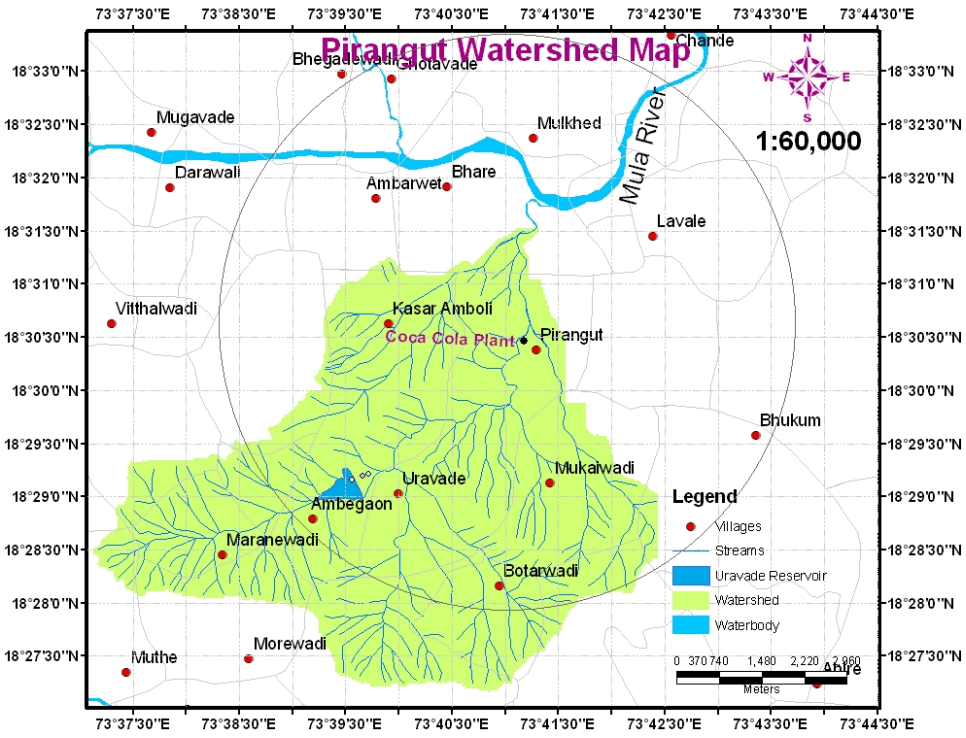


Figure 4E.1 Topography and drainage map of Pirangut watershed

The river in the north of the watershed is the Mula river, and the one in the south is the Mutha river. The watershed forms the catchment of a tributary of the Mula river. The watershed lies in the elevation range of 560–1120 m amsl (metres above the mean sea level), as shown by the hypsometric curve in

Figure 4E.2. The mean elevation is 702 m amsl and the standard deviation, 110 m.

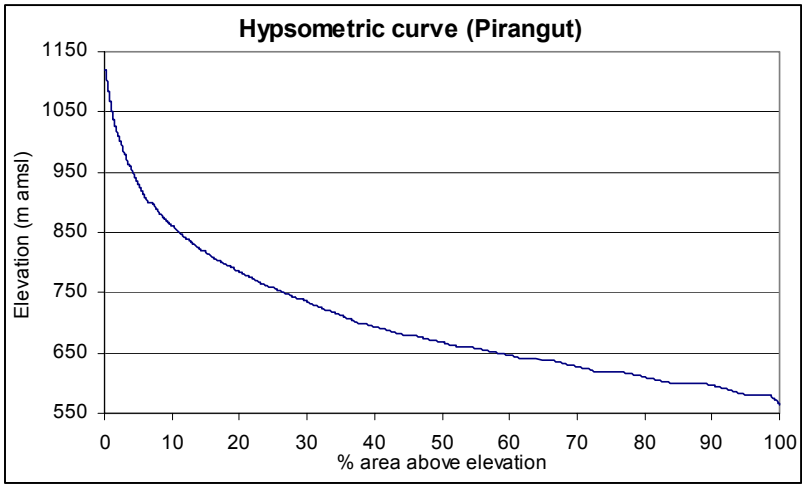


Figure 4E.2 Hypsometric curve of Pirangut watershed

Hydrometeorology

Hydrometeorological details of the watershed have been derived from the Pune observatory data and climatological tables for the period 1951–80. Rainfall data has been taken from the rainfall station close to the watershed, namely Paud. The observatory is situated at latitude 18° 32' N and longitude 73° 51' E at an elevation of 559 m amsl, and the rainfall station is situated at latitude 18° 31' 48" N and longitude 73° 36' 36" E at an elevation of 662 m amsl.

Rainfall

Rainfall data was available for the period1984–98. The analysis, shown in figure 4E.3 and 4E.4, indicates that the watershed area witnesses an average annual rainfall of about 3600 mm, which is more than three times the national average of 1100 mm. More than 85 percent of the rainfall occurs during the monsoons that usually come in late June or early July for about two-and-a-half months. The period from mid- September to about November constitutes the post-monsoon period.

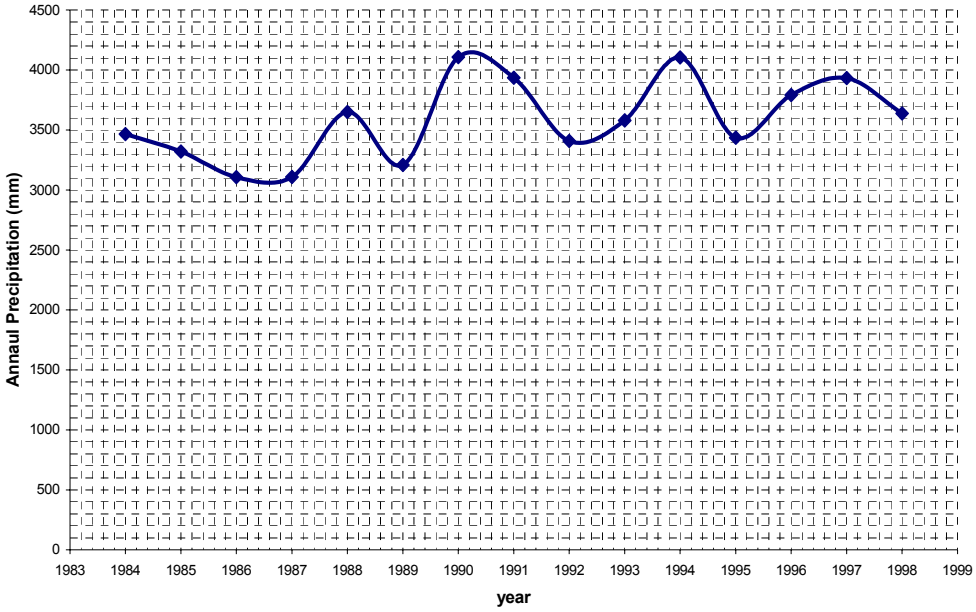


Figure 4E.3 Annual rainfall pattern in Pirangut watershed

Source Indian Meterological Department

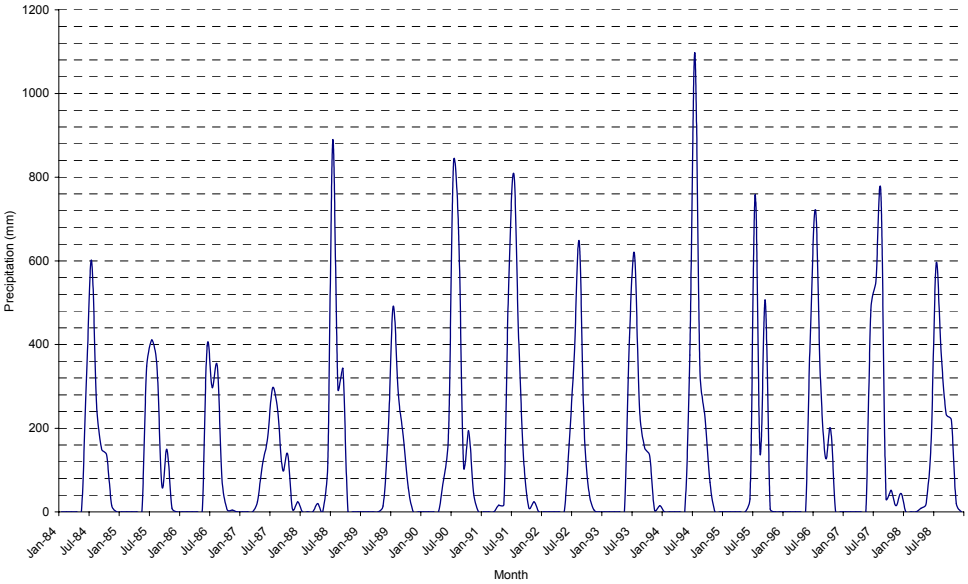


Figure 4E.4 Monthly rainfall pattern in Pirangut watershed

Source Indian Meterological Department

Temperature

Pirangut experiences a humid subtropical climate, with high variation between summer and winter temperatures. The average of daily maximum temperatures in a year is 32 °C, going as high as 38 °C in April in summer. Similarly, the

average of daily minimum temperatures is about 18 °C, going as low as 11.4 °C in January. Figure 4E.5 shows mean monthly minimum and maximum temperature.

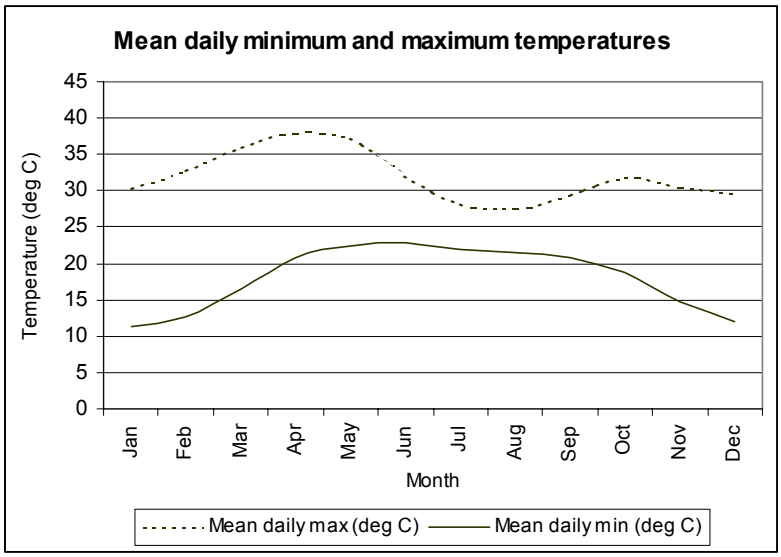


Figure 4E.5 Minimum and maximum temperature in Pirangut watershed
Source Indian Meterological Department

Socio-economic profile

The study area, which comes under Mulshi block of Pune district, is largely a rural region, with 6 percent people residing in urban areas. The population growth in Mulshi block has been very slow (0.32 percent per year between 1991 and 2001), and urbanization is taking place at a very slow pace. Between 1991 and 2001, the population of Mulshi block had only increased from 0.123 million to 0.127 million. The density of population rose from 118 persons/km^2 in 1991 to 123 persons/km^2 in 2001.

Agriculture is the primary occupation in Mulshi block, with more than one-third of the population engaged in crop cultivation (see Figure 4E.6). Apart from agriculture, nearly 10 percent of the people are engaged in industrial activities and another 10 percent are marginal farmers.

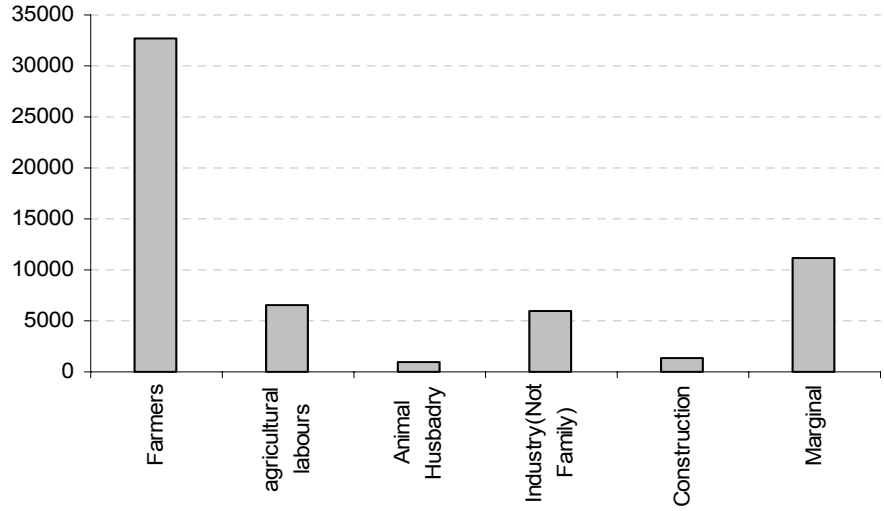


Figure 4E.6 Occupational pattern of Mulshi block in 2001 (Numbers on Y – axis indicates population in numbers)

Source Census of India (2001)

Land use and agriculture

Figure 4E.7 provides the land-use pattern for Mulshi block for the period 1992–99 to 2006/07. Area under agriculture forms the predominant share in the block. Over the years, forest land and the area not available for agriculture have gone down, and there has been an increase in the net sown and the more than once sown area. As a result, there has been an increasing dependence on water for irrigation; agriculture is primarily rain-fed.

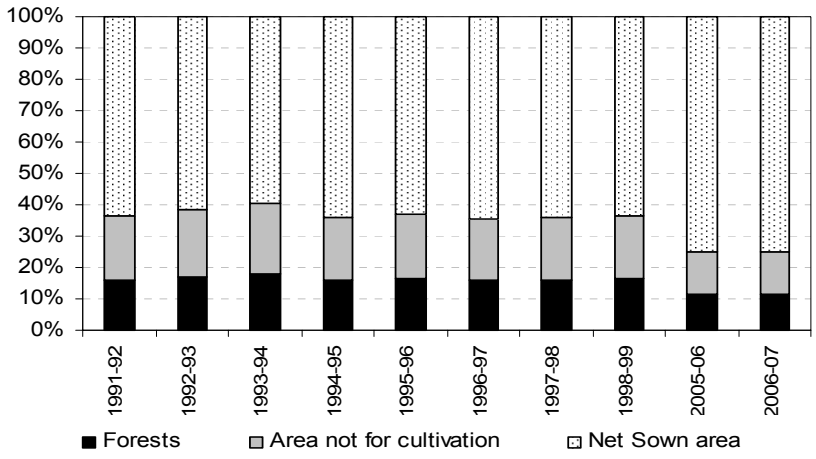


Figure 4E.7 Land-use pattern (%)

Source Statistical Abstract of Pune District for Different Years up to 2004/05. Bureau of Economics and Statistics, Government of Maharashtra

The average cropping intensity (ratio of gross sown area to net sown area) in Mulshi block over the past few years is about 1.10. Table 4E.1 gives the details of the land use pattern and cropping intensity in the block since 1990/91.

Table 4E.1 Land-use pattern in hectares and cropping intensity

Land-use pattern	*1990/91*	*1994/95*	*1995/96*	*1996/97*	*1997/98*	*1998/99*	*2005/06*	*2006/07*
Mulshi block: total geographical area = 1039 hectares								
Forest area	167	167	167	167	167	120	120	167
More than once sown area	40	116	129	132	21	77	77	40
Gross sown area (A)	701	756	797	799	667	856	856	701
Net sown area (B)	659	640	668	667	646	779	779	659
Cropping intensity (A/B)	1.06	1.18	1.19	1.20	1.03	1.10	1.10	1.06

Source Statistical Abstract of Pune District for Different Years up to 2004/05. Bureau of Economics and Statistics, Government of Maharashtra

The principal crops grown in the study area in various seasons are as follows.

- Rabi (November–March): wheat, jowar, pulses
- Kharif (July–October): rice, sugar cane, pulses, groundnut

Figure 4E.8 shows the major cropping pattern in the study area. Paddy is the main crop grown in the area. Since 1995/96, while the area under paddy cultivation has gone up steadily, the area under cultivation of wheat has remained more or less constant. After 1997, the cultivation of jowar has suddenly dropped to very low levels. On the other hand, there has been a sudden jump in the production of cash crops such as sugar cane, groundnut, and oilseeds. Rice and these cash crops require large quantities of water, and are thus grown mostly in the kharif season. However, in the event of low rainfall, existing irrigation facilities come under immense pressure.

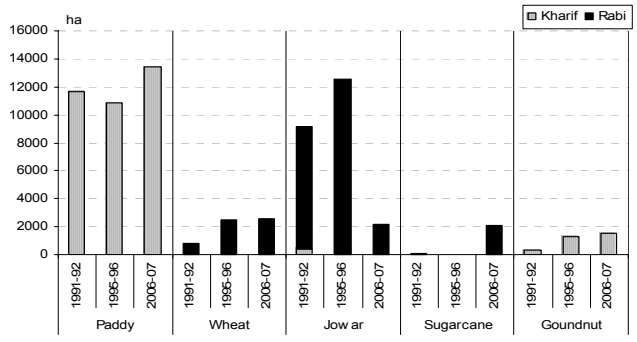


Figure 4E.8 Major cropping pattern

Source For data pertaining to 1991–96: Statistical Abstract of Pune District for Different Years. Bureau of Economics and Statistics, Government of Maharashtra; Data pertaining to 2005–07: Block Development Office, Mulshi, for 2005–06

Irrigation and sources

Irrigation in the Mulshi block and its surrounding region is carried out mainly through community and individual water-lifting schemes and wells. Surface water irrigation is also prevalent, the source of surface water being Pawana dam, located in the neighbouring Maval block, and other bunds. Table 4E.2 gives various sources of irrigation in the region including Mulshi block and the areas in hectares irrigated by each during 2002/03.

Table 4E.2 Sources and irrigated area for 2002/03 in the region (in ha)

Source	*Number of sources*	*Area covered (hectares)*
Water-lifting scheme from Pawana dam	4	550
Community and individual water-lifting scheme	75	1875
Bhugav bund	1	75
Rehe bund	1	110
Community and individual wells	390	680
Khamoli bund	1	75
Lavhard bund	1	125
Total		3490

Source Statistical Abstract of Pune District for Different Years up to 2004/05. Bureau of Economics and Statistics, Government of Maharashtra

The status of irrigation sources (electric and diesel pumps) in Mulshi block over the years is given in Figure 4E.9. Clearly, there is increased use of electric pump sets with each passing year, with diesel pump sets also becoming more prominent than before.

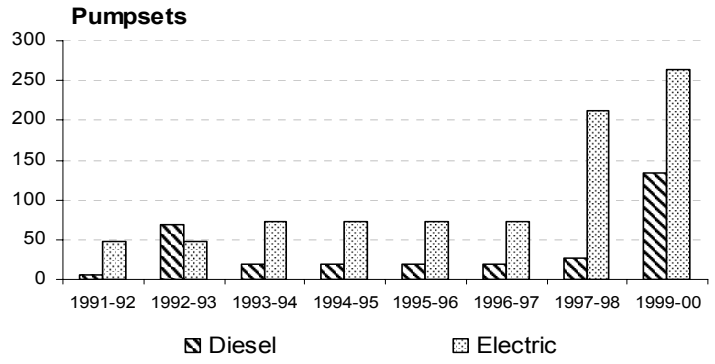


Figure 4E.9 Status of irrigation sources over time in Mulshi block

Source Statistical Abstract of Pune District for Different years up to 2004/05. Bureau of Economics and Statistics, Government of Maharashtra

Surface water movement

Two rivers lie each in the north and south of the delineated watershed respectively. The river in the north of the watershed

is the Mula river, and the one in the south is the Mutha river. The watershed drains into the Mula river. The general flow of the surface water in the watershed is in the south-west to north-east direction. The area is completely dependent on the reservoirs that have been constructed by the irrigation department to hold and store surface run-off. Water used for various purposes in the watershed is taken through infiltration wells dug close to the water reservoirs.

Groundwater development, a ratio of water use to utilizable recharge, for Pune district, as reported by the CGWB (2005) is 70 percent, which puts the district in the category of safe groundwater zone.

Hindustan Coca-Cola Beverage Pvt. Ltd, Pirangut

This plant is owned and operated by HCCBPL since June 1996. The plant produces CSD[1] in RGBs, PET bottles, and cans. This plant uses only surface water drawn through infiltration wells.

Plant capacity

Potentially, the plant has the capacity to produce 600 BPM (bottles per minute) from the RGB line. In addition, the plant, in full-swing operation, has the capacity to produce 200 BPM from one PET line and 1100 CPM (cans per minute) from one can line. The plant in the past two years, 2004/05 and 2005/06, has utilized annually up to 40 percent of its installed capacity as shown in Figure 4E.10. [2] The UC (utilization capacity) of the RGB line has declined from about 40.68 percent to 35.9 percent, while that of PET line has increased from 35.32 percent to 37.73 percent from 2004/05 to 2005/06, respectively. The UC of can line was less than 4 percent for both the years.

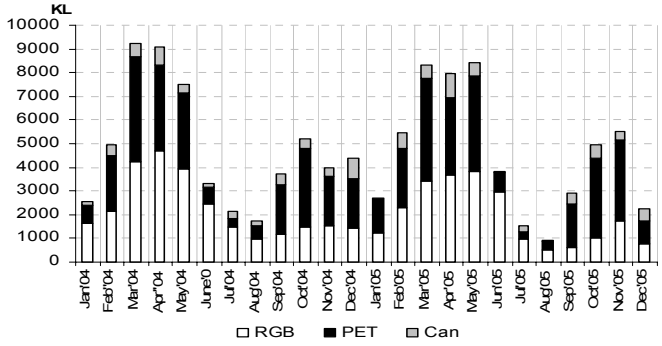


Figure 4E.10 Installed capacity and utilization capacity of the plant

[1] Carbonated soft drinks cover products like Coca-Cola, Thums up, Fanta, and so on.

[2] The plant has not provided the installed capacity and UC (%) for 2003/04.

Water intake and production

The water intake and production for the Pirangut plant indicate a distinct mix of RGB, PET, and can. There has been a marginal drop in the total production of CSDs in 2005 compared to the previous year. While the total production of RGBs has declined, the production of PET bottles has gone up over the past two years. The share of can production has remained the same (Table 4E.3).

Table 4E.3 Share of RGB, PET bottles, and cans in total production

Year	*Ratio* (RGB/PET)	*Total production* (kl)	*RGB share* (%)	*PET share* (%)	*Can share* (%)
2004	1.05	58 122.8	46.7	44.1	8.67
2005	0.86	56 819.3	40.5	47	8.68

RGB – refillable glass bottle; PET – polyethylene terephthalate

Figure 4E.11 shows the monthly distribution of CSD production vis-à-vis RGBs, PET bottles, and cans. The production level is high during March, April, and May. Also, there is a shift in production from RGBs to PET bottles between 2004 and 2005.

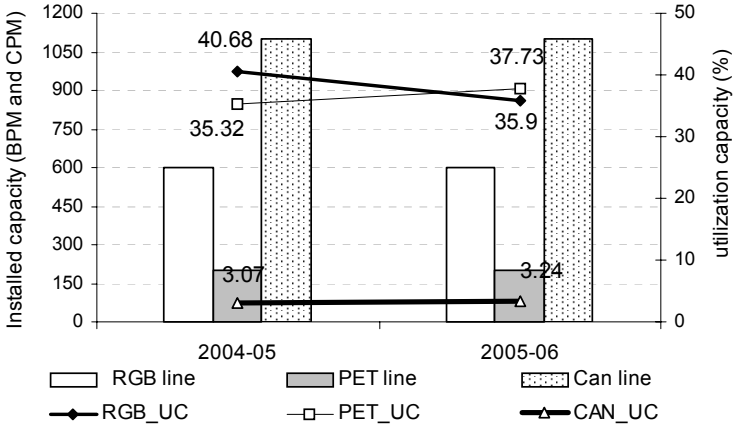


Figure 4E.11 Monthly production of refillable glass bottles, polyethylene terephthalate bottles, and cans

The surface water intake during the period January 2003 to December 2005 declined, with April, May, and June being the peak months. Figure 4E.12 shows the monthly water intake by the plant and the corresponding production.

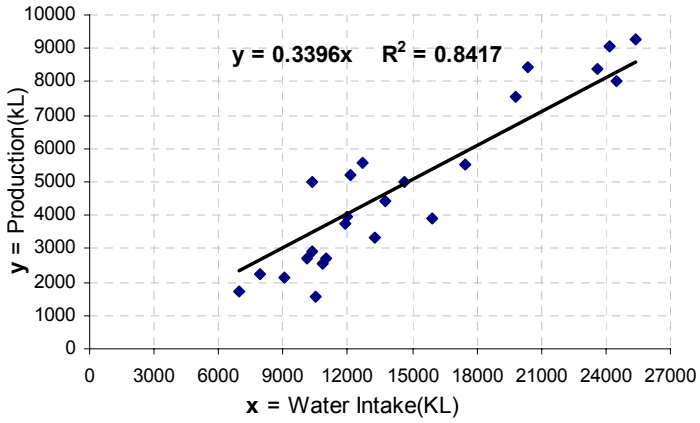


Figure 4E.12 Water consumption and carbonated soft drink production trends

High degree of linear correlation (r=0.93) was observed between the water intake by the plant and its total production over a 24-month period (from January 2004 to December 2005)[1]. With higher demand in the production of beverages, the surface water intake goes up, as depicted in the scatter plot in Figure 4E.13.

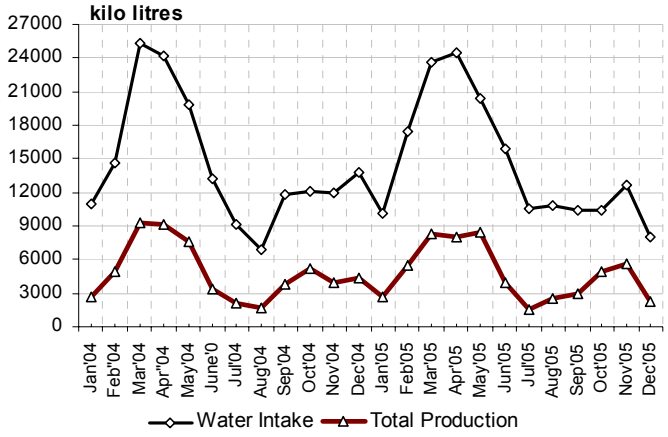


Figure 4E.13 Scatter plot between groundwater intake and production

Water utilization ratio

Based on the data provided by The Coca-Cola Company, the annual WUR (water utilization ratio) could be computed for only two years, 2004 and 2005. The results thus obtained were in close conformity with the estimates provided by Coca-Cola (Table 4E.4). The annual WUR has marginally gone up in 2005 compared to the previous year.

[1] The plant provided data for only two years, that is, 2004 and 2005.

Table 4E.4 Annual water utilization ratio

Year	Plant estimate
2004	2.96
2005	3.07

Selection of villages and stakeholder interaction

Identification of villages for techno-social assessments

The villages identified using the approach, as discussed in the Chapter 2 on approach and methodology, have been identified as following.

- Village in which the plant is located (M 1): Pirangut
- Village immediately upstream of the plant, considering the regional direction of water flow (U 1): Uravade
- Village immediately downstream of the plant considering the regional direction of water flow (D 1): Pirangut
- Village at the extreme upstream end of the watershed in the direction of water flow (U 2): Ambegaon
- Village at the extreme downstream end of the watershed in the regional direction of water flow (D 2): Pirangut

In addition to above another extreme upstream village namely, Maranewadi was also included in social assessment.

Figure 4E.14 gives the location of the selected villages in the watershed (arrow shows the direction of flow).

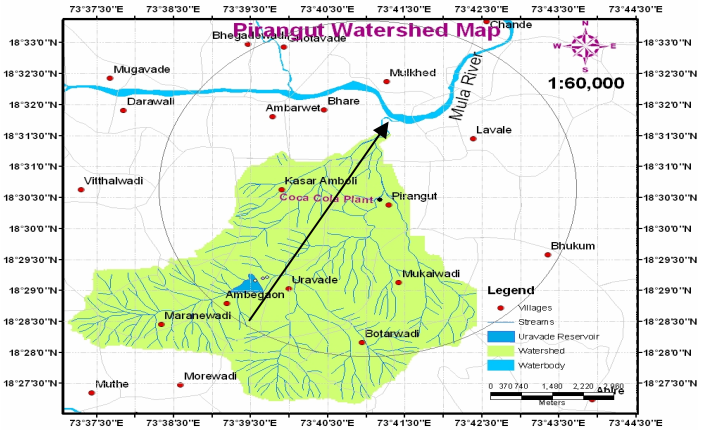


Figure 4E.14 Location of the selected villages in the watershed (arrow shows the direction of flow).

Key stakeholder interactions

Stakeholder perceptions capture the views of different stakeholders on the issues of trends in water availability, quality, utilization, and access across the study villages. The

section only records the views as presented by different stakeholders in the course of FGDs (focus group discussions) and key stakeholder interviews. It does not aim to make judgements nor draw conclusions based on these recorded perceptions.

The rationale for selection and relevance of stakeholders has been discussed in detail in chapter 2 on approach and methodology.

Panchayat

The seven study locations that were selected fell under four gram panchayats (village council). A total of four FGDs were conducted, one in each gram panchayat, namely Maranewadi (for village Maranewadi, further downstream of Ambegaon outside the 5 km radius), Ambegaon (for the locations Ambegaon and Bhilarewadi), Uravade (for the locations Uravade and Gadewadi), and Pirangut (for villages Pirangut and its hamlet, Mukaiwadi). Pirangut was the biggest panchayat with two revenue villages. FGDs were conducted with the panchayats to gauge the panchayat's role in water supply and management. Additionally, discussion with the panchayats brought forth the issues and areas of concern in terms of water availability, quality, utilization, and access in the area. Panchayat members also gave information about the caste composition, literacy level, occupation, and so on in their respective villages.

Women

Seven FGDs were carried out with women's groups. The education levels of the women respondents varied from being illiterate to having studied till the 12th standard. Most of the respondents had been staying in their respective villages for more than 10–12 years. Their long stay in their respective villages enabled them to indicate the changes in water availability over a period of time. Agriculture and service (mainly employment in the factories) were the main sources of family income, and majority of the respondents supplemented the family income by working as agricultural labourers or wage labourers in the nearby Pirangut industrial area. A few women respondents were also self-employed.

Farmers

Seven FGDs were conducted with farmers in the seven locations. The average size of landholdings in the region was between 2 acres and 3 acres. The smallest landholding was 20

guntha[1] (0.5 acre), while the largest landholding was 15 acres. Farmers who had a landholding of more than 5 acres were categorized as large farmers and they constituted about 35 percent of the farming community in the study area. About 40 percent of the farmers were small farmers whose holdings were less than 5 acres. Marginal farmers comprised 25 percent of the farming group and their landholdings were less than 1 acre.

An additional FGD was conducted in Uravade with farmers who were members of a dairy cooperative.

Weaker sections

Four FGDs were conducted with weaker section groups in Maranewadi, Ambegaon, Uravade, and Pirangut. FGDs were not carried out in Bhilarewadi, Gadewadi, and Mukaiwadi, as the weaker sections in these locations were absent, as per the community.

The respondents of the FGDs in all the four villages except Maranewadi lived in their respective *bastis*. In Ambegaon and Pirangut all the respondents were Hindus and belonged to the Boudh community. In Uravade, all the respondents belonged to the Scheduled Caste. The literacy rate among the respondents varied from being illiterate to having studied till the 12th standard. A majority of the respondents were landless labourers. In Ambegaon and Uravade, most of the respondents worked as agricultural labourers; while in Pirangut, nearly 30 percent to 40 percent of the respondents worked as daily labourers in factories in and around the village. About 30 percent of the respondents had small landholdings, of the size 2–4 gunthas; but they did not cultivate the land as the expenditure in cultivation on that small piece of land was huge. In Maranewadi, some of the respondents belonged to the Sutar (carpenter), Mochi (cobbler), and Navi (barber) caste groups.

Key persons

A total of eleven key persons were interviewed as a part of the study. Local leaders, namely, the *up-sabhapati* or vice-president of the taluk, ex-sarpanch of one of the selected study villages, and an ex-zilla parishad member were interviewed to get their perceptions of the water availability in the region and the changes (if any). The discussions helped gauge the development scenario (like industrialization) in the region during their tenure, and it also gave an insight into the internal village dynamics and issues regarding water consumption by the Coca-Cola plant.

[1] *Guntha* is a local unit for measuring land; 40 *gunthas* = 1 acre.

Two officials of cooperative banks and an irrigation department staff were interviewed. Cooperative bank officials were interviewed to know the trend of loans being availed of by the farmers for irrigation, which would give the indirect estimate of the prevailing water situation. The staff member of the irrigation department was interviewed to understand the allocation of water quota, and the prevailing schemes and provisions for the sanction of permission to install irrigation pump sets to farmers and wells to industries.

Primary schoolteachers were interviewed in Marnewadi and Pirangut. Their opinion was sought to get an understanding on water availability, quality, and utilization.

A private tanker water supplier to the Coca-Cola plant was also interviewed on the water scenario in the region, Coca-Cola's use of water, and also the dynamics of the protests that were held against the plant.

Representatives of the Coca-Cola plant in Pirangut were interviewed to know the CSR activities being implemented by the plant and also to get information about the concerns raised by the community.

A representative of an NGO (non-governmental organization) Pratham, which is working in Mulshi taluka and has carried out several activities in association with the Coca-Cola plant, was interviewed to comprehend the general water scenario in the region. Information was also sought on the CSR activities carried out by the Coca-Cola plant.

Stakeholder perceptions on water quantity

Sources of water

In the sub-watershed, both surface water and groundwater are used as sources of water. While in most villages, surface water is the source for agriculture as well as household use, in Uravade and Pirangut, groundwater is also used for irrigation or for both agriculture as well as domestic purposes.

Presently, water for domestic use is supplied to all the villages through a piped system that is provided and managed by the panchayat. In Uravade and Maranewadi, the panchayat has formed a committee called Jalrakshan Pani Parothana Samithi, which is responsible for water treatment and the distribution of water to households.

The source from where water is fed into the piped supply varies. In Maranewadi, Bhilarewadi, and Ambegaon, water is directly

lifted from the Maranewadi or Uravade–Ambegaon reservoir through pump sets, into ground tanks or OHTs (overhead tanks), and then supplied through the private or public taps.

In Uravade, Gadewadi, and Pirangut, water is drawn out from the infiltration wells (that are fed by the respective reservoirs) into OHTs. In Pirangut, water from the infiltration well is not sufficient to meet the needs of the community; so groundwater is also drawn out by electric pump sets and filled into OHTs. The Pirangut panchayat also supplies water through tankers in one of the hamlets during summer when there is water shortage.

Women and panchayat members in Uravade and Pirangut also reported the use of handpumps or *hapsaas*.[1]

In the past, prior to the introduction of piped supply, handpumps and dug wells were used to draw groundwater.

Farmers' groups in the selected villages reported that 90 percent of the agriculture is rain fed, while only 10 percent is irrigated. Irrigation is practised for only those fields that lie in the valley/plains, close to the different sources of water. The fields located on the ghats are completely rain-fed. Further, of the two main agricultural seasons, the first crop of the year (that is, the kharif crop) is completely rain-fed. Irrigation is carried out primarily for the second crop (that is, the rabi crop). Even during rabi season, not all farmers have access to irrigation. The sources of irrigation that are used are discussed subsequently.

Direct use of water from the reservoirs was reported in four FGDs, that is, in the villages Maranewadi, Ambegaon, Uravade, and Gadewadi. The water from Uravade reservoir was pumped out through pipes with the use of electric or diesel pump sets.

The main source from which most farmers, who have irrigation facilities, draw water is the *nullah*—a natural stream that starts from the reservoir and winds its way downstream. In all the seven farmers' FGDs, the *nullah* was stated to be a source of irrigation. Water from the *nullah* was directly lifted through diesel or electric pump sets. Some farmers also purchased water.

Infiltration wells, or vihir (as it is known locally), are another source of water for irrigation. Infiltration wells are dug close to a surface water body—the reservoir, the *nullah* or any other water body. In four locations, private infiltration wells were used; the locations were Marnewadi, Uravade, Gadewadi, and

[1] *Hapsaa* is the term used locally for handpumps.

Pirangut, including its hamlet Mukaiwadi. In two FGDs – in Pirangut and Ambegaon – it was reported that a few farmers used boring (to draw ground water) close to the *nullah*. In Pirangut, the use of boring was more common.

Water from the above-stated sources (reservoir, *nullah*, or infiltration wells) was drawn through pipes and pumped out with the use of electric or diesel pump sets ranging between capacities of 5 HP (horsepower) and 7 HP on an average. Once the water was pumped out, it was let in the fields in the form of flood irrigation, sprinkler or drip irrigation.

Farmers also added that irrigation was being carried out only after the reservoirs were built; prior to this, agriculture was wholly rain-fed.

Changes in water availability

Stakeholder groups comprising women, weaker sections, and panchayat members in all the study locations reported an improvement in the availability of domestic water over the past 8–13 years. The improved availability was chiefly attributed to the piped water supply. Earlier, when the community fetched water from traditional sources such as a *nullah*, well, pond, handpump, and so on, they had to tread long distances. Apart from being inconvenient, it caused physical exhaustion because of the long hours that were spent on collecting water. In Pirangut, changes in the past few years were not reported. However, the women's group there felt that the situation had improved as compared to 15 years back; water was now available at the doorstep because of the piped supply.

Stakeholder groups across the study locations, however, mentioned that even after the piped supply, availability of water varied across seasons. In Bhilarewadi (hamlet of Ambegaon), the women's group observed that there was adequate water for household usage in monsoons and winter, but they encountered water shortages during summer months. In Gadewadi and Ambegaon, shortage was reported during monsoons. In Pirangut, both the women and the weaker section groups reported shortage during summer and rainy seasons.

The quantity of water available for irrigation was not reported to be a problem by the farmer-groups and the panchayat members.

The panchayat members stated that agriculture was primarily rain-fed before the construction of the Uravade reservoir. It was around 1992 that the government built the reservoir to tap the water resources of the region. The reservoir also has a *nullah*,

which is a natural offtake of the reservoir. Subsequently, farmers who had their fields close to the reservoir or the *nullah* started using water from it for irrigation purposes. Farmers whose lands were far away from the reservoir or the *nullah* started owning infiltration wells, which were mainly fed by the reservoir. Irrigation is practised only for rabi crops and the kharif crops in the region are entirely rain-fed.

However, farmers groups in all the study locations expressed concern over access to infrastructure for irrigation. A few of the key persons interviewed reiterated this concern. Coca-Cola representatives observed that the Uravade reservoir never dried up. Although there was no dearth of water in the adjoining villages, farmers lacked the necessary infrastructure to access the available water. One of the key informants stated that permissions were required from the irrigation department and the electricity board for directly lifting water from the reservoir as well as from the *nullah*.

Some of the key persons also expressed concern over the water shortage during summer months in Pirangut. They opined that Pirangut village faced more water problems compared to other villages. Also, in Pirangut village water demands did not match the water supply. A rating of water availability by different stakeholders was also carried out across the study villages (Table 4E.5.)

Table 4E.5 Rating of water availability

Village	*Panchayats*					*Women*					*Farmers*					*Weaker sections*				
Scale	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Maranewadi	X		X			X							X			X				
Bhilarewadi								X			X									
Ambegaon	X					X	X[a]					X				X				
Uravade		X	X	X		X		X			X				X[b]		X			
Gadewadi							X						X	X						
Pirangut								X	X						X			X[a]		X[b]
Mukaiwadi								X			X		X							

a–Rating for monsoon, b–Rating for summer

Scale: 1 – no scarcity; 5 – very high scarcity

Reasons

Different stakeholders cited a number of reasons for the inadequate availability of water. Some of these are listed below.

- Erratic power supply
- Infrastructural and resource constraints to access water
- Demands did not match the supplies in Pirangut
- Limited infrastructure
- Location disadvantage

All the stakeholder groups spoke at length about the erratic power supply in the region. Inadequate availability of water for domestic purposes either during summers or monsoons was mainly attributed to irregular electric supply. All stakeholder groups in Pirangut mentioned that rapid industrialization in Pirangut has led to an increase in 'in-migration' and 'floating population', and the current supply of water did not match the demand.

The panchayat members in Uravade reported that the pipelines were not fully laid in some of the villages, which led to water shortage. In Uravade and Mukaiwadi, women reported a variation in availability of water related to the altitude at which dwellings were located.

A majority of the farmers indicated that sufficient water existed, but water available for agriculture was inadequate due to 'infrastructure' (means of water transportation and electricity availability) and 'resource' (monetary) constraints. Even among those whose fields were close to the water sources, not all had sufficient infrastructure to draw out water. Farmers whose fields lay on the ghats suffered in terms of infrastructure. The cost involved in providing infrastructure to irrigate these fields was stated to be high. In Gadewadi, the women's group attributed the water shortage to the lack of resources to own private pipe connections.

In Uravade, the panchayat members stated that the Coca-Cola plant was using too much water from the infiltration wells, and hence farmers experienced water shortages. However, one of the key informants was of the opinion that the shortage of water had nothing to do with Coca-Cola plant or other industries. The Coca-Cola plant lifted water from its own wells and also purchased water from other owners of wells during the peak season. Communities and panchayats had their own separate wells. So, the informant opined that, technically, the Coca-Cola plant was not encroaching on communities' water share.

Impacts

Different stakeholder groups described various impacts and coping measures related to water shortages, some of which are described below.

The farmer groups indicated several impacts with regard to shortage in availability of water for irrigation.

- Water for irrigation had become expensive.
- Levels of yield had fluctuated.

- Farmers were looking for alternative employment to supplement the income from agriculture. For example, some farmers worked in nearby industries on a temporary basis for three to six months. Those who failed to get job in these industries migrated to cities looking for jobs.
- A few farmers had started their own business enterprises—petty shops, transport business, and so on.
- Farmers, due to their inability to access sufficient water resources, had switched over to sowing hybrid variety of seeds, which required less water.
- Farmers had taken loans from cooperative banks to get infiltration wells constructed or to install drip irrigation equipment.

The strategies adopted by farmers for coping with water shortages are indicated below.

- Farmers irrigated only during critical stages of plant growth due to inadequate availability of water.
- Farmers left the land on the ghats fallow, as they did not have access to sufficient water for irrigation.
- More and more farmers were acquiring diesel or electric pump sets.
- Farmers in Pirangut pointed out that their long-run strategy would be to use less-water-intensive crops.
- Farmers in Mukaiwadi said that they would request the panchayat to divert some water from the Mula river, which was about 5–6 km away from the village.

Similarly the women's group indicated several impacts with regard to shortage in availability of water for irrigation.

- On the whole, in a majority of the study, villagers' life had become much easier after the introduction of piped water supply. Women were able to save on time, which they used to spend on fetching water from distant sources. They were also able to maintain better personal and domestic hygiene.
- However, during peak hours, women had to wait for long hours in queue to fetch water from public taps.
- Sometimes villagers had to traverse long distance to fetch water, especially during the times of water shortages.
- During times of shortages, the communities harvested rainwater, purified it with metachlor (provided by the panchayat), and used it for drinking and cooking purposes.

The strategies adopted by women for coping with water shortages are indicated below.

- Women stored water whenever piped supply was adequate.
- During water shortages, women took cattle to the reservoir or well for bathing purposes.

- In Gadewadi and Bhilarwade (hamlet of Uravade), during acute water shortage, the communities went to a nearby poultry where water was given free of cost.
- In Mukaiwadi, during times of water shortages, the Panchayat provided water through tankers.
- Weaker sections in Uravade had applied to the Panchayat requesting for an extra pipe connection to the *basti*.

Stakeholder perceptions on water quality

Panchayat members, women, farmers, and weaker section groups in Ambegaon, Uravade, and Maranewadi opined that water quality was good and the water was fit for domestic use and irrigation.

Women's groups in Bhilarewadi and Mukaiwadi reported problems in water quality. In Bhilarwade, the women's group reported that water obtained from handpumps was muddy during summer and hence unfit for drinking purposes. Muddiness in water was attributed to extensive utilization of handpumps during summer season. Water in the nearby *nullah* was also reported to be contaminated and hence not suitable for drinking purposes. The women's group in Mukaiwadi complained that the water supplied through taps was not filtered before it was supplied to the households.

Panchayat members, women, and weaker section groups in Pirangut reported deficiencies in water quality. The respondents complained that the water was not sweet and palatable. Women and weaker section groups pointed out that there was a powdered deposition in the utensils, if water was stored in them for two days. They were not sure if the residue was because the water was treated or because the groundwater was contaminated. Besides, they said that the water did not lather easily. They added that water supplied through the taps contained a white powder-like substance.

However, water-related health problems were not reported by any stakeholder group in any of the study locations.

The panchayat was responsible for purifying the water and providing it to the households through piped connections. Water is purified using chlorination. In addition, during rainy season, the panchayat supplied chlorine liquid to the households to further purify the drinking water.

Protests and agitations

Panchayat members, farmers groups, and two of the key persons interviewed spoke about the agitation or protest against

the Coca-Cola plant. It was reported that at the time of establishment, the plant dug bore wells and got good yield during the rainy season. However, in the summer months the bore water dried. It was after this that the plant started drawing water directly from the Uravade reservoir for a very short duration lasting few days, for which they had obtained permission from the irrigation department. There were widespread protests by farmers against the extraction of water from the reservoir by the Coca-Cola plant. Farmers groups mentioned that some residents of Uravade and Ambegaon villages joined in the protest and lodged a written complaint to the collector of Pune. The community believed that it had the first right on the reservoir and that the reservoir should not be subjected to commercial exploitation. However, panchayat members of Uravade and one of the key persons mentioned that it was people from 'outside' who were mainly involved in the agitation.

Based on the protests, a written order was issued by the collector to the plant to stop drawing water directly from the reservoir. It was reported that subsequent to the order, the plant, after obtaining necessary permissions, started drawing water from the canal that originated from the reservoir. But once again the farmers protested and this time they removed the Coca-Cola plant pipes overnight. Finally, HCCBPL, Pirangut, started using water from their existing infiltration wells, bought from a private owner in 1998/99. It was informed that the wells were originally small but the company had deepened and widened them. The key persons also pointed out that the wells had less water in summer, which was not sufficient for the plant. Hence, the plant purchased water from private suppliers in the summer. In addition, recently, the irrigation department had given permission to the plant to draw water from KT Weir (Kolhapur Type *Bandhara*) at Ambarwet, on the Mula river.

Barring the protests against the Coca-Cola plant for lifting of water from the Uravade reservoir in the initial years of the establishment of plant, no other agitation at the local level was reported.

State, governance, regulations, and compliance

As reported by the plant management, the Coca-Cola plant in Pirangut was the first plant commissioned directly by TCCC in India (in 1996). Commercial production of RGB line began in the plant in June 2000; it is the only plant in India that manufactures cans. The plant meets its industrial water requirements from surface water, sourced from the local

Uravade reservoir through infiltration wells. A total of four pump sets have been installed to pump raw water. According to the plant, only one of the pump sets is used and the other three are kept on standby mode. The average HP of three pump sets is 10 HP, while that of the fourth one is 7 HP. This section reviews the following issues.

- Water policy in Maharashtra
- Compliance of HCCBPL, Pirangut, with legal and administrative requirements governing the plant's establishment and operations, with a focus on water resources management and wastewater disposal
- Compliance of HCCBPL, Pirangut, with TCCC corporate requirements on water resources management

Water policy and regulation in Maharashtra

The MSWP (Maharashtra State Water Policy), formulated in 2003, adopts an integrated, multisectoral, and decentralized approach to water resources management based on hydrologic or watershed units, thus including both the river basin and the sub-basin; much of the policy advocated in the MSWP finds reflection in the MWRRAA (Maharashtra Water Resources Regulatory Authority Act), 2005. This section discusses the salient features of both.

Maharashtra State Water Policy

The MSWP advocates the development, management, and use of the state's water resources plan such that economic and social benefits are maximized while ecological values are maintained. The water resources plan would be based on the existing water resource development status and the management plans developed by the respective river basin agencies in the state. There are several distinguishing features in the MSWP, as listed below.

- While according priority to water usage for drinking purposes and meeting cooling, hygiene, and sanitation needs of people and livestock, the MSWP prioritizes the water requirements of industry above those of agriculture and hydropower. Environmental and recreational uses of water are fourth in the order of priorities, followed by all other uses.
- The policy seeks to legally empower WUAs (water users associations) such that they can participate effectively in water resource planning and development; the policy recommends that WUAs be empowered to determine internal water charges.
- The MSWP recommends the assigning of stable bulk water entitlements for water user entities and service providers; it also notes that expropriation of water entitlements

established by the state without equitable compensation should be prohibited.

- The MSWP advocates the establishment of a system of water tariffs such that it recovers the cumulative administration, operation, and maintenance costs of providing water services to all categories of water use, and all or a portion of the capital costs involved for storage, delivery, and use of the water. Water charges should be imposed on a volumetric basis. In order to negate the impact of such charges on those unable to pay, the policy advises the state to allow cross-subsidies and allocate funds for the vulnerable.
- The policy emphasizes the importance of maintaining water quality and advocates that the state control all discharges into water bodies; unregistered discharges should be penalised as per the laws of the state. Also, new and existing industries should set up ETPs (effluent treatment plants), either individually or collectively.
- The Policy recommends mandatory water audits for water resource projects.
- In addition to the above, the MSWP, like most other state water policies in India, also reiterates the importance of private sector participation for efficient water resources management and emphasizes on the importance of water conservation and efficient water utilization. For the latter, water harvesting, recycling, and reuse as well as programmes on water literacy are recommended.

Policy tools like water audits and bulk water entitlements have not been recommended in the state water policies of other states under the purview of this analysis; thus, the MSWP advocates policy directions that are relatively new to the water sector in India. However, the policy fails to take cognizance of the fact that groundwater resources are privately owned in India since they are viewed as an attachment to land. Nevertheless, the MSWP is relatively dynamic in its perspective, recommending revisions every five years or as per requirement.

Maharashtra Water Resources Regulatory Authority Act, 2005

The Government of Maharashtra enacted the MWRRAA in 2005; it was the first state in India to have passed an act and constitute an institution (Maharashtra Water Resources Regulatory Authority [MWRRA]) to manage water resources. The enactment of the MWRRAA formalized many of the policy recommendations contained in the MSWP, 2003. Accordingly, it contains provisions for establishing a water-tariff system; empowering water user entities; promoting efficient use of water; preserving water quality in the state through the 'polluter pays' principle; and empowering the MWRRA to establish a

comprehensive regulatory system for the water resources of the state, including surface and sub-surface waters.

The most significant provisions of the MWRRAA, however, pertain to the establishment of bulk water entitlements that can be transferred, bartered, bought or sold on an annual or seasonal basis within a market system, for various categories of water use. An entitlement is defined as an authorization by a river basin agency to a water-using entity for the use of water. The important features of the system are highlighted below.

- Entitlements have to be allocated to the relevant water-user entities for various categories of water use, subject to the priority assigned to each category under the MSWP.
- The allocation of entitlements for facilities or groups of facilities will be determined jointly by the river basin agencies and water-user entities, based on the hydrology and other relevant parameters with regard to the specific basin.
- Bulk water entitlements registered by a river basin agency have to be monitored by the authority or its duly delegated competent representative.
- In the event of water shortage, the authority shall have to, in compliance with the MSWP and the MWRRAA, adjust the quantities of water to be made available to all entitlements and permit the temporary transfer of water entitlements between users and categories of users, with the approval of the concerned river basin agencies.
- The MWRRAA allows the transfer and modification of water entitlements on an annual or seasonal basis through the trading of water entitlements according to criteria established by it. If a water-using entity, which desires an increase in its entitlement allocation, fails to do so through the voluntary, market-based system, it is required to demonstrate this failure at a public hearing and justify its requirement for an increase in its entitlement allocation. A transfer or modification of entitlements will be effected with the approval of the concerned river basin agency if the authority deems it to be legal and in the interest of the people. The transfer is to be based on the compensation to be paid to the original entitlement holder by the water-using entity seeking an increase in its entitlement allocation; the market value of the water resources determines the compensation.
- Permanent transfers of entitlements can also be effected with the approval of the respective river basin agency and the authority in compliance with the rules promulgated by the authority for this purpose.
- The law provides for a review of entitlements at intervals of not less than three years, if warranted.

Besides, the authority has to ensure that cross-subsidies among categories of use, if any, being given by the government (as mentioned in the MSWP) are totally offset by stable funding from such cross-subsidies or government payments. Further, the authority is empowered to review and revise the applicable water charges after every three years.

The MWRRA is currently engaged in initiating the concept of entitlements in pilot irrigation projects in the state. The authority comprises three members—a chair, a specialist in water resource engineering, and a specialist in water resource economy. However, the authority is not completely autonomous in its functioning since it is bound to act upon policy directions provided by the government. Also, the approach to be adopted for the allocation of entitlements across all sectors and categories of water-users is unclear; in this context, it remains to be seen whether bulk water entitlements will be allocated from a top-down or a more democratic approach.

Regulatory framework governing water usage

An NOC (no objection certificate) was issued by the Pirangut gram panchayat for the establishment of the Coca-Cola plant in Pirangut and an annual tax is paid by the plant to the zilla parishad, receipts of which were shown to TERI at the plant. However, the NOC did not contain any provisions with respect to water withdrawal or usage by the plant.

Water withdrawal and water charges

HCCBPL, Pirangut, draws water for operational purposes from a state agency, the MKVDC (Maharashtra Krishna Valley Development Corporation), as well as private agencies. As per the plant management, about 25 percent of the facility's water requirements are met by private sources during the peak season. An agreement between MKVDC and HCCBPL, dated 3 February 2003 (Box 1), permits the company to draw 0.255 million cubic metres of water per year from the Uravade M I (minor irrigation) Tank for operational purposes; the water so drawn cannot be sold to any other party. The agreement is valid till terminated by either of the parties.

Box 4E.1 Agreement between Hindustan Coca-Cola Beverage Pvt. Ltd, Pirangut, and MKVDC (Maharashtra Krishna Valley Development Corporation) on water withdrawal: key features

As per the agreement, water meters ascertain the extent of water withdrawal by the Coca-Cola company; meter readings are taken jointly by the executive engineer of the MKVDC and company personnel. The government and MKVDC reserve the right to change, amend, modify or cancel or revise any of the terms and conditions of the agreement. Should any breach occur, the agreement could be cancelled without the payment of compensation to the plant.

Water rates mentioned in the agreement can be subjected to revisions. In this context, as per the GR (government resolution) number 2006/396/03, dated 31 July 2006, the currently applicable water rate for the Coca-Cola plant is Rs 410 per10 000 litre. The above resolution hiked the water rate from that provided in the agreement (Rs 125 per 10 000 litre) as per MKVDC's letter number MKVDC/Sinahan-1/498(89208)3-002/5231, dated 9 July 2002. The rates are billed and paid monthly. Also, as per a GR dated 9 may 2003, if the source well is within 35 m from the water source (Uravade *nullah*), then 50 percent of the water rate is applicable to the facility. Accordingly, the rate applicable to the Coca-Cola plant is 50 percent of Rs 410. This was intimated by the irrigation department and verified during discussions with the plant management, although the distance between the reservoir and the well was not physically verified. The agreement also mandates the payment of an additional 20 paise per every rupee of water withdrawal by the company towards a local fund cess. According to the plant management, the zilla parishad of the district manages the local fund cess.

With respect to the quantum of water withdrawal, the agreement requires the company to submit its seasonal water indent for the kharif, rabi, and hot weather seasons on or before 15 days of the start of the season, and furnish the exact quantity of water drawn in each season after completion of the season. For water drawn in excess of 10 percent of the sanctioned quota, no penalty will be levied on the plant. However, for water withdrawal in excess of 10 percent of the sanctioned quota, a penal rate of 25 percent over the basic water rate will be charged.

The agreement also specifies that the company should not discharge any pollutant or effluent into any water body, and if found doing so shall be penalized with Rs 5000 per such incidence per day; it must recycle the effluent water so that at least 50 percent reduction in consumption of fresh water is achieved. (In this regard, as reported by the plant in 2005, it recovered 85 percent of backwash water, 63 percent of bottle wash, and 43 percent of effluent after tertiary treatment at the effluent treatment plant. The plant is zero discharge and uses all the treated effluent either for crate washing or floor washing or for the maintenance of the green belt.)

Besides, the plant also draws water from privately owned infiltration wells located off the Uravade reservoir (dug to about 30 feet). As per an agreement between HCCBPL, Pirangut, and a private supplier, effective from April 1997 (copy shared by Coca-Cola with the study team), the following apply.

- A guaranteed supply of 300 000 LPD (litres per day) to the plant
- A minimum purchase of 20 000 000 LPY by the plant from the supplier
- Water charges to be paid by the plant at the rate of 1.2 paise per litre
- A minimum payment of Rs 20 000 every month by the plant to the supplier, irrespective of the water usage, provided the supplier is in a position to supply a minimum quantity of 300 000 LPD.

Also, as mentioned in chapter 3, the Water Cess Act, 1977, and its amendments require industrial units that consume 10 kilolitres per day or more of water, to file water cess returns to the respective state pollution control boards. As per the documents received from the Coca-Cola plant, India, the plant has paid Rs 20 403.00 as water cess to the MPCB for 2005/06.

Categorization and consent

The Consent to Establish was not received by TERI for the Pirangut plant despite repeated requests, although a copy of the latest Consent to Operate, issued by the MPCB to HCCBPL, Pirangut, was received. The MPCB has categorized HCCBPL, Pirangut, as an orange category industry.

Compliance with regulatory and The Coca-Cola Company requirements

The Consent to Establish was not received for the Pirangut plant. The Consent to Operate issued to HCCBPL, Pirangut, was issued on 21 March 2006. The Consent to Operate for the Pirangut plant stipulated discharge standards for eight parameters and suggested that the plant should be a zero-discharge plant. The conditions stipulated by the MPCB and the status of compliance by the Pirangut facility are summarized in Table 4E.6.

Table 4E.6 Compliance with conditions specified in CtO by HCCBPL, Pirangut

Requirements	*Compliance in Pirangut plant; remarks, if any*
General	Copy of the CtO issued to HCCBPL on 21 March 2006, valid till 31 March 2008, enclosed
Limit on discharge for wastewater	592 KLD Based on daily discharge data for 2005 and 2006; Shared by Coca-Cola, the plant is within the limit prescribed above
Mode of discharge of wastewater	The plant is zero discharge as per the CtO of MPCB, and as per the information provided by the plant
Compliance with discharge standards	Compliance to discharge limits set by the MPCB for eight parameters The parameters in test reports provided by CCI are in compliance
Requirement of sampling and flow measurement	Not mentioned in the CtO
Interlocking of pollution control devices with process	Not mentioned in the CtO
Annual environment statement	Not mentioned in the CtO
Any other issues (s)—monitoring and inspection	Not mentioned in the CtO

CtO – Consent to Operate; MPCB – Maharashtra Pollution Control Board; HCCBPL – Hindustan Coca-Cola Beverage Pvt. Ltd; KLD – kilolitres per day; CCI – Coca-Cola India
Note: The compliance of the plant is based on secondary data provided by CCI: results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

Compliance with The Coca-Cola Company corporate practices on water management in Hindustan Coca-Cola Beverage Pvt. Ltd, Pirangut

Water withdrawal and usage

As noted previously, HCCBPL, Pirangut, withdraws surface water for its manufacturing activities through pump sets installed in its own infiltration wells fed by the Uravade reservoir. Table 4E.7 gauges the compliance of the bottling unit with water resources management requirements of the Coca-Cola Company.

Table 4E.7 Compliance with TCCC water resource management requirements by HCCBPL, Pirangut

Requirements	*Compliance in Pirangut plant; remarks, if any*
Conduct environmental due diligence prior to siting of the plant	Conducted; part of the report shared emphasizes on long-term water availability in the area
Document the assessment of water availability	Hydrological studies conducted around the site; report shared states that water availability is adequate in the region
Assess initial and periodic water utilization	Carried out as evident by stable water use ratio
Implement and maintain a process for water utilization	Process of water balance and audit is maintained
Establish a continuous process for improvement of water utilization	Water utilization ratio varied between 2.93 in 2002 and 3.10 in 2006; potential unknown
Define water utilization objectives and goals in annual business plans	Optimization of water utilization per litre of the beverage produced remains the annual objective; water conservation targets are defined each year in consultation with corporate office.

Develop and execute internal and external water contingency plans	Various rainwater-harvesting assignments have been initiated as a response to the contingency measures. Total potential of 14 046 m^3 of rainwater harvesting is created at the plant site, but figures for actual rainwater harvested are not provided. Also, as per discussions with the plant management, there are plans for a pipeline to be laid to lift water from the Mula river as a business continuity measure; an assessment is being conducted for the process of acquiring land for laying a 4-km long pipeline from the lifting point on the reservoir to the factory. Coca-Cola is also providing financial support for a government-initiated drinking water pipeline for 10 villages, sourced from the Mula river

Note: Based on information provided by TCCC and CCI and site visits by the project team

As mentioned in Chapter 3, the Coca-Cola Company also has certain water management guidelines. Table 4E.8 assesses whether HCCBPL, Pirangut, is compliant with the water management guidelines of TCCC

Table 4E.8 Compliance with TCCC water resource management guidelines by HCCBPL, Pirangut

Guideline	*Observation in HCCBPL, Pirangut*
A self-assessment on water utilization	A plant level water distribution, or balance, is maintained and water use is optimised at each level of the process based on in-plant trials and suggestions from the corporate office. As a result, the water use ratio has remained more or less stable over the years. A self-assessment on water usage is done annually at the plant in the TCCC format; the document was shown to TERI by the plant management but a copy of the responses by the plant was not shared by CCI due to 'legal and confidentiality reasons'
A self-assessment on water supply	As per documents received, a safe yield of the water supply source is assessed at the time of establishment of the plant. Quality of raw water is checked on a daily basis for selected parameters at the plant and once in a year by an accredited laboratory. A self-assessment of water supply is also done annually at the plant in the TCCC format; the document was shown to TERI by the plant management, but a copy of the responses by the plant was not shared by CCI due to 'legal and confidentiality reasons'
The data collected during self-assessments to be used to build a water conservation plan	Since self-assessment responses were not shared, it is difficult to ascertain how information collated during self-assessments are used to build a water conservation plan
The establishment of a cross-functional team for water resources	As intimated during the plant visit, a cross-functional team has been established at Pirangut for water resources management. This includes the factory manager and the quality assurance manager, apart from other executives; the WRM programme focuses on 4 Rs for water conservation: reduce, reuse, recycle, and recharge. The

Guideline	*Observation in HCCBPL, Pirangut*
management	various initiatives undertaken include creating awareness and training employees, and technological interventions, for example, reuse of wastewater in applications like gardening and shop-floor cleaning

Note: Based on information provided by TCCC and CCI and site visits by the project team

Wastewater discharge

Coca-Cola corporate policy lays down company standards for effluent disposal as well, as noted in Chapter 3. The regulatory standards for the Pirangut plant are specified in the Consent to Operate issued by the MPCB, which specifies limits for eight pollutants for the treated effluent discharged from the ETP of the company. The limits are as follows.

- pH between 5.5 and 9.0
- Suspended solids: not to exceed 200 mg/l
- BOD at 270 °C, three days: not to exceed 100 mg/l
- Chemical oxygen demand: not to exceed 250 mg/l
- Oil and grease: not to exceed 10 mg/l
- Total dissolved solid: not to exceed 2100 mg/l
- Chloride: not to exceed 600 mg/l
- Sulphate: not to exceed 1000 mg/l

As per the corporate requirements, the plant needs to get its treated effluent analysed once a year by an accredited laboratory and send the results to the corporate office. All the eight parameters listed in the requirements in Consent to Operate are also part of the corporate requirements. Table 4E.9 gives a checklist of the compliance of the HCCBPL plant, Pirangut, with these wastewater requirements.

Table 4E.9 Compliance with TCCC wastewater management requirements by HCCBPL, Pirangut

Requirements	*Observations in Pirangut plant*
Meet applicable regulatory requirements	Yes (as per documents received; the MPCB officials, too, did not point to any anomaly)
Maintain an effluent quality that will have no adverse effects on fish or other aquatic biota in receiving waters	Yes, as per the data sheets provided by the plant
Maintain and operate treatment facilities in an efficient manner	Yes, as per the documents received
Compliance with wastewater quality requirements developed by the TCCC	Yes, as per the documents received
A detailed drainage plan of all water and wastewater streams in the facility	Yes, existence of separate plans verified during the site visit

Requirements	*Observations in Pirangut plant*
Separate wastewater streams for process wastewater, sanitary wastewater, cooling water, and storm water	Yes, sewage treated in STP, separate line for storm water and cooling and process wastewater taken to ETP
Prevent the pollution (of) from water and wastewater	Adequate measures provided as per the evaluation during the site visit
Minimize the volume, strength, and hazardous nature of wastewater	Backwash recovery: 85 percent; bottle wash recovery: 63 percent; and tertiary treatment plant at ETP: 40 percent (all data for 2005); plant is also zero discharge as per the information provided
Treatment of process water such that it is	
Compliant with TCCC analytical standards	Yes, verified as per the data provided
Compliant with government effluent discharge standards	Yes, verified as per the data provided
Conducive to the long-term survival of fish in the treated effluent	Yes, verified as per the data provided
Sanitary wastewater to be discharged to a sewer connected or an STP	Yes, plant in compliance, STP exists at the site
Treatment of storm water according to government regulations if applicable; else prevent the pollution of water and wastewater streams due to the run-off	Yes, the storm water collected is filtered and discharged
Non-contact cooling water may be discharged into the local environment unless otherwise dictated by local laws or regulations	Not applicable
If treated wastewater discharge is through infiltration, prior to infiltration, the wastewater must meet TCCC requirements and local regulations	Not applicable
If treated wastewater is disposed through land application, then	
Groundwater must be monitored quarterly within the application area, as well as up and down gradient of the application area	No monitoring by the plant
The carrying capacity of the soil should not be exceeded such that there is surface run-off	As per Coca-Cola, surface run-off is monitored by the plant
Water intended for spray fields should not be discharged into the nearby water bodies; nor should excess run-off from spray fields be allowed to enter nearby water bodies	Not applicable; the treated wastewater meets the local regulatory requirements for land disposal. No separate TCCC standards exist for treated wastewater to be applied on land

MPCB – Maharashtra Pollution Control Board; KLD – kilolitres per day; CCI – Coca-Cola India; STP – Sewage Treatment Plant; ETP – Effluent Treatment Plant

Note: The compliance of the plant is based on secondary data provided by CCI: results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

According to the documents received, HCCBPL, Pirangut, attained the E1 level of compliance in 2006 under the TCCC audit system (refer Chapter 3). Apart from the above, it has also received the ISO 9001 certification for quality in 2002, and the ISO 14001 certification for environmental management standards in 2004.

Water-related Corporate Social Responsibility Initiatives

The representatives of HCCBPL, Pirangut, informed that currently, the focus on CSR activities is on three broad areas: water management (special focus on drinking water), primary education, and primary health. The plant noted that CSR initiatives are identified and based on the consultations with and requests from community members in the vicinity, gram panchayat, block development officer, NGOs etc; the bottling operation's public affairs and communications team and human resource team are in touch with the local communities.

As per the plant management, till 2003 HCCBPL, Pirangut, regularly supplied drinking water to Pirangut village through tankers during periods of water scarcity on the request of the gram panchayat. This was discontinued when the village laid out a new pipeline for drinking water. The company further plans to support a government project, the Swajaldhara Rural Drinking Water Scheme, by constructing a drinking water pipeline from the Mula river for 10 villages; a request for this has been received by the plant management from the gram panchayat. The company is planning to contribute Rs 0.5 million for this drinking water project, which would be aided partly by the government. In addition to the above, the company has implemented a rainwater-harvesting project at Paud tehsil office to showcase the potential of rainwater harvesting to villagers in the area. This project has a potential to harvest 3600 million litres of rainwater annually.

Technical assessment

Regional assessment of water quality

The ex situ assessment has been undertaken with an aim to provide an insight into the quality of surface water that is sourced and consumed by the plant and the impact, if any, of the effluent discharged, after processing, from the plant. As discussed subsequently, the surface water has been studied by undertaking water quality monitoring in and around the Pirungut village, where the plant is located. The assessment

here does not relate the regional groundwater quality to the operations of the Coca-Cola plant.

Selection of sampling location

Uravade village was selected for surface water quality monitoring. The following sources were chosen.

- Uravade reservoir
- Infiltration well number 3 (connected to Uravade reservoir and owned by HCCBPL, Pirangut)
- Private infiltration well (connected to Uravade reservoir)

Figure 4E. 15 depicts the location of sampling points.
The samples were collected from the above locations on the following dates.

First round	*22 February 2007 and 23 February 2007*
Second round	02 May 2007 and 03 May 2007
Third round	05 June 2007 and 06 June 2007

These samples were collected, preserved, and transported to the designated laboratories as per the set protocols, the description of which is discussed in Chapter 2 on approach and methodology.

Test results

Summarized results of site-specific parameters that have exceeded the prescribed standards are presented in Figures 4E.15 to 4E.20.

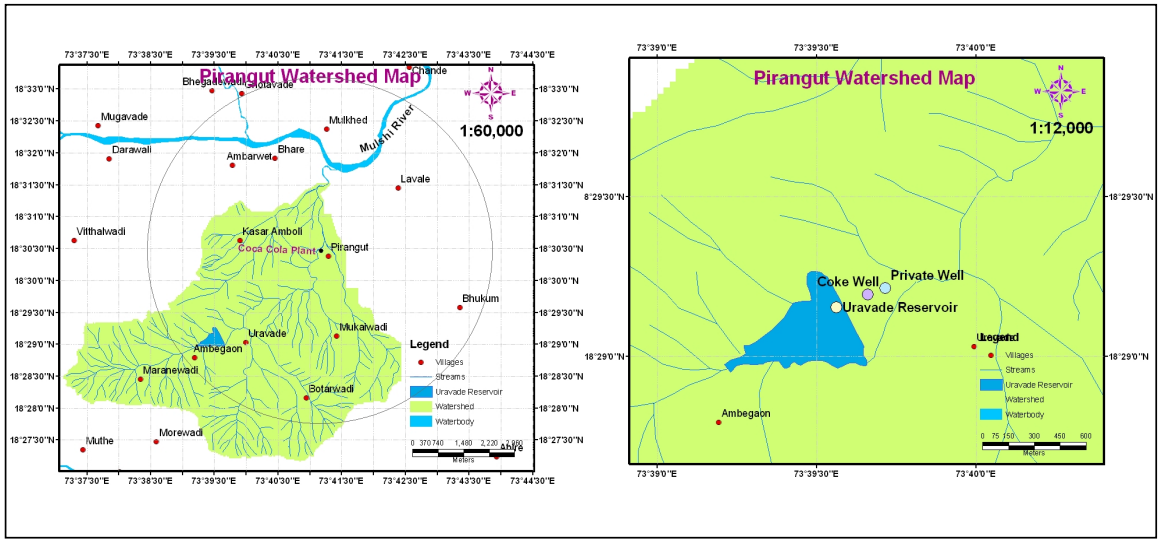


Figure 4E.15 Location of sampling points

The regional water quality analysis results show that of the various tested parameters, and when compared to the drinking water standard BIS: 10500, turbidity value exceeds the standard in all the three sources, that is, Uravade reservoir, infiltration well number 3, and private infiltration well. Total alkalinity values exceeded the standards in the two infiltration well sources and iron was found to exceed in Uravade reservoir. Uravade reservoir showed the presence of MPN coliform, faecal coliform, and *Escherichia coli*. Private infiltration well showed exceedance for MPN coliform. The value of lead was found to exceed the WHO (World Health Organization) guideline value in all the three sources.

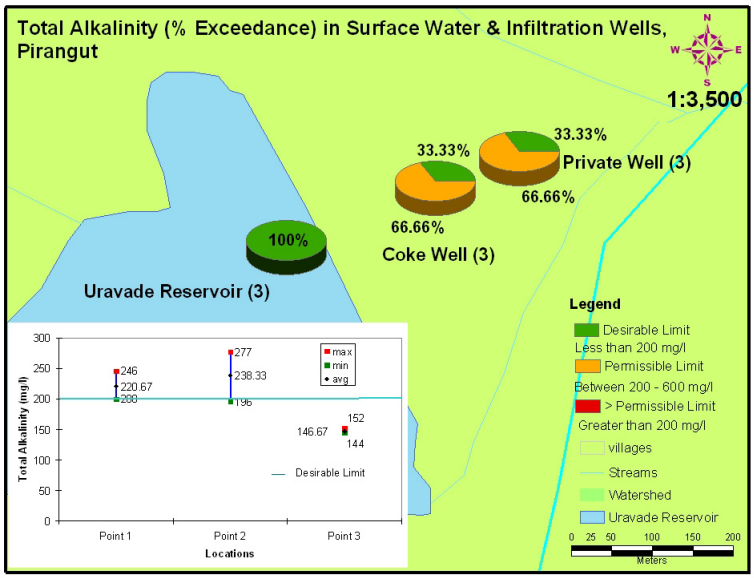


Figure 4E.16 Percentage samples that exceeded limits for total alkalinity at Pirangut region.

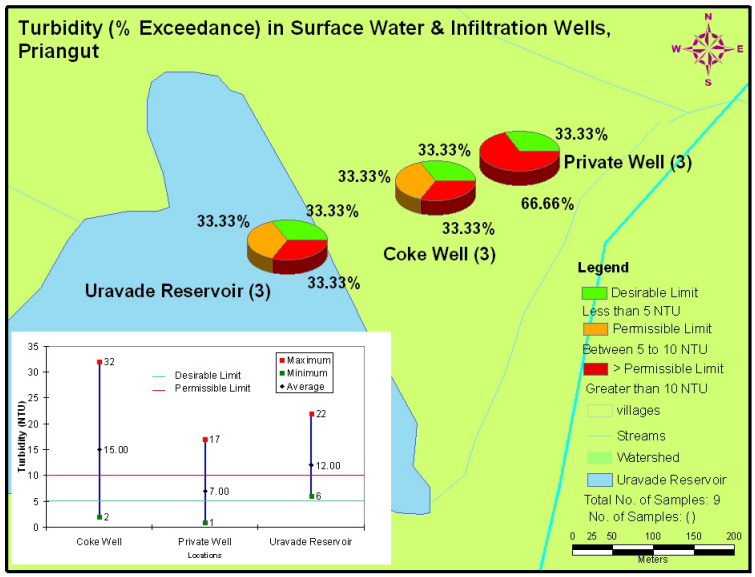


Figure 4E.17 Percentage samples that exceeded limits for turbidity at Pirangut region

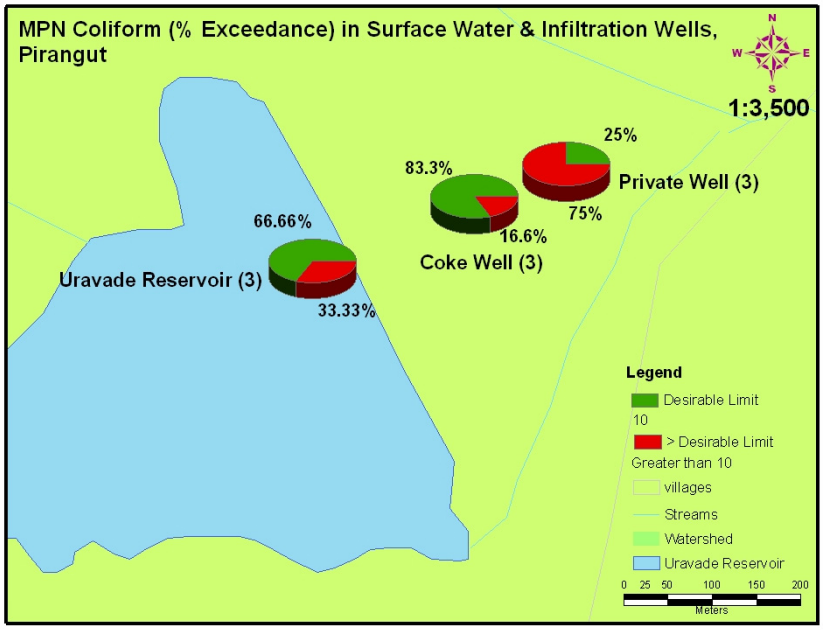


Figure 4E.18 Percentage samples that exceeded limits for most probable number coliforms at Pirangut region.

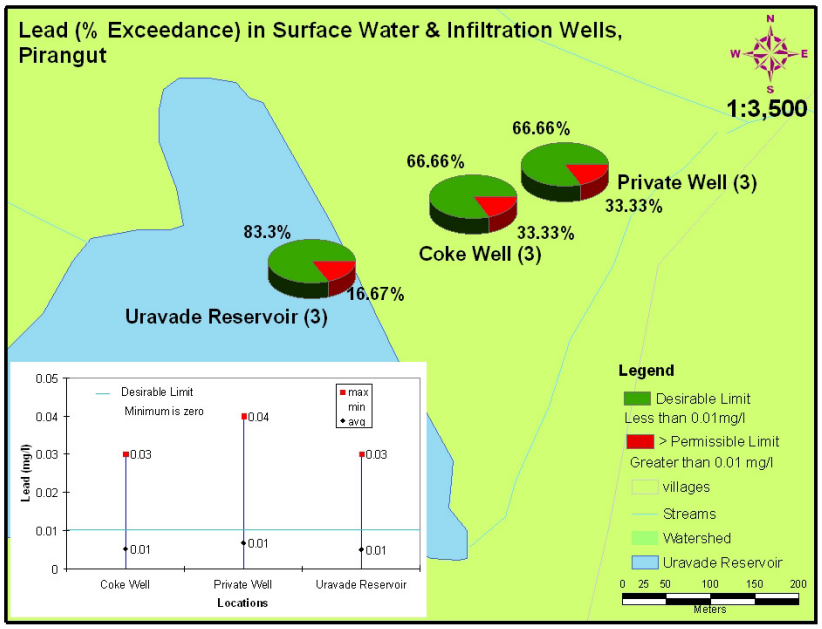


Figure 4E.19 Percentage samples that exceeded limits for lead at Pirangut region

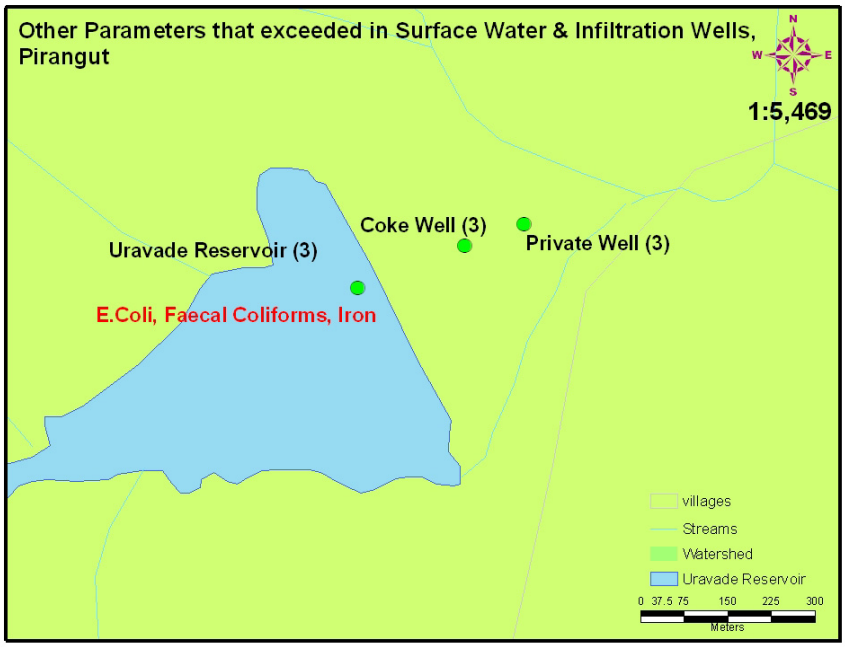


Figure 4E.20 Water quality parameters that exceeded limits at Pirangut region

Pesticides were not found in the water of the monitored region. Table 4E.10 presents test parameters that did not conform to WHO guidelines and BIS standard for drinking water.

Table 4E.10 Non-conforming test parameters

World Health Organization guidelines	*BIS 10500 : 1991 drinking water specifications*
(In addition to non-conforming parameters identified under IS 10500) Lead	Physiochemical Turbidity, iron, and total alkalinity. (Of these iron was found in the Uravade reservoir only) Microbiological MPN coliform, faecal coliform, and *Escherichia coli* Of these faecal coliform and E Coli was found in Uravade reservoir only

MPN – most probable number

Water with the quality as given in Table 4E.10 needs to be treated for potable consumption in the villages.

Plant-level assessment of quality and practice

Plant-level water assessment

The HCCBPL Pirangut plant sources its water from two infiltration wells. The water is pumped to a raw water storage tank where it is chlorinated and further sent to different sections and processes for respective treatment and usage in the

beverage production, for domestic use and for use in the boilers and cooling towers as shown in Figure 4E.21. Wastewater discharges from the production line, boilers and cooling towers, and domestic usages (except domestic sewage) are finally collected into a common ETP, wherefrom it is treated and used for horticulture.

Water quality

Table 4E.11 gives the description of the points of sample collection and the sampling details.

Table 4E.11 Details of the in situ sampling locations

Sample source	*Location of sampling*	*Quantity of sample*	*Type of sampling*	*Number of samples (from each location in each round)*	*Protocol and guidelines for sampling and testing*
Raw intake water	Raw water inlet (before PSF)	20 l	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
	Raw water outlet (before coagulation WTP tank)	20 l	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
Wastewater/effluent	ETP inlet-1 (RGB sump)	20 l	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
	ETP inlet-2 (can/PET sump)	20 l	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
	ETP outlet (inside splitter tank)	20 l	Composite (1 hourly for 22 hours)	1	APHA 20th ed. 1998/ IS 3025
Sewage treatment plant (third round only)	STP inlet	20 l	Grab	1	APHA 20th ed. 1998/ IS 3025
	STP outlet	20 l	Grab	1	APHA 20th ed. 1998/ IS 3025
Process water	Plant process After chlorinated soft water tank WTP outlet Before CAN/PET paramix (bottle-filling unit) Before RGB paramix (bottle-filling unit)	20 l	Composite (1 hourly for 22 hours)	4	APHA 20th ed. 1998/ IS 3025

WTP – water treatment plant; PSF –pressure sand filter; ETP – effluent treatment plant; STP – sewerage treatment plant; RGB – refillable glass bottle; PET – polyethylene terephthalate; APHA – American Public Health Association

Figure 4E.21. depicts the sampling locations on the process flow diagram of the plant.

The results observed have been compared, for compliance, with the relevant guidelines/ limits/requirements as follows.

- *For wastewater and STP discharge* Relevant local regulation by the MPCB, CPCB guidelines, and TCCC internal quality guidelines
- *For process water* Relevant national standard for drinking water (BIS 10500 : 1991, IS 14543 : 2004), international guideline (WHO guidelines for drinking water), and TCCC internal specification for treated water
- *For raw water* Relevant national standard for drinking water (BIS 10500 : 1991) and international guideline (WHO guidelines for drinking water)

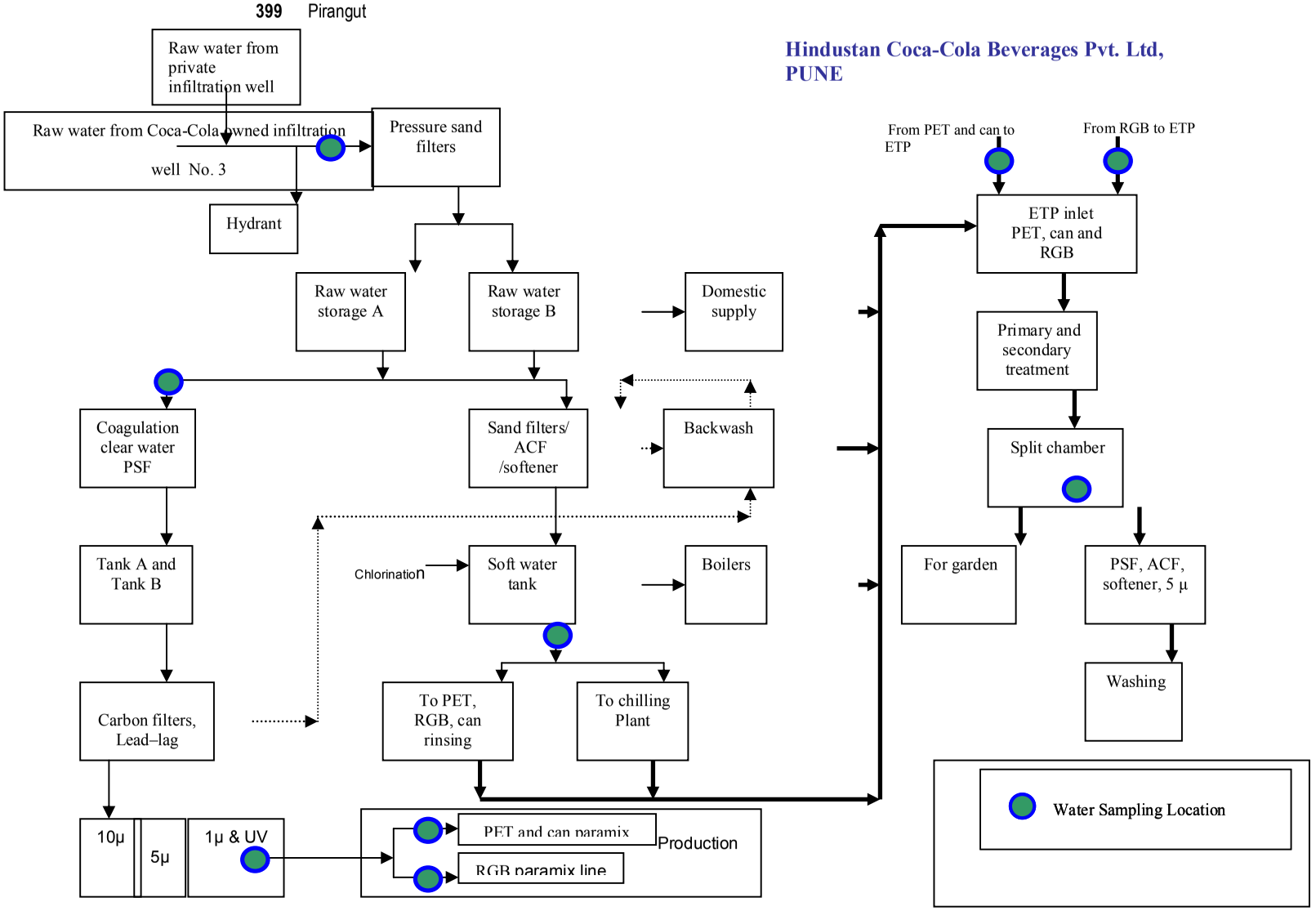


Figure 4E.21 Hindustan Coca-Cola Beverage Pvt. Ltd, Pirangut, process flow diagram and sampling locations

PSF –pressure sand filter; ETP – effluent treatment plant; STP – sewerage treatment plant; RGB – refillable glass bottle; PET – polyethylene terephthalate; ACF – Activated Carbon Filters (**Source** HCCBPL plant data, Pirangut, Pune)

Sample collection, preservation, and transportation

For all the selected locations composite sampling was carried out from 22 February 2007 to 23 February 2007 in the first round; 02 May 2007 to 03 May 2007 in the second round; and 05 June 2007 to 06 June 2007 in the third round. Protocols for sample collection, preservation, and transportation to designated laboratories have been discussed in chapter 2 on approach and methodology.

Test results

The parameters that have shown frequent exceedances compared to IS 10500 in the plant intake raw water are alkalinity and turbidity. In addition to above-mentioned parameters, iron and manganese have shown one-time exceedances. Lead has also shown one-time exceedance compared to the WHO guidelines. Rest of the monitored parameters, including pesticides, were found within the stipulated limits in the plant intake raw water.

In case of process water obtained after treating it in the water treatment system (that is, before input to beverage production and after micron filtration), none of the parameters were found to be in exceedance when compared to IS 14543 and IS 10500.

The quality of the ETP discharge (that is, after ETP from the splitter tank (tank at the end of the treatment system just before the final outlet) indicates effective treatment for all of the monitored parameters except for chlorides that showed a marginal exceedance in one of the sampling rounds. The parameters were found to be within the specified MPCB and CPCB limits for land application.

As compared to TCCC's own treated wastewater quality standards for discharge into natural waterbodies, TKN, cadmium, and BOD have shown one-time exceedance.

Pesticides were not detected in any of the monitored in situ sources, which include raw water used in the plant as well as process water used for beverage production.

Plant-level water audit

Water auditing exercise at HCCBPL, Pirangut, Pune, involved an examination of water flows at the inlet and outlet of unit processes with the following objectives.

- Establish water balance of the facility for the monitoring period
- Assess ETP/WTP (water treatment plant) inlet and discharge

Details of plant operations

The plant operations with respect to water balance can be divided into four broad segments, namely, RW (raw water), PW (process water), SW (soft water), and effluent. Figure 4E.22 shows the schematic diagram of WTP and locations of meters for three rounds of auditing.

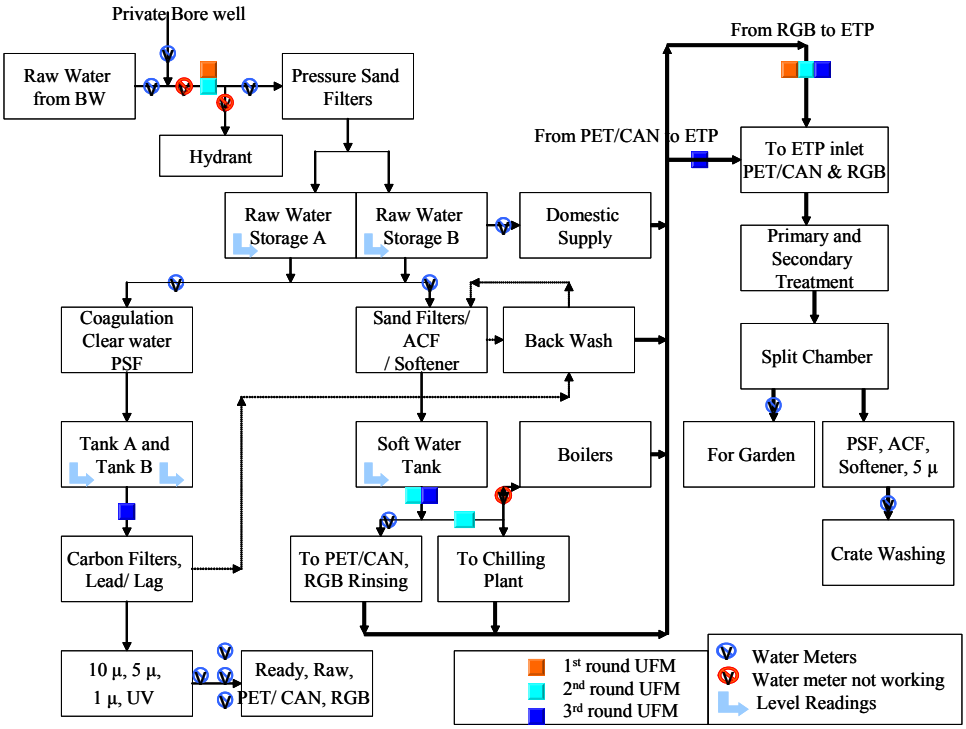


Figure 4E.22 Schematic diagram of the plant showing water meter locations

Water balance

Water balance of individual storage unit for the entire plant was carried out to assess the inflow and outflow of water in the plant and to estimate water usage in process and soft water. Table 4E.12 gives water balance compiled for RW tank for three rounds of water auditing.

Table 4E.12 Raw water balance (for soft water) during the three rounds of water auditing

Water balance component	*First round*	*Second round*	*Third round*
Inlet			
Raw water intake (m^3)	443.06	491.90	492.8
Outlet			
Soft water (m^3)	197.9	319.45	222.65
Process water (m^3)	219.9	446	201.3
Domestic water (m^3)	42.22	51.7	64.45
Total outlet (m^3)	460.02	817.15	488.4
Storage			
Measured (inlet–outlet in m^3)[a]	–1.653	–309.94	19.4
Observed (m^3)[b]	–7.59	–349.14	51.86
Per cent error in balancing (UWL [Unaccounted for water losses])	1.3	7.73	6.39

[a]Measured change in storage is the change calculated based on the meter readings at the inlet and outlet by applying continuity equation.

[b]Observed change in storage is the storage change based on the difference in water levels of the tanks.

Note: Negative tank storage shows net outflow from the tank, that is, reduction in water storage level of the tank.

The plant water balance derived from the audit shows that the components of the continuity equation (that is, inlet, outlet, and change in storages) are in conformation with each other (that is, plant water balance results are satisfactory). The percentage of agreement between the observed change (from level indicators installed by the plant) and measured change (from our digital flow meter results) in storage with respect to inflow is in the range of about 92 percent to 99 percent.

In addition to water balance, water usages for different unit processes were also calculated. Table 4E.13 presents a brief overview of observations for three rounds of water auditing.

Table 4E.13 Volume of water/effluent used in various units of Hindustan Coca-Cola Beverage Pvt. Ltd, Pirangut, during three rounds of water auditing

Water use	*First round*	*Second round*	*Third round*
Date of monitoring	21–22 February 2007	3-4 May 2007	6–7 June 2007
Monitoring hours	20	23	23
Process water (m^3)	249.52	332.74	169.12
Soft water (m^3)	203.44	328.95	201.86
Domestic	42.22	51.7	64.45

water (m^3)			
ETP outlet (for gardening) (m^3)	122.64	232.84	NA
Tertiary treatment (m^3)	1.06	0.09	NA
Production (m^3)	206.6	282.519	114.93
WUR treated water	2.41	2.535	3.842
Production	330 ml cans and 200 ml RGBs	330 ml cans and 200 ml RGBs	330 ml cans and 600 ml PET

WUR – water utilization ratio; ETP – effluent treatment plant; RGBs – refillable glass bottles; PET – polyethylene terephthalate

Annual WUR reported by the plant is 2.9 to 3.10 for the past five years while WUR calculated from auditing are 2.41, 2.53, and 3.84 for the first, second, and third round, respectively.

Based on the production data from plant, it was observed that there was three hours of continuous CIP (clean-in-process) during the third round, probably leading to higher use of water and a higher WUR. A shift from the Diet Coke can line to 600 l Limca PET bottles took place during the third round.

During the second round, one hour of CIP was carried out for RGB production where product was changed from Sprite to Thums Up. Again, for can production, two hours of CIP was carried out but no changeover of the product was reported.

The inlet and outlet of ETP could not be linked dynamically as the storage of various units in ETP is very high and pumping is also done at intermittent stages from one process unit to another. As a result of this non-continuity in flows, it is not possible to measure pollution load discharged from ETP in relation to the inflow for that day.

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January 2008

CHAPTER 4F Sathupalle

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CHAPTER **4F** Sathupalle

Executive summary

Franchisee plant located in stable water area – categorized as 'safe'

The Sathupalle plant of the SSSL (Sri Sarvaraya Sugars Limited), is a franchisee plant of CCI (Coca-Cola India), located in the state of Andhra Pradesh, in South India, and sources its raw water from groundwater aquifers. The area experiences rainfall levels that are close to the national average (1100 mm), and 80 percent of it is in the months of June to September. According to the CGWB (Central Ground Water Board; 2005), district Khammam belongs to the 'safe' category, where the groundwater development is estimated to be 21 percent.

Rural, largely rain fed area

The population in Sathupalle block is delineated as a completely rural area having no reported urban population according to the 2001 census. The total population increased from 53 287 in 1991 to 65 952 in 2001, and the population density (239 persons per km^2) is more than in Khammam district (160 persons/km^2), where it is located. Since 1997 the cropping intensity has grown by about 20 percent and the irrigation intensity by about 40 percent, with paddy, which is grown in both the seasons, as the dominant crop, followed by sugar cane maize, and groundnut. Only one-third of the total cropped area is under irrigation, of which about one-third is based on groundwater irrigation. The rest is rain fed.

Plant produces only packaged drinking water

The plant specializes in producing Kinley packaged drinking water. The production has gone down in the last three years by 3300 kl, from around 16 300 kl in 2003/04. The peak months for groundwater intake were April, May, and June, while in December and January, the plant consumes relatively much less water.

Panchayats responsible for provision of drinking water supply; perceived decline in water table levels

The primary mode of water for domestic use in all the four study locations is piped supply provided by the respective panchayats. Groundwater is drawn through bore wells with electrified pump sets and stored in OHTs (overhead tanks).

Water is chlorinated in the OHTs and then supplied into the pipes, both private and public, either twice or once a day . Among the stakeholders interviewed, there was a general feeling that there has been a noticeable drop in the groundwater level over the last 2–3 years. The various reasons for the dropping groundwater levels were cited as follows.

- Decrease in rainfall over the years
- Increase in the number of bores for various purposes
- Increase in agriculture
- Increase in population, also leading to increase in demand
- Presence of the Kinley plant, seen as affecting the water sources of the community in the vicinity of the plant

Some concerns over bore water quality

Perception: Some stakeholder groups reported that water used from boring contained fluoride. Many stakeholder groups across all the study locations around this plant perceived health-related problems attributed to bore water. The problems mentioned were related to gastric, knee aches, leg and joint pain, body pain, and rashes. Problems of this nature, it was said, had been occurring for the past three to four years.

The quality of water used for irrigation was not cited to be an issue by most farmers' groups. However, the farmers' group in Gowrigudem (part of Siddaram panchayat) reported the problem of wastewater release into a channel that was used for irrigation. They perceived that wastewater from the Kinley plant was released into a drain, into which the drainage of one of the colonies of Sathupalle municipality was also released thereby affecting crop yields of the farmers who used water from the channel . However, they stated that they do not face a problem with wastewater from the Kinley plant in summer months as it is released only in the rainy and winter seasons.

Technical assessment: During the field surveys by TERI, it was found that treated effluent from the Coca-Cola plant was used for green belt maintenance and not released into any drain. The 'consent to operate', issued by the Andhra Pradesh Pollution Control Board, also reveals that the plant is a zero-discharge plant and treated effluent is not discharged outside the plant boundaries.

Results of the quality of the ETP (effluent treatment plant) wastewater discharge indicate that the plant meets all the requirements as specified by the CPCB (Central Pollution Control Board) for discharge on land for irrigation.

Regional groundwater quality assessment reveals that all of the monitored villages in the watershed showed exceedance for

total alkalinity and coliforms as compared to IS 10500 standards for drinking water quality. In addition to the above parameters, village Jagganathapuram (at the extreme upstream, U 2) showed exceedance for aluminium and *E. coli*. Village Bethupalle (D 2) showed exceedance for additional parameters like TDS (total dissolved solids), calcium, fluoride and *E. coli*. Of the four regional study locations (villages), the most exceedances for the drinking water quality parameters were observed for Sathupalle (M 1). Exceedances were observed for parameters namely, pH, TDS, calcium, nitrate, iron, fluoride, aluminium and chloride, along with nickel, compared to IS 10500 and WHO (World Health Organization) guidelines. Similarly, another village, Kakarlapalle (U 1), showed exceedances for TDS, calcium, nitrate, iron, fluoride, aluminium and *E. coli* along with nickel (as per WHO guideline). The assessment results for village Bethupalli (D 2) also showed marginally high concentration of the pesticide Atrazine as per IS 14543. However, no other monitored pesticides were detected in any of the monitored ground water sources.

The regional groundwater quality assessment here does not relate the regional groundwater quality to the operations of the Coca-Cola plant. However, the regional water quality assessment also shows the need to carry out a detailed study to establish/rule out any causal relationship between water quality found in villages to the existence of the plant.

Plant in compliance with regulatory requirements

The Consent to Establish was issued by the APPCB (Andhra Pradesh Pollution Control Board) in the year 2006 for the expanded production capacity of 4750 m^3/month and is valid for five years. It has placed the facility in the 'orange' category of industries. Details on limit effluent generation and mode of disposal allowed are provided in the consent, and the plant is a zero-discharge one as per the terms of the Consent to Operate issued by the APPCB (land application for irrigation). Compliance reports with TCCC (The Coca-Cola Company) guidelines were shared with TERI and regulatory compliance observed. Monitoring of ex-situ groundwater quality and quantity and assessment of carrying capacity of soils is not done by the plant at present, though in situ ground water quality and quantity are monitored periodically. The plant received the ISO 9001 certification for quality in 2002, and the ISO 14001 certification for environmental management standards in 2004.

Process water and wastewater quality mostly indicate compliance with regulations and requirements; however wastewater treatment needs to look beyond compliance

In the plant process water all the water quality parameters except pH were meeting the standards prescribed by IS 14543

and IS 10500 (national packaged water and drinking water standards). The pH was found to be showing marginal exceedence after 0.22 μ filter outlet, found slightly in excess (towards acidic side) to IS 10500 limits. The pH of ultra-pure water in Sathupalle plant can drop a little below 6.5 as it may absorb carbon dioxide (CO_2) from the atmosphere during grab sample collection or pH measurement, but this does not mean that the water is now grossly contaminated; just a fraction of a ppm of CO_2 will cause the pH to fall. The pH values found in samples range between 6.0 – 6.3 which is possible for reason stated above (ref: American Society of Testing of Materials, ASTM-D 5464-93 (2001)). Rest all of the monitored parameters including pesticides were found well below the specified standards for process water.

The quality of the ETP discharge water indicates that the plant meets all the requirements as specified by the CPCB for discharge on land for irrigation.

As compared to TCCC's own treated wastewater quality standards, TKN (total kjeldahl nitrogen) was found to exceed the prescribed limits. Bioassay test, for estimating fish survival rate in treated effluent, was found to be conforming to the requirements prescribed by CPCB.

Corporate social responsibility initiatives unstructured in the past; however, structured framework being considered for the future

The Kinley plant currently does not have a CSR (corporate social responsibility) framework in place, or any specific person who looks after CSR activities. However, they are now considering establishing a structured framework and having more systematic CSR undertakings. Many stakeholder groups and other interviewed stakeholders reported that no CSR activities or development work for the community had been carried out by the Kinley plant.

Site profile

The Sathupalle plant of the SSSL is located in block Sathupalle, district Khammam, in the state of Andhra Pradesh, in South India. It sources its raw water from groundwater aquifers. The area for the study was delineated with 1: 50 000 scale base map (toposheet no. 65C/15 and 65C/16) of the Survey of India . Figure 4F.1 shows the delineated watershed and the sub-basins .

Geographic

The delineated Khammam watershed comprises an area of 360 km² and lies between longitudes 80° 48′ E and 81° 00′ E, and latitudes 17° 10′ N and 17° 24′ N. The watershed is slightly undulating in nature and the hill ranges trend in north-east tosouth-west direction, with elevation ranging from 142 m to 420 m amsl (above mean sea level). The mean elevation is 213 m amsl and standard deviation is 41 m amsl as shown by the hypsometric curve in Figure 4F.2. The watershed forms a part of a larger divide that separates the Godavari and Krishna basins.

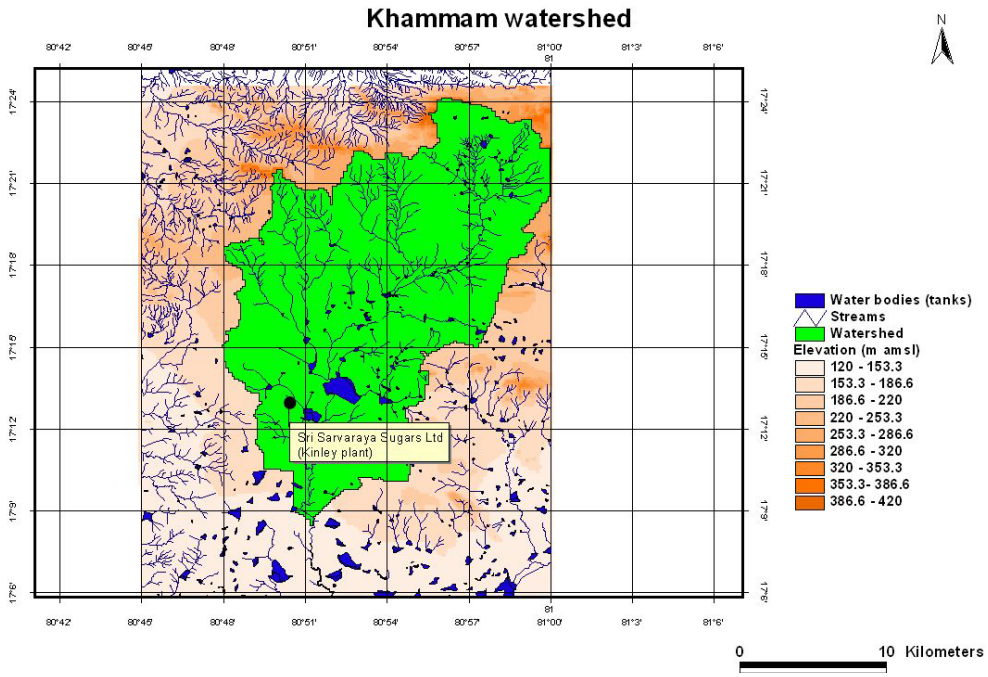


Figure 4F.1 Topography and drainage map of Khammam watershed

m amsl – metres above mean sea level

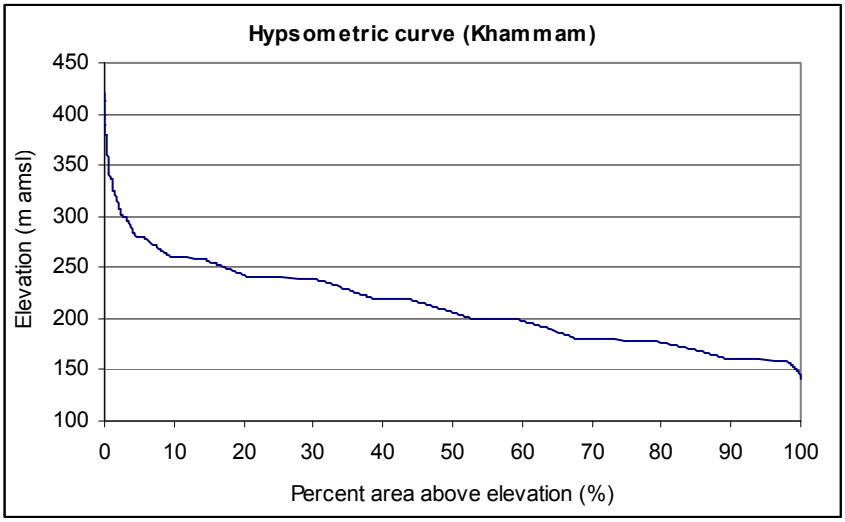


Figure 4F.2 Hypsometric curve of Khammam watershed

Hydrometeorology

The area witnesses an average annual rainfall of around 1030 mm, which is close to the national average of 1100 mm (refer Figure 4F.3). Approximately 80 percent of the rainfall occurs during the south-west monsoons that usually come in the first week of June and withdraw by the end of September. July is the rainiest month, recording more than 200 mm rainfall in about 12–15 days. October and November constitute the post- monsoon season. During this period the watershed receives rainfall mostly due to the peripheral influence of the cyclonic storms over the Bay of Bengal, which accounts for about 14 percent of the annual rainfall.

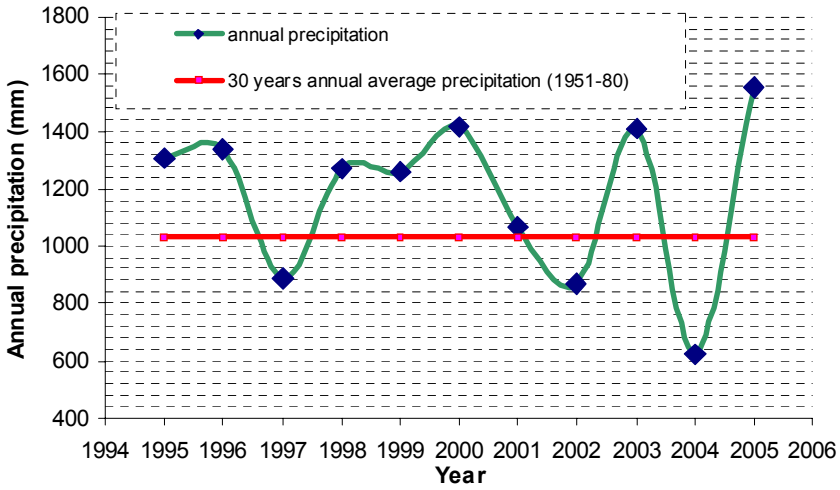


Figure 4F.3 Rainfall pattern in Khammam watershed

mm – millimetres

Temperature

Temperature begins to rise from about the middle of February. May is the hottest month, with mean maximum temperature of 42° C. It begins to drop rapidly with the onset of the south-west monsoon in early June. During the south-west monsoon period mean temperature remains more or less uniform, at around 29 °C and begins to drop after the withdrawal of the monsoon. December is the coldest month, with the mean minimum temperature of 16 °C.

Drought analysis shows that during the period 1970–2005, the district of Khammam experienced drought conditions during the years 1977, 1979, 1984, and 2004. The area experienced below-normal rainfall (deviation of [–] 20 percent of the normal rainfall) during the years 1971, 1977, 1979, 1980, 1984, 1986, 1992, and 2004. The polarity of occurrence of below-normal rainfall is 0.25 and that of normal rainfall is 0.75 (CGWB 1998) climate data up to 2005 from the IMD (Indian Metereological Department).

Socio-economic

The population in Sathupalle block, spread over 274.47 km^2, is delineated as a completely rural area having no reported urban population according to the 2001 census. The total population of Sathupalle increased from 53 287 in 1991 to 65 952 in 2001, which indicates a decadal growth rate of about 24 percent . The population density of Sathupalle (239 persons per km^2), is comparable to that of Khammam district (160 persons per km^2) where it is located.

Andhra Pradesh is an important producer of groundnut, cotton, chillies, sugar cane, and quite a number of horticultural crops. Therefore such secondary linkages of agriculture assume added importance to its rural economy. The number of non-agricultural workers and marginal workers has been increasing in Sathupalle block (Figure 4F.4). These workers are involved in various secondary and tertiary activities like businesses, fisheries, animal husbandry, mining, industries, transportation, and construction.



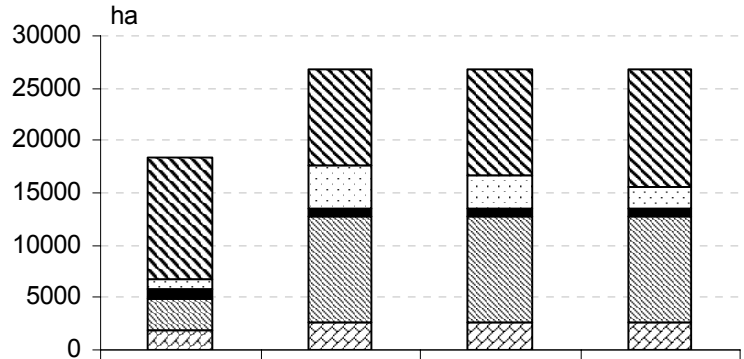
Figure 4F.4 Occupational pattern in the region

Source Statistical abstract of Khammam district for different years up to 2004/05, Bureau of Economics and Statistics, Government of Andhra Pradesh

Land use and agriculture

Figure 4F.5 shows the land-use pattern in Sathupalle Block for the period 1985–2005 . The geographical area of Sathupalle block underwent a change during the mid 1990s. From the available datasets, the total geographical area is found to have increased from 183 14 ha (hectares) in 1985 to 26802 ha in 1997. The share of land under forests went up from 16 to 37 percent, whereas the area under agriculture was reduced from almost 62 to 35 percent, during the same period. Given that comparable datasets are available from 1997 onwards, for the purpose of analysis of this region, the period has been confined to 1997–2005.

After 1997, the area under cultivation has increased and area under fallow land has decreased. The area under forests has remained the same since 1997 and comprises teak, *nallamaddi*, c*handre,* and bamboo as the major tree species.



	1985-86	1997-98	2001-02	2004-05
Net sow n area	11473	9209	10192	11251
Fallow land	1115	4120	3138	2079
Barren & uncultivable Land	824	714	714	714
Forests	2939	10122	10122	10122
Others	1962	2635	2635	2636

Figure 4F.5 Land use pattern (in percent)

Source Statistical abstract of Khammam district for different years up to 2004/05, Bureau of Economics and Statistics, Government of Andhra Pradesh

The principal crops grown in Sathupalle block include the following.

- Rabi (November to March)–paddy, maize, red gram, green gram, black gram, groundnut, sugar cane
- Kharif (July to October) – paddy, chilli, sugar cane, cotton, gram

Table 4F.1 gives the gross and net cropping area and the cropping intensity over the last two decades. The average cropping intensity in Sathupalle has improved from 1.05 in 1997/98 to 1.22 in 2004/05.

Table 4F.1 Land-use pattern in hectares and cropping intensity in Sathupalle (in ha)

Land-use pattern	*1997/98*	*2001/02*	*2004/05*
Geographical area	26 802	26 802	26 802
Gross sown area (A)	9 705	11 234	13 731
Net sown area (B)	9 209	10 192	11 251
Cropping intensity (A/B)	1.05	1.10	1.22

Source Statistical abstract of Khammam district for different years up to 2004/05, Bureau of Economics and Statistics, Government of Andhra Pradesh

The area under principal crops grown in Sathupalle is given in Figure 4F.6. It can be clearly seen that paddy, which is grown in

both the seasons, is the dominant crop, followed by sugar cane maize, and groundnut. The area under paddy, maize and sugar cane cultivation has increased steadily since 1997/98, accompanied by a decline in groundnut cultivation in 2001/02.

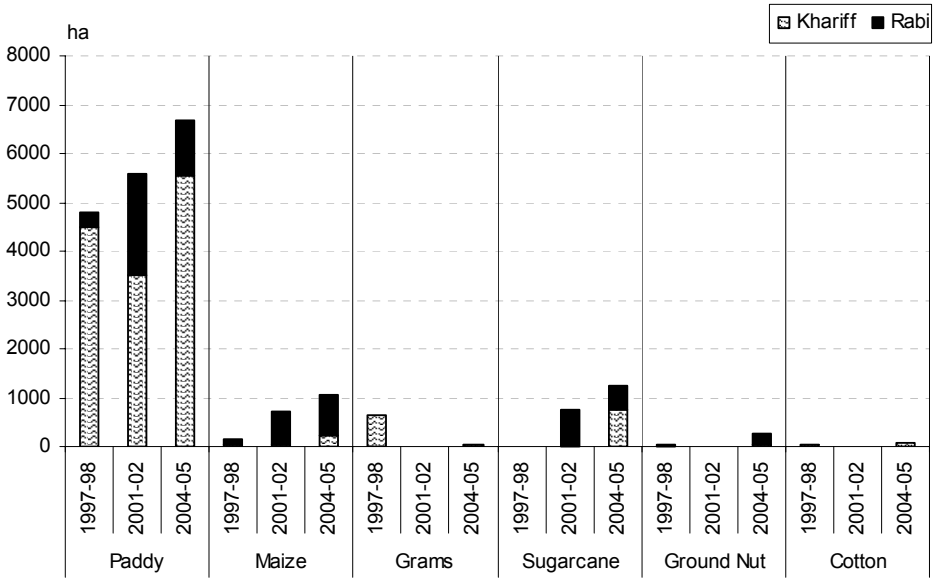


Figure 4F.6 Major cropping pattern

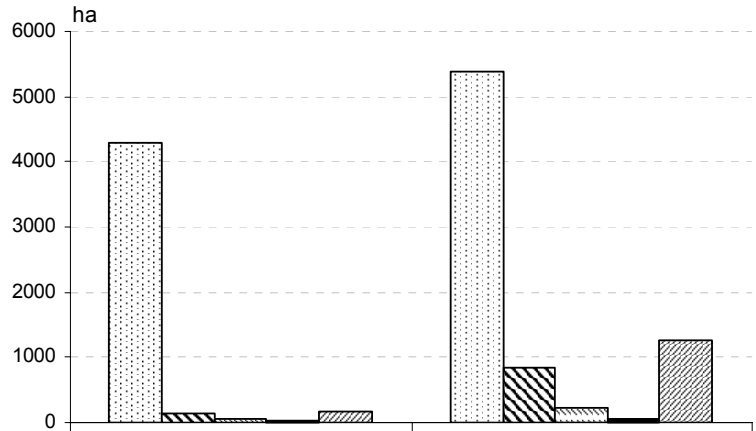
Source Statistical abstract of Khammam district for different years up to 2004/05. Bureau of Economics and Statistics, Government of Andhra Pradesh

Khammam district as a whole is endowed with agro-climatic and soil conditions in which a wide range of horticultural crops like mango, banana, cashew, coconut, oil palm, cocoa, pepper, and areca nut are also grown.[1] This provides opportunities for more marketability and trade to the community.

Irrigation and sources

Agriculture in Andhra Pradesh is mostly dependent on rainfall. The gross area under irrigation for each of the major crops is given in Figure 4F.7. Both paddy and sugar cane are extremely water-intensive crops and an increase in their cultivation and irrigation areas implies more water requirement for agriculture.

1 Details available at <http://khammam.nic.in/html/enconomic-development/horticulture.htm#>, last accessed on 9 July 2007



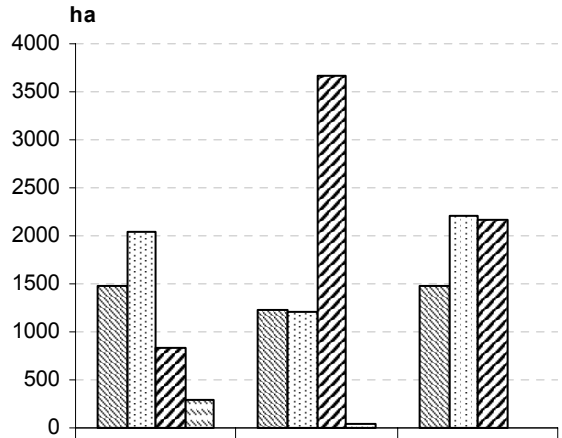
	1997-98	2004-05
Paddy	4292	5389
Maize	127	845
Ground Nut	45	235
Chilles	36	52
Sugarcane	163	1259

Figure 4F.7 Gross irrigated area under principal crops

Source Statistical abstract of Khammam district for different years up to 2004/05, Bureau of Economics and Statistics, Government of Andhra Pradesh

Taking into account all major and minor crops, the gross area irrigated in Sathupalle block increased to 8273 ha in 2004/05 from 4911 ha in 1997/98. However, the net area irrigated has increased to 5850 ha from 4642 ha during the same period. As a result, the irrigation intensity, defined as a ratio of gross irrigated to net sown area, of Sathupalle block has increased from 1.06 to 1.41 in 1997/98 and 2004/05, respectively.

Nearly two-thirds of the total cropped area is rain fed, and the rest is irrigated. Out of the remaining one-third area under irrigation, the share of surface irrigation systems, including tanks and canals, is more than 60 percent as per 2004/05 (Figure 4F.8). The share of tube well irrigation is around 37 percent in this year. Analysis of the last 6–7 years shows that the dependence on groundwater sources of irrigation, namely, tube wells, increased from 18 percent in 1997/98 to 37 percent in 2004/05 measured again in terms of total irrigation sources.



	1997-98	2001-02	2004-05
Canal	1472	1235	1469
Tanks	2036	1198	2210
Tubew ells	834	3663	2171
Others	300	50	0

Figure 4F.8 Irrigation source

Source Statistical abstract of Khammam district for different years up to 2004/05, Bureau of Economics and Statistics, Government of Andhra Pradesh

Diesel pumps and electric motors are the most commonly used irrigation equipment. There has been a significant rise in the number of electric motors, while the number of diesel pumpsets is on the decline (Figure 4F.9).

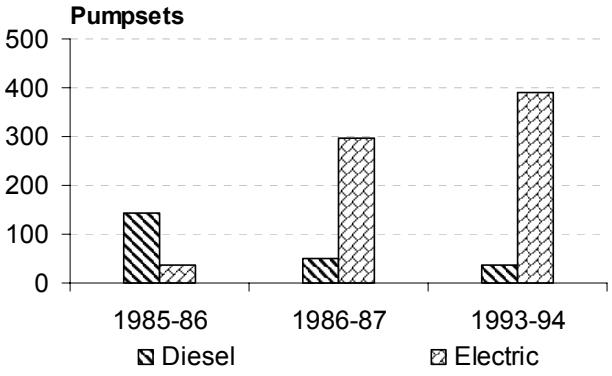


Figure 4F.9 Number of irrigation pumpsets

Source Statistical abstract of Khammam district for different years up to 2004/05, Bureau of Economics and Statistics, Government of Andhra Pradesh

Fertilizer use

Fertilizer consumption data is not available for Sathupalle block and is only available for the entire Khammam district. Total fertilizer consumption in Khammam district was 137 917 MT (metric tonnes), with N (nitrogen) (40 658 MT), P (phosphorus) (19 556 MT) and K (potassium) (8990 MT) in 2006 (Department of Agriculture, Khammam district, 2006/07) . The relatively larger share of nitrogenous fertilizer vis-à-vis phosphorous and potassium explains cultivation of hybrid varieties of cotton in the district. Cotton and paddy are the two crops that are chiefly grown in the district. Apart from these red gram and green gram cultivation has also been significant in the whole of Khammam district and these crops also require fertilizers in huge amounts.

Pesticide use

Like fertilizer consumption data, pesticide consumption data is not available for Sathupalle block. Data on the total consumption of pesticides is available only for the entire Khammam district. Considering the huge scale of cotton cultivation, agriculture at the district and state level has witnessed a massive increase in use of insecticides. Despite the government's target of introducing bio-pesticides and organic pesticides, application has not yet been significant . However, it has been reported by the Department of Agriculture in Khammam district that while the application of chemical pesticides is declining gradually, the quality of pesticides is still a concern. For the entire state, pesticide application has also declined gradually with the adoption of integrated pest management, from 3850 MT to 1918 MT between 2001/02 and 2005/06.

Water situation

According to the CGWB (2005) district Khammam belongs in the 'safe' category, where the groundwater development is estimated to be 21 percent. Sathupalle block also belongs to the same category . The gross groundwater draft is estimated to be 1316 ha.m (hectare metres) against the net annual groundwater availability of 5480 ha.m (GWD 2007).

The soils are predominantly red sandy, soils with occasional loamy soils. Black clayey soils are common in the low-lying irrigation tank bed areas. The region is underlain by Gondwana sandstones. These are coarse grained in nature. Groundwater occurs under the water table, as well as confined conditions in the region.

According to the CGWB (1998), the groundwater for various uses such as irrigation, industry and domestic is exploited by means of dug wells and dug-cum-bore wells in the area. The dug wells range in depth from 5.0 m to 17.98 m bgl (below ground level). The

depth of the water table varies from 3.0–17.7 m bgl. The depths of the bores in the dug-cum-bore wells vary from 24.39–72.4 m bgl. The yields of the dug-cum-bore wells range from 0.3 to 1.0 l/s (litres per second). In addition to the above, a number of tube wells constructed in depths of 100–422 m recorded piezometric levels from 9–15 m bgl and yields of 12 – 55 m^3/day for drawdowns varying from 3.30–24.60 m. The transmissivity values range from 3.82–954 m^2/ day. Figure 4F.10 depicts the changes in the groundwater tables for observation wells maintained by the GWD (Ground Water Department). One of these is a dugwell and other is a tube well. The figures show that the area in general has experienced a rise in the water tables. Water tables are highly fluctuating in nature mainly governed by the hydrometeorological characteristics prevalent in the region, large number of tanks that are a source of recharge, hydrogeologic formations, and extractions.

Dominant direction of groundwater flow is estimated to be south – south-east.

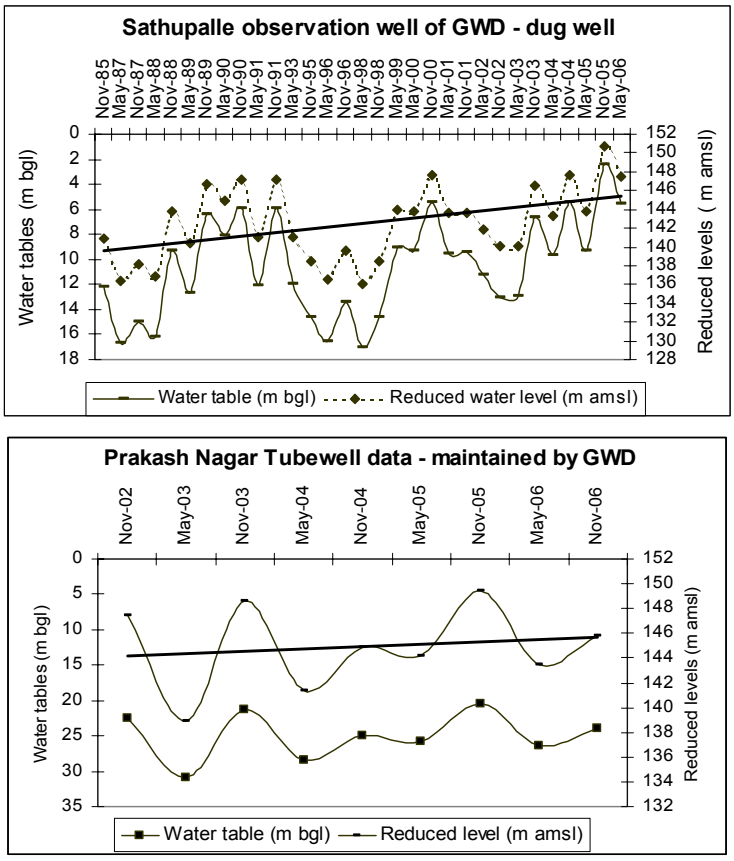


Figure 4F.10 Water table fluctuations in the study area

Source GWD (Ground Water Department), Government of Andhra Pradesh

Sri Sarvaraya Sugars Ltd, Sathupalle

The plant only produces Kinley water. There are one or two other factories in the 5 km radius around the plant, but they are very small and not water-intensive. Recently, a few lignite mines have been discovered but they are located outside Sathupalle block.

Plant capacity

The installed capacity of the plant is 120 BPM (bottles per minute) and has not changed in last three financial years. Figure 4F.11 shows installed capacity for the last thee financial years. The plant did not provide information about the capacity utilization of the plant.

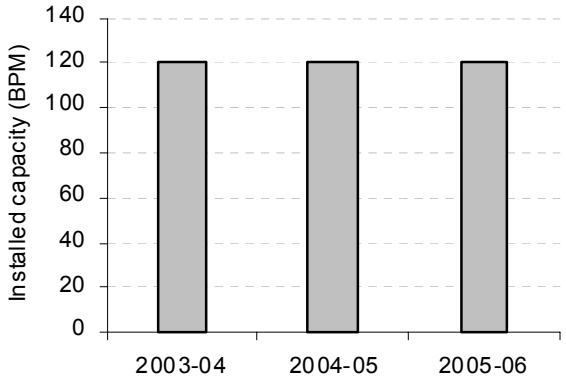


Figure 4F.11 Installed and utilization capacity of the plant

BPM – bottles per minute; m bgl – metres below ground level; m amsl – metres above mean sea level; GWD – Ground Water Department

Water intake

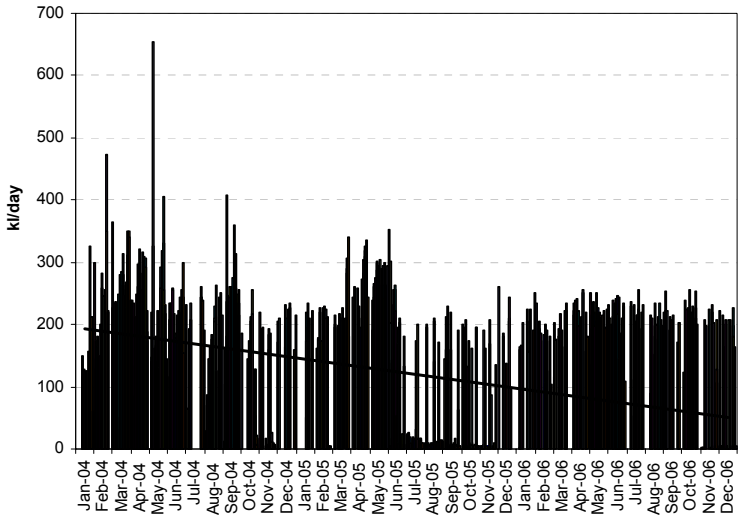


Figure 4F.12 Daily groundwater intake

The Sathupalle plant uses treated groundwater for production of bottled drinking water. The daily average raw water intake for the last 36 months has been showing a declining trend (Figure 4F.12).

The peak months for groundwater intake were April, May, and June, while in December and January, the plant consumes relatively much less water.

Production level

The plant only specializes in producing Kinley packaged drinking water. In all the three years, 500 ml, 1000 ml, and 2000 ml products have been sold. Annual plant production has gone down in the last three years by 3300 kl, from around 16300 kl in 2003/04 . Out of the total volume of products sold, more than three-fourths of the total sales were from 1000 ml in all the three years. Figure 4F.13 shows the volumes of Kinley water produced by the plant in the last three financial years according to the bottle capacity.

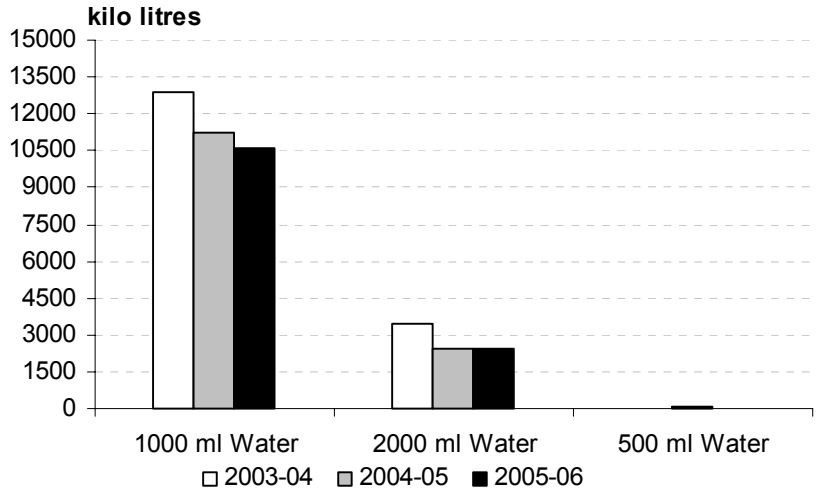


Figure 4F.13 Category-wise production

Water intake and production

Figure 4F.14 shows the monthly groundwater intake by the plant and the corresponding volume of production for three years (2003/04 to 2005/06). The relation, as shown, reveals a strong correlation (r= 0.83) between the two . The decline in the monthly plant production levels has resulted in the decline of groundwater intake by the Sathupalle plant from 46 647 kl in 2003/04 to 33 806 kl in 2005/06.

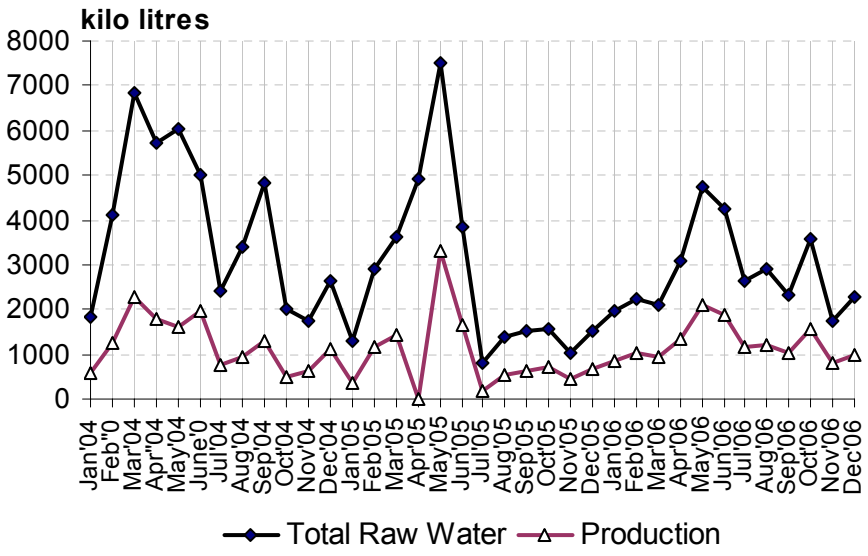


Figure 4F.14 Water consumption and production trends

Higher the level of production, greater is the groundwater intake as depicted through a scatter plot shown in Figure 4F.15. The equation presented in Figure 4F.15 is obtained by analysing the monthly groundwater intake and the total production by the plant over a 33-month period (from January 2004 to November 2006).

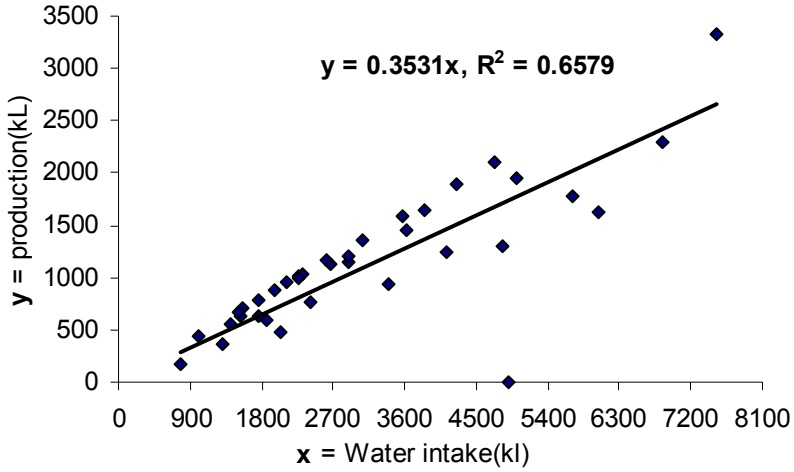


Figure 4F.15 Relationship between monthly groundwater intake and production

Water utilization ratio

The annual WUR (water utilization ratio) of a plant is defined as the ratio of total volume of water intake to total volumes of product produced, in physical units, in a given year . The WUR

computed based on the plant level raw data was found to be fairly different in 2004 and 2005 from the annual WUR values provided by the plant (Table 4F.2). However, the estimate for 2006 is almost same in 2006. The WUR has come down over the years.

Table 4F.2 Annual water utilization ratio

Year	*Plant estimate*	*TERI estimate*
2004	2.9	3.18
2005	2.26	2.88
2006	2.25	2.26

Selection of villages and stakeholder interaction

Identification of villages for techno-social assessment

The villages identified, using the approach as discussed in the chapter on approach and methodology, are the following.

- Town in which the plant is located (M 1): Sathupalle
- Village immediately upstream of the plant considering the regional direction of groundwater flow (U 1): Kakarlapalle
- Village immediately downstream of the plant considering the regional direction of groundwater flow (D 1): Bethupalle
- Village at the extreme upstream end of the watershed in the direction of groundwater flow (U 2): Jagannathapuram
- Village at the extreme downstream end of the watershed in the regional direction of groundwater flow (D 2): Bethupalle

In addition to the above, another village namely Siddaram (lying south of Sathupalle and west of Bethupalle) was also taken up for assessment.

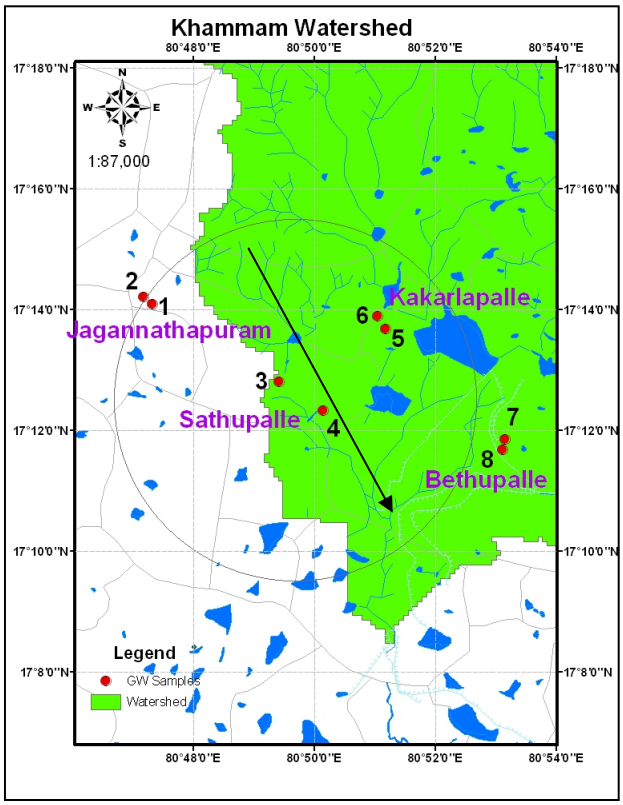


Figure 4F.16 Location of selected villages in the watershed

Note Arrow indicates the direction of groundwater flow

Key stakeholder interaction

Stakeholder perceptions capture the views of different stakeholders on the issues of trends in water availability, quality, utilization, and access across the study villages. The section only records the views as presented by different stakeholders in the course of FGDs (focus group discussions) and key stakeholder interviews . It does not aim to make judgements nor draw conclusions based on these recorded perceptions.
The rationale for selection and relevance of stakeholders has been discussed in detail in chapter 2 on approach and methodology.

In the Sathupalle watershed FGDs were conducted with key stakeholders at the four chosen study locations, namely, Kakarlapalle village, Sathupalle town, Bethupalle village, and Siddaram village. The stakeholder groups included panchayats, women, farmers, and weaker sections. In addition, key person interviews were also conducted. The description of the respective stakeholder groups and key persons interviewed is given below .

Panchayats

The study villages fall under four different panchayats. Hence, a total of four FGDs were done with the panchayats. Meetings with the panchayat members were done to gather information about availability of water and the mechanism for its provision and management. In addition, the panchayats were also provided general information about the study locations such as: demographic composition; main occupations; enterprises; existence of community-based groups; and so on .

While Kakarlapalle, Bethupalle, and Siddaram are revenue villages[2] and fall under the respective gram panchayats, Sathupalle is a municipality and has a *nagar* panchayat.[3] Kakarlapalle gram panchayat consists of only one village Kakarlapalle; Bethupalle gram panchayat consists of Bethupalle village and a hamlet Talamadda; and Siddaram gram panchayat consists of Siddaram village and a hamlet Gowrigudem.

A total of 32 respondents attended the four panchayat FGDs. The respective sarpanchs and chairperson (for Sathupalle) were present for the meetings, barring the sarpanch of Siddaram, who was not present during the FGD. The panchayat secretaries (appointed representatives) of the three gram panchayats and the municipal commissioner of the Sathupalle nagar panchayat were also present. The meetings were also attended by women members and members of the different castes–general caste/open caste[4], and other members belonging to the reserved sections—SC (scheduled caste), ST (scheduled tribe), and BC (backward caste). In Siddaram, three village members who were not elected representatives also attended the meeting.

Women

A total of five FGDs were conducted with women's groups in all the four study locations, one each in the three villages and two in Sathupalle. One meeting in Sathupalle was done in Aiyyagerpeta colony, located in the north-west of the town and away from the Kinley plant, and another meeting was conducted with women staying in Ward 5, close to the plant. In Bethupalle, the women's meeting was conducted in the hamlet Talamadda. Discussion with women's groups primarily helped to gauge their experiences with water availability and its utilization for domestic purpose.

[2] A revenue village is the smallest administrative unit, which has definite surveyed boundaries. 'The revenue village may comprise several hamlets but the entire village will be treated as one unit for presentation of the data'.
Details available at < http://7thsurvey.ncert.nic.in/glossary.htm#Village>
[3] As informed during the field visit, Sathupalle has been converted into a nagar panchayat in 2005, prior to which it was a gram panchayat. It was also informed that Sathupalle is a Grade IV town, and falls in the lowest rung of the *Nagarpalika* system in India.
[4] Open caste is a term that is used more commonly in the region to refer to general caste.

The total number of women attending all the five FGDs was 81. Participants attending the meetings were in the age group of 19–60 years, with majority of them being in the age group of 25–30 years. Women from all the caste categories attended the meetings. In the FGD conducted in Siddaram, most of the women belonged to the SC category, whereas in Bethupalle, most of the participants were from the general caste category. Most women were literate and had basic education. The women respondents had been residing in the study locations ranging from four to 27 years. All the women were members of SHGs (self-help groups). The primary sources of income for their families were agriculture, agricultural labour work, and also traditional caste-based occupations. The women themselves were either housewives or worked as agricultural labourers.

Farmers

A total of six FGDs were done with farmers' groups. One each was done in Kakarlapalle and Bethupalle, two each were done in Sathupalle and Siddaram. In Sathupalle, one meeting was done with farmers residing in Aiyyagerpeta colony and one with farmers who had fields close to the Kinley plant. In Siddaram, one meeting was done in the main village and another with farmers residing in Gowrigudem hamlet. Gowrigudem hamlet is closer to the Kinley plant than Siddaram main village. Hence, the need was felt to gauge the perceptions of the farmers living there .

A total of 49 farmers participated in all the six FGDs. The age group of the respondents was a 27 –72 years, but the majority of the total respondents were aged 43–65 years. The size of the landholdings of the farmers who participated in the meetings ranged from a minimum of 0.25 acre to a maximum of 30 acres. The majority had landholdings of 1.5–15 acres. Thus, overall there was representation of small, medium, and large farmers. Majority of the farmers grew paddy; nine of them grew sugar cane; five grew maize; and one farmer reported growing vegetables. The source of irrigation reported by the majority was tank/canal irrigation and some reported using bore wells. Most farmers were members of farmers' cooperative societies.

Weaker sections

Four FGDs were conducted with weaker sections, one in each of the study locations. The objectives of conducting FGDs with this section were to know their access to water resource, differences in access vis-à-vis those groups that may not be classified as weaker sections, and also to know their perceptions on water availability and changes (if any).

Both men and women of weaker sections participated in the FGDs. A total of 53 respondents took part in all the four FGDs. The

respondents belonged to SCs (*Madiga, Mala, Uppara,* and *Masinavallu*), BCs, and general caste categories. In one of the FGDs, Muslim women also participated. The age of the respondents was 25–65 years. Their education levels varied from being illiterate to having completed their graduation. Some of the respondents earned a living by working as agricultural labourers, while others worked as teachers, college attendants, cooks in hotel, insurance agents, and *dhobis* .

Key persons

A total of ten individual stakeholder interviews were done. A description of the key persons interviewed is given below.

Representatives of neeti sanghas, or WUAs (water users' associations) Two representatives of two different *neeti sanghas* were interviewed to gain insight on the membership, role, and workings of the *neeti sanghas*. One of them was a member of the Bethupalle *Cheruvu*[5] (tank) *Sangha* of the village Bethupalle, for three years. The second representative was the president of a *neeti sangha* in Sathupalle .

*Representatives of farmers' cooperative societies*The secretaries (appointed representatives) of two farmers' cooperative societies in two of the study locations were met with. The objective of meeting them was to understand the nature of the societies and also capture trends and changes in pattern of loans availed of by farmers .

Government officials Two government officials were interviewed, one official from the RWS (rural water supply) and one from the ID (irrigation department). The officials discussed the provision and management of water for domestic use and for irrigation. Interviews with them also included their perspectives of the water scenario in the region.

Retired schoolteachers Two retired schoolteachers in Sathupalle were interviewed. Their long years of stay in the study location and their knowledge of the region provided a long-term perspective on residents' experience with changes in the water scenario over the years.

Representatives of the CPI (ML)-New Democracy The CPI (ML)-New Democracy (a political group) has been an active participant in the protests/agitation that were led against the Kinley plant in Sathupalle. Thus, representatives of the CPI (ML)-New Democracy, local faction, were interviewed to gain their perspectives about the dynamics of the protest. One of the

[5] *Cheruvu* is a Telugu word that means lake. In the context of the study undertaken at the Sathupalle sub-watershed, it refers to an irrigation tank.

representatives was specifically interviewed, while other representatives of the party and its affiliates were also present during the interview.

Representatives of the Kinley plant Representatives of the Kinley plant were also interviewed, primarily to inquire about the plants' CSR activities in the study locations.

Stakeholder perceptions on water quantity

Water sources

Discussion with the different stakeholder groups revealed that in Sathupalle watershed, both surface and groundwater form the sources for domestic use and irrigation. While for irrigation, the use and dependence on surface water is more than on groundwater; for domestic purposes the dependence on groundwater is more vis-à-vis surface water.

The stakeholders in all the four study locations mentioned that the primary mode of water for domestic use is piped supply provided by the respective panchayats. They further added that groundwater is drawn through bore wells, with electrified pump sets and stored in OHTs chlorinated and then supplied into the pipes .

Stakeholders in each of the study locations also mentioned that surface water from the Bethupalle tank provided under the RWS scheme, is stored in underground tanks or 'sumps' (as referred to locally) by the panchayats. This water, termed as 'fluoride-free' water[6], by the community, is supplied by the panchayats through the piped connections.

A few households in Bethupalle informed using private bore wells, as they do not have piped connection. Handpumps and *bawis* (dug/open wells) are also used in the sub-watershed; though their use remains marginal. The use of handpumps was cited in Kakarlapalle, Bethupalle and Sathupalle, while *bawis* were mentioned as being used only in Kakarlapalle and Sathupalle. They stakeholders mentioned that only a few handpumps and *bawis* are working, and most have dried. Prior to the piped supply, however, these served as the main means of water for domestic use.

The source for irrigation varies according to the crop grown. For the first crop of the year (*kharif*), which is paddy, the primary source is tank irrigation. There are irrigation tanks in the area, which are rain-fed. Water from the tanks feeds into various canals

[6] It is termed as 'fluoride–free' water by the local community as it does not contain the said compound.

that have been made for irrigation purpose, and from the canals, it is routed into the fields through field irrigation channels. The technique of irrigation used in this case is flood irrigation. The biggest irrigation tank in the area is the Bethupalle tank, which, as informed by a staff member of the irrigation department, irrigates an area of more than 5000 acres. There are other irrigation tanks, as well, in the area and each of the study locations has different tanks as sources of irrigation. Sixty to hundred percent of the agriculture is reliant on tank/canal irrigation (as the source for the first crop). Water from the Bethupalle tank is used in village Bethupalle. For farmers in Aiyyagerpeta, Sathupalle, the Damara tank is the main source. In Siddaram, water from two tanks and a canal is used for irrigation by different farmers; these being the Enguluru tank, the Appala tank, and the Kattu canal (which flows from the Thamleru river dam), and in Gowrigudem, farmers also use water from Gadidalu Vagoo, another channel that joins a canal coming from the Thamleru dam .

A WUA or *neeti sangha*[7], a body elected by farmers, manages the respective irrigation tank in each location. The WUA takes the decisions for undertaking development work of tanks/canals.

Tank irrigation, however, is not assured for the second crop of the year. Thus, bore wells are used for irrigation for the second crop, which is either paddy or maize. Groundwater is drawn through bore wells using energized pump sets. The pump sets used range from 5 HP (horse power) to 10 HP and are mostly electric pump sets; diesel pumps are not used much. The percentage of farmers having bore wells varied in the different locations, from 10 – 50 percent. Other crops, sugar cane and mango are also grown; of which sugar cane being a one-year crop is irrigated by means of tank/canal water and also with bore wells; while bore wells are used for mango. Hence, conjunctive use of surface and groundwater is followed for irrigation in the study villages .

Tank irrigation has been the main source of irrigation for many years now; while bore wells have been in use for the past 10–15 years. *Bawis* were also used in the past. One farmers' group reported that *bawis* were used till 5–6 years back.

[7] The PIM (Participatory Irrigation Management Programme) in Andhra Pradesh, widely known as the AP Model of Irrigation Reforms, was initiated with the enactment of the APFMIS Act (Andhra Pradesh Farmed Managed Irrigation System Act) in 1997. The Act enables the transfer of rights over the canal water and its assets to the newly constituted WUAs (water users associations). In the state, 10 292 WUAs have been formed.
Details available at <http://www.wca-infonet.org/servlet/CDSServlet?status=ND0xMjQ2LjExNDMxMCY2PWVuJjMzPWRvY3VtZW50cyYzNz1pbmZv>, last accessed on 28 August 2007.

Water availability

Surface water

Stakeholder groups did not report any problems in availability of surface water. Different stakeholder groups and key persons interviewed highlighted that currently there was enough water in the Bethupalle tank, the biggest water body in the area. One of the key persons pointed out that complete drying of the tank happened only twice, once about 30 years back, and the second time, more recently, 10 years back.

With regard to groundwater sources, stakeholder groups brought out issues related to first, changes in groundwater level, as observed by them and second, availability of and their access to groundwater in the present scenario.

Groundwater level

Panchayat members, farmers' groups, and weaker sections reported a drop in the groundwater level over the years. A few of the key persons also reiterated the above perception. Stakeholder groups observed the fall in groundwater level with the drying of handpumps and *bawis*. The fall in groundwater was reported by some groups to have occurred in the past five to ten years. But two groups pointed out that the drop had been more noticeable in the past 2–3 years. The farmers' groups in Kakarlapalle, Siddaram, and Gowrigudem, and the panchayat members in Kakarlapalle reported a fall at the rate of 10 feet per year. One of the individuals interviewed observed the change in groundwater level in different years based on his bore well: 1969–76 at 20 feet; 1976–80 at 30 feet; 1981–90 at 40 feet; and after 1990 at 50 feet.

Some of the stakeholder groups and individuals also expressed concern for the future availability of groundwater due to the coming up of lignite mining by Singhreni, very close to Sathupalle, although they had not yet seen its impacts.

A few of the women's and farmers' groups perceived an improvement in availability of groundwater; while women articulated that the coming of piped supply had led to improvement in availability, farmers who had bore wells reported that they got enough water from the bore wells. The women's and weaker section in Talamadda, Bethupalle, emphasized that after the provision of piped supply to their colonies, especially after the construction of separate OHTs for their colonies, they had abundant water. A few other women's groups felt that the situation was better during the time when they had *bawis*, as water was available 24 hours, whereas now they had to rely on electricity.

Women's, farmers' and weaker sections pointed out that availability of water was dependent on electricity supply. A few of the stakeholder groups – women's group in Aiyyagerpeta colony of Sathupalle, weaker sections in Kakarlapalle, and the women's, weaker sections and farmers' groups in Siddaram pointed out problems in availability to certain parts of the respective village/town owing to locational disadvantage. Women's groups also added that the supply of water was less in the summer season, when compared to the rainy season or the rest of the year. There were also times when water was not released regularly, for example, when cleaning, repair, pipe burst, motor problems, and so on . A rating of water availability in the region by different stakeholders across various villages has been indicated in the Table 4F.3

Table 4F.3 Rating of water availability

Location in the sub-watershed	*Location*	*Panchayats*					*Women's groups*					*Farmers' groups*					*Weaker Sections*				
	Scale	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Upstream	Kakarlapalle			X			X^{a}	X^{c}						X				X^{h1}		X^{h2}	
Plant location	Sathupalle (Aiyyagerpeta)	X^{h}		X^{i}					X					X							
Plant location	Sathupalle – (Near Kinley plant)																	X^{a}		X^{c}	
Downstream	Bethupalle	X					X							X			X^{i1}	X^{h}	X^{i2}		
Downstream	Siddaram	X						X^{c}											X		

a – rating for monsoon; c – rating for summer; h – household use; h1 – household use (private taps); h2 – household use (public taps);
i – irrigation; i1 – irrigation for first crop; i2 – irrigation for second crop
Scale: 1– no scarcity; 5–very high scarcity

Reasons

The various reasons for the drop in groundwater levels were cited as follows.

- Decrease in rainfall over the years
- Increase in the number of bores for various purposes
- Increase in agriculture
- Increase in population, leading to increase in demand
- Kinley plant – seen as affecting the water sources of the community in the vicinity of the plant

Stakeholders articulated that over the years rainfall had decreased, which had been a factor behind the decrease in groundwater level. The increase in the number of bore wells for different purposes had also contributed to the decline. Besides, there had been an increase in agriculture and the number of crops grown. One stakeholder group also cited the increase in population as leading to an increase in demand and thereby use of groundwater.

In addition to above, few stakeholders perceived that the Kinley plant has had a significant impact on groundwater levels in the immediate vicinity. Stakeholders in the vicinity of the plant indicated that they believe the plant has two bore wells that go much deeper than usual and higher-capacity pump sets that run 24 hours each day. However, others (specifically a representative from the RWS) expressed that the plant's water intake is negligible when compared with the amount of water used for domestic purposes and that the plant has only two bore wells, each not more than 10 HP .

Impacts

Although the stakeholder groups did not mark the impacts of problem in water availability, or the drop in groundwater level, the coping mechanisms of the community in response to it were brought out. The coping mechanisms by women to deal with problem in water availability were as follows.

- Women make use of public/private *bawis* (that are functional) in the summer.
- Women go to agricultural pumps to fetch water.
- Women fill up extra pots while water is being supplied so that they can use these at times of shortage in supply.
- Pit taps[8] have been made to store water.

The coping mechanisms of farmers to deal with the drop in groundwater level and problem in availability due to electricity are given below.

- Use of higher capacity and submersible pump sets to draw groundwater.
- Building of tanks to store water if electricity is available at night and then diverting the stored water into fields the next morning.

In addition, the response of government or elected bodies (state and local) to deal with change in the water scenario was brought out by different groups. The response has been as follows.

- Building of check dams on the Thamleru river— three check dams were built through the zila parishad, close to the study locations, to conserve groundwater.
- A proposal by the state government to bring water from river Godavari to the region is in the pipeline.
- The Kakarlapalle panchayat is trying to get one more pipeline for its village.

[8] 'Pit taps' refers to pits dug near pipelines to collect water.
Source< http://nizamabad.nic.in/code/dwm.htm>, last aAccessed on 31 October 2007

Stakeholder perceptions on water quality

The taste of groundwater used for domestic purposes, in all the four locations, was reported to be fine. Stakeholder groups remarked that water was sweet to taste and not salty. However, some stakeholder groups reported that water used from boring contained fluoride. The Bethupalle panchayat members pointed out that testing had been done and fluoride had been found in bore water. They also added that fluoride had been present in the water for 20 years.

Many stakeholder groups across all the study locations reported health-related problems attributed to bore water. The problems that were mentioned were gastric ailments, knee aches, leg and joint pains, body pain, and rashes. Problems of this nature, it was said, had been occurring for the past 3–4 years and were not restricted to the elderly, but were reported across all age groups. The weaker sections in Kakarlapalle also spoke about the common occurrence of stones in kidneys among the villagers. The main reason that was attributed to these problems was the composition of water. Two women's groups cited that when doctor was consulted for the problem of pain in the legs, they were told that it was possibly due to the water they consumed. The farmers in Gowrigudem, Siddaram, reasoned that now the community had to go deeper to draw groundwater, and as a result, such problems were occurring. The same group also cited changes in habits and lifestyle as yet another reason.

The quality of water used for irrigation was not cited to be an issue by most farmers' groups. However, the farmers' group in Gowrigudem (part of Siddaram panchayat) reported the problem of wastewater release into a channel, Gadidalu Vagoo, which was used for irrigation. They perceived that wastewater from the Kinley plant was released into a drain, into which the drainage of one of the colonies of Sathupalle municipality was also released thereby affecting crop yields of the farmers who used water from the channel . However, they stated that they do not face a problem with wastewater from the Kinley plant in summer months as it is released only in the rainy and winter seasons.

A key person, who has been active in protests against the Kinley plant, claimed that farmers who had fields within a distance of a furlong from the plant had suffered from the wastewater that was released by the plant into a drain. Another key person, however, maintained that wastewater release from the plant was not an issue, and that farmers had not complained about it.

Protests and agitations

Many stakeholder groups pointed out that protests and agitations had been staged against the Kinley plant in the recent past. Those involved included the local community around the plant, local farmers, and members of local political parties like the Communist Party. This view was also echoed by some of the key persons.

One of the key persons informed that the local community living around the plant had given a written complaint a few years back to the then gram panchayat of Sathupalle, as they perceived that due to the operations of the Kinley plant around 10–15 *bawis* in the neighbourhood had failed. A Communist Party (political party) representative informed that in 2002, it was the farmers who first gave statements against the plant in the press. The key person further added that later the Communist Party joined to support the locals and demonstrations were held against the plant in 2002 and in 2003; during one of which work at the factory was stopped for nearly 12 hours. The reasons for the then protests were cited as follows.

- The Kinley plant consumed a lot of water.
- Groundwater was being depleted 1–2 km around the plant.
- Bores for irrigation and also for domestic use around the plant were failing.
- Alleged contamination of the product of Coca-Cola company with pesticides.

In addition to the above, key persons cited the occurrence of another demonstration that was held outside the district collectorate in the year 2002/03. Key persons also cited tests having been carried out by the Groundwater Department around three years back in response to local complaints. They added that during these tests the Kinley plant pumps were run continuously for 24 hours and the report that came out was in favour of Kinley, which stated that there were no impacts due to the plant .

Plant representatives denied the occurrence of any protests. They maintained that Communist Party representatives gathered outside the plant on those days when the party organized its own strikes.

State, governance, regulations, and compliance

As reported by the plant management, the bottling unit of M/s SSSL, located at Sathupalle, was established as a carbonated soft drinks manufacturing facility in 1988. The plant was initially established as a franchisee of the soft drinks department of Parle products, the manufacturer of leading Indian soft drink brands like Thums Up, Gold Spot, and Limca. It became a franchisee operation of CCIin 1993, when Parle products sold its entire

carbonated soft drinks department toCCI, which was re-entering the Indian market after almost 15 years . As a Coca-Cola franchisee, the plant discontinued manufacturing carbonated soft drinks in 2000 and thereafter began manufacturing Kinley water, the bottled drinking water brand marketed by Coca-Cola.

The plant meets its industrial water requirements from two pump sets installed in the factory premises to draw groundwater; the HP of each pumpset is 5. According to the plant, while one of the pumpsets is used, the other is on standby. The two bore wells have been dug to a depth of 83.5 m and 88.5 m respectively. This section comprises a review of the following.

- A brief review of the Andhra Pradesh WALTA (Water, Land and Trees Act) 2002, which governs the drawal of both ground and surface water, and the WALTA rules for effective implementation of the Act. In this context, although Andhra Pradesh has not formulated a water policy of its own, it was the first state in India to effect legal changes to enable the institutionalization of water sector restructuring and reforms in India.
- Compliance of SSSL Sathupalle, with legal and administrative requirements governing the plant's establishment and operations, with a focus on water resources management and wastewater disposal.
- Compliance of SSSL, Sathupalle, with TCCC corporate requirements on water resources management.

Legal framework governing drawal of water

Andhra Pradesh enacted the APWALTA (Andhra Pradesh Water, Land and Trees Act) 2002 to promote water conservation and enhance tree cover in the state; the Act seeks to regulate the exploitation and use of ground and surface water for the protection and conservation of water sources, land, and environment. Prior to this, the APWRDC (Andhra Pradesh Water Resources Development Corporation) Act was enacted in 1997 to manage all water resources through coordination and cooperation between the conflicting sectors like domestic, industrial, and irrigation through a single window agency, that is, the APWRDC. However, provisions of the APWRDC Act control the drawal of surface water and not groundwater (Madhav 2007).

Andhra Pradesh Water, Land and Trees Act 2002

APWALTA 2002 required the constitution of an authority called the Andhra Pradesh State Water, Land and Trees Authority. The charges of the Authority so constituted include the following groundwater-related responsibilities.

- Registration of wells and water bodies: The APWALTA requires all well owners, including those whose wells are not

fitted with power-driven pumps, and water bodies in the state, to register their wells/water bodies with the Authority.

- Prohibition of water extraction and restriction of sinking wells, except for drinking water purposes, if such pumping is likely to cause damage to the level of groundwater or cause deterioration or damage to natural resources or environment.
- Declaration of overexploited groundwater basin if expert opinion deems a particular groundwater basin as overexploited, after taking into consideration the quantum and pattern of rainfall, the degree of extraction of groundwater, and any other relevant factor. Following such a declaration, only public drinking water wells, or handpumps used for drinking water can be sunk. The Authority may also issue guidelines for improving the groundwater; it is mandatory for persons/ institutions or state bodies to follow these guidelines. The declaration of an area as overexploited may be revoked following a satisfactory groundwater status review .
- Protection of public drinking water sources: If any existing well is found to adversely affect a public drinking water source, the extraction of water from it can be prohibited .
- Directions with respect to the use, distance, and depth of wells in order to ensure supply of drinking water to the local population, and prevent wastage of water from the public water supply system or from public drinking water sources
- Compensation for closed wells: When an order is given to permanently close down or seal a well, the Authority may issue directions with respect to compensating the well-owner/owners. This amount should not be less than the market value of the well, and should include the cost of the standing crop at the time of making such an order.
- Issue guidelines for groundwater recharge, recycle, and reuse: The Authority may also formulate suitable incentives for recycling and reuse of wastewater by industrial and commercial users, and local bodies. Groundwater resources should not be contaminated and direct disposal of wastewater into aquifers is prohibited.
- Implementing agencies for various provisions of the APWALTA include the state groundwater department, municipal and urban development bodies the SPCB (state pollution control board), village secretaries/municipal commissioners, villages/ municipalities, and block revenue officers/municipal commissioners. Fees prescribed for the registration of wells/water bodies and rig machines are.
  - Rs 10 for registration of existing wells/water bodies
  - Rs 10 000 for registration of machines
  - Rs 100 for permission of digging of new wells
- Industries are not allowed to use fresh water in excess of the maximum unit quantity specified by the APPCB.

The APWALTA clearly prioritizes drinking water requirements over all other requirements in the state. By establishing an Authority, it establishes a governance structure for the institutionalization of water sector reforms in the state. A vital issue mandated by the APWALTA is with respect to the specification of the quantum of water usage permitted to industrial units in the CtO (consent to operate) issued by the APPCB. The continuity of industrial operations over time is dependent on the periodic renewal of the CtO granted by the concerned SPCB; the renewal is granted subject to the terms and conditions of the previous CtO being fulfilled. In this context, the currently applicable CtO issued to M/s SSSL by the APPCB includes a limit on water usage, as noted below. As per discussions with APPCB officials, and documents obtained therein, the application for a CtO in the state of Andhra Pradesh requires the industrial applicant to provide details on source of water supply, purposes of water usage, and status of functioning of water meters, apart from water cess payment details.

Registering water drawal, monitoring groundwater level

An NOC (no objection certificate) was issued by the Sathupalle gram panchayat for the establishment of M/s SSSL bottling unit on 12 November 1987; the NOC does not contain any stipulations with respect to the quantum of water drawal or usage by the plant. Also, the plant pays a business licence fee, a property tax and a non-agricultural land assessment tax to the panchayat on an annual basis.[9]

M/s SSSL Sathupalle was registered with the CGWA (Central Ground Water Authority), Ministry of Water Resources, Government of India, in 2003; this was as per requirements stated in a public notice issued by the CGWA in 2001 and applicable for all groundwater-based mineral/drinking water industries. The certificate of registration, a photocopy of which has been provided by Coca-Cola, was valid for a period of two years, until July 2005.

Box 4F.1 Bore well details in the certification of registration issued by the gram panchayat of Sathupalle

- The respective depth of the two bore wells are 83.5 m and 88.5 m with their diameters being 160 m; both have submersible motor capacities of 5 HP.
- The water output of both the wells is 26 m^3 per hour.
- The certificate of registration was signed by the executive officer, gram panchayat Sathupalle, district Khammam, on 10 May 2004.

Subsequent to the enactment and implementation of APWALTA 2002 in Andhra Pradesh, discussed above, the plant was required to register its bore wells with the gram panchayat of Sathupalle (Box 4F.1). A photocopy of the certificate of registration document

has been shared by Coca-Cola. Table 4F.4 studies the compliance of M/s SSSL with the applicable requirements of APWALTA 2002.

Table 4F.4 Compliance of SSSL, Sathupalle, with applicable provisions of APWALTA (Andhra Pradesh Water, Land and Trees Act) 2002

Applicable provision under APWALTA 2002	*Compliance*
Registration of well	Registered with gram panchayat Sathupalle, Khammam district, dated 10 May 2004
Rainwater harvesting	As reported, the plant installed three rainwater-harvesting structures within the complex in 2005 with the dimensions 3 m x 3 m x 3 m; 4 m x 2 m x 3 m; and 3 m x 2 m x 3 m
Wastewater requirements as per the Act	The Authority constituted under the Act has not issued any notification till date; APPCB requirements are still followed.

APPCB – Andhra Pradesh Pollution Control Board

In 2004, the government of Andhra Pradesh initiated an enquiry into the water drawals of the plant following media reports of excessive groundwater extraction by the plant leading to declining water levels in the area. The enquiry, conducted by the GWD of the district concluded that the aquifers in the area were not under severe stress during the time of investigation but recommended the plant to undertake the following.

i. Construct a shallow tube well to a depth of 85 m bgl in between the pumping well and standby well as an observatory well; the proposed observation well should be located at a distance of 45 m from the pumping well.
ii. Install an AWLR (automatic water level recorder) on the proposed observatory well.
iii. Conduct pump tests on a seasonal basis for the first two years and every two years subsequently.
iv. Install artificial recharge structures for the augmentation of groundwater.

Documents received from Coca-Cola and site visits suggest that (i), (ii), and (iv) above have been undertaken. However, it is not possible to attest to the implementation of (iii) in the absence of documentary support.

Categorization and consent

The APPCB originally issued a CtE (consent to establish) to M/s SSSL, Sathupalle, in 1988; another was issued when the plant was converted from a soft drinks manufacturing unit to a bottled water-manufacturing unit in 2001. Subsequent to the above, a third CtE was issued in 2006, when the plant applied for capacity expansion . The APPCB has categorized the facility in the orange category of industries.

Compliance with regulatory and The Coca-Cola Company requirements

The CtE was issued by the APPCB in the year 2006 for an expanded production capacity of 4750 m^3/month. It prescribes conditions necessary for wastewater disposal; these conditions and compliance against them by the SSSL Sathupalle, are presented in Table 4F.5. This is the only state among the studied states, where the PCB (Pollution Control Board) has imposed a restriction on the drawal of groundwater for industrial use, as discussed in the table below; this is a requirement under the APWALTA 2002.

Table 4F.5 Compliance with conditions specified in CtE by SSSL, Sathupalle

Requirements	*Compliance in Sathupalle plant; remarks, if any*
General	CtE (consent to establish) for expansion issued in 2006. Valid for five years from the date of issue
Limit on discharge of wastewater	149.5 KLD (kilolitres per day)(limit also on daily drawal of water at 358.0 KLD) *No data provided by plant on volume of effluent discharge, hence compliance cannot be checked. However, the daily drawal data for the year 2006 supplied by the plant indicates compliance with the above limit.*
Mode of discharge of wastewater	Separate collection of domestic and process wastewaters; land application for process wastewater; septic tank, followed by soak pit for domestic wastewater. Plant is zero discharge as required by the CtE.
Compliance with discharge standards	Waste to be treated as per the conditions/standards stipulated by the APPCB (Andhra Pradesh Pollution Control Board) The parameters in test report provided by the plant enclosed are in compliance.
Any other issues(s)	Industry shall submit groundwater data pertaining to the surroundings of the industry duly obtained from GWD (Ground Water Department) every year Green belt width of 5 m shall be developed along the boundary of the industry

Note The compliance of the plant is based on secondary data provided by CCI (Coca-Cola India): results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

The consent to establish issued originally in the year 1988 for generation of 56 KLD (kilolitres per day) trade effluent and 5 KLD domestic effluent also specified the same conditions as specified in the CtE issued in 2006 for expanding industrial operations. However, one important difference is that the CtE issued in 2006 imposed a limit on daily withdrawal of groundwater at 358 KLD, reflecting, as mentioned, the provisions of the APWALTA 2002.

The currently applicable CtO for the Sathupalle plant was issued by the APPCB in the year 2007 and is valid for four years. It prescribes conditions necessary for wastewater disposal; these conditions and compliance against them by SSSL, Sathupalle, are presented in Table 4F.6 .

Table 4F.6 Compliance with conditions specified in CtO by SSSL, Sathupalle

Requirements	*Compliance in Sathupalle plant; remarks, if any*
General	Copy of CtO (consent to operate) dated April 2007 provided, valid till 31March 2011
Limit on discharge for wastewater	147 KLD (kilolitres per day) trade effluent and 2.5 KLD domestic effluent
Mode of discharge of wastewater	Land application Plant is zero discharge
Compliance with discharge standards	Five parameters suggested for monitoring by the APPCB (Andhra Pradesh Pollution Control Board) Analytical reports provided by the plant show compliance
Requirement of sampling and flow measurement	Requirement of installing flow measuring devices mentioned in CtO
Interlocking of pollution control devices with process	Separate energy meters provided for pollution control equipment
Rainwater harvesting to be done	Rainwater-harvesting systems installed at the site
Monthly progress report for compliance, quarterly compliance report and annual environmental statement to be submitted to SPCB	Yearly environmental statement, monthly analysis report of domestic as well as trade effluent and monthly statement of daily discharge of trade, and domestic effluent required to be submitted to the APPCB . Copies of environmental statement, analysis reports provided, compliance observed.
Any other issues(s)	Maintenance of green belt of 5 m width all around the plant boundary Green belt present; physical verification of actual dimensions not conducted. The industry shall reduce the packaged water/raw water consumption ratio from 1: 2.95 to 1: 2.26 by December 2004 Non-compliance in 2004 but compliance in 2006 as per the data provided by TCCC (The Coca-Cola Company)

Note: The compliance of the plant is based on secondary data provided by CCI (Coca-Cola India): results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

Compliance with The Coca-Cola Company corporate practices on water management in Sri Sarvaraya Sugars Limited, Sathupalle

Water drawal and usage

As noted, SSSL, Sathupalle, draws water from two bore wells present at the site. These bore wells are operated alternatively to meet the plant's water demand. Table 4F.7 gauges compliance of the bottling unit with water resource management requirements of the Coca-Cola system.

Table 4F.7 Compliance with TCCC water resource management requirements by SSSL, Sathupalle

Requirements	*Compliance in Sathupalle plant; remarks, if any*
Environmental due diligence to be conducted prior to siting of the plant	Conducted, EDD (environmental due diligence) report not shared since, as per TCCC (The Coca-Cola Company), it may contain 'sensitive information of both a business and legal nature'.
Documented water availability assessment	Pump test apparently conducted, report not shared since 'it may contain 'sensitive information of both a business and legal nature'. Report on hydrological surveys conducted for the area around the plant provided by TCCC, report suggests the aquifer which the plant is tapping is deep, has no contamination and is safe for use; has no influence of pumping on nearby observation wells.
Initial and periodic water utilization assessments	Carried out as evident by reducing water use ratios over the years, as reported by the plant.
Implement and maintain a process for water utilization	Process of water balance/audit is maintained.
Establish a continuous improvement process for water utilization	WUR (water utilization ratio) was 3.70 in 2001, reduced to 2.25 in November 2006, as reported by the plant; potential unknown
Define water utilization objectives and goals in annual business plans	Optimization of water utilization per litre of the beverage produced remains the annual objective; water conservation targets are defined each year in consultation with corporate office.
Develop and execute internal and external water contingency plans	Various rainwater-harvesting initiatives have been undertaken in the plant as part of contingency measures.

Note Based on information provided by TCCC (The Coca-Cola Company) and CCI (Coca-Cola India) and site visits by the project team

As stated in Chapter 3, Coca-Cola has certain guidelines on water resources management. These, and their implementation in SSSL Sathupalle, are summarized in Table 4F.8 below.

Table 4F.8 Compliance with TCCC water resource management guidelines by SSSL, Sathupalle

Guideline	*Observation in SSSL Sathupalle*
A self-assessment on water utilization	A plant-level water distribution/balance is maintained and water use is optimized at each level of the process based on in-plant trials and suggestions from the corporate office. As a result, the water use ratio has reduced over the years. Water usage self-assessments are conducted by the plant in the TCCC (The Coca-Cola Company) format; however Coca-Cola has not shared a copy of the responses by the plant for reasons of legal and business confidentiality.
A self-assessment on water supply	As per documents received, a safe yield of the water supply source was assessed at the time of establishment of the plant. Quality of raw water is checked on a daily basis for selected parameters in the plant and once in a year by an accredited laboratory . Self-assessment with respect to water supply has been conducted by the plant in the TCCC format; however a copy of the responses by the plant has not been shared by Coca-Cola India for reasons of legal and business confidentiality.
The data collected during self-assessments to be used to build a water conservation plan	Since self-assessment responses were not shared, it is difficult to ascertain how information collated during self-assessments is used to build a water conservation plan.
The establishment of a cross-functional team for water resources management	As intimated during the plant visit, a cross-functional team of four members belonging to the quality and production areas has been established at the Sathupalle plant for water resources management. The quality assurance manager, who is part of the team, coordinates its activities. TERI was informed that

Guideline	*Observation in SSSL Sathupalle*
	the WRM (water resources management) team is responsible for preparing WRM plans, implementing and monitoring programme and legal requirements, and organizing awareness training on WRM for plant associates. The WRM programme focuses on 4 R's for water conservation: Reduce; Re-use; Recycle; Recharge.

Note: Based on information provided by TCCC (The Coca-Cola Company) and CCI (Coca-Cola India) and site visits by the project team

Wastewater discharge

Coca-Cola corporate policy also establishes company standards for effluent disposal, as noted in Chapter 3. The regulatory standards for the Sathupalle plant are stated in the latest CtO issued by the APPCB, which specifies limits for five pollutants for the treated effluent discharged from the ETP of the plant. The limits are

- pH – 5.5 to 9.0
- Total suspended solids – not to exceed 200 mg/L
- BOD (biological oxygen demand) at 27 °C, three days - not to exceed 100 mg/L
- TDS – not to exceed 2100 mg/L
- Oil and gas – not to exceed 10 mg/L

All the five parameters listed in the requirements of APPCB are also part of the corporate requirements. As per corporate requirements, the plant must get its treated effluent analysed once a year by an accredited laboratory and send the results to the corporate office. Table 4F.9 checks the compliance of SSSL Sathupalle with TCCC's wastewater standard requirements.

Table 4F.9 Compliance with TCCC wastewater management requirements by SSSL, Sathupalle

Requirements	*Observations in Sathupalle plant*
Meet applicable regulatory requirements	Yes, (as per documents received; APPCB [Andhra Pradesh Pollution Control Board] officials too did not point to any anomaly)
Maintain an effluent quality that will have no adverse effects on fish or other aquatic biota in receiving waters	Yes, as per the data sheets provided by the plant
Maintain and operate treatment facilities in an efficient manner	Yes, as per the documents received
Compliance with wastewater quality requirements developed by TCCC (The Coca-Cola Company)	Yes, as per the documents received
A detailed drainage plan of all water and wastewater streams in the facility	Yes, separate plans existing; verified during the site visit
Separate wastewater streams for process wastewater, sanitary wastewater, cooling water, and storm water	Sewage discharged in septic tanks, separate line for storm water and cooling and process wastewater taken to ETP (effluent treatment plant)
Prevent the pollution (of) from water and wastewater	Adequate measures provided

Requirements	*Observations in Sathupalle plant*
Minimize the volume, strength, and hazardous nature of wastewater	No recycling in place at present, however, the plant is zero discharge as per the CtE (consent to establish) issued in 2006 with its treated wastewater being used to irrigate the plantation in the factory premises
Treatment of process water such that it is	
Compliant with TCCC analytical standards Compliant with government effluent discharge standards Conducive to the long-term survival of fish in the treated effluent	Yes, as per the information provided by SSSL (Sri Sarvaraya Sugars Limited), Sathupalle Yes, as per the information provided by SSSL, Sathupalle Yes, as per the information provided by SSSL, Sathupalle
Sanitary wastewater to be discharged to a sewer connected or a sewage treatment plant	Yes, plant in compliance. Septic tank arrangement at site
Treatment of storm water according to government regulations if applicable; else prevent the pollution of water and wastewater streams due to the run-off	Yes, separate management of stormwater water through dedicated drains
Non-contact cooling water may be discharged into the local environment unless otherwise dictated by local laws or regulations	Not Applicable
If treated wastewater discharge is through infiltration, prior to infiltration the wastewater must meet TCCC requirements and local regulations	Not Applicable.
If treated wastewater is disposed through land application, then	
Groundwater must be monitored quarterly within the application area, as well as up- and down gradient of the application area	No monitoring by the plant.
▪ The soil's carrying capacity should not be exceeded such that there is surface run-off	No monitoring done at present by the plant
▪ Water intended for spray fields, should not be discharged into nearby water bodies; nor should excess runoff from sprayfields be allowed to enter nearby water bodies	Not Applicable; The treated wastewater meets the local regulatory requirements for land disposal. No separate TCCC standards exist for treated wastewater to be applied on land

Note The compliance of the plant is based on secondary data provided by CCI (Coca-Cola India): results of compliance based on technical assessment that are at variance with the secondary data are presented in level 2 assessments in sections below

According to the documents received, SSSL attained the E1 level of compliance in 2006 under the TCCC audit system (refer Chapter 3) . The plant has also received the ISO 9001 certification for quality in 2003; however, it has not yet received the ISO 14001 certification for environmental management standards.

Water-related Corporate Social Responsibility initiatives

As per the representatives of SSSL Sathupalle, CSR initiatives of the plant are largely in response to local requests from *gram panchayat*, Municipal Officials, Health Officials, Schools, Police, politicians etc. The plant does not currently have a CSR framework in place, or a designated person who has responsibility for community related CSR activities. Proposals for CSR initiatives are developed by the department heads and senior staff of the plant based on interaction with local community members. Plant representatives also noted that their community initiatives are broadly based on CCI guidelines on the Manifesto for Growth and community framework (referred to in Chapter 3).

Plant representatives cited the following water-related activities as having been undertaken by them .

- Supply drinking water by providing taps to about 1000 households located near the plant. The taps have been installed in Ward 5 of Sathupalle town. Water is provided free of cost during specific times of the day, i.e., one hour in the morning and one hour in the evening every day. According to the plant representative, taps were installed, as a result of being approached by the Nagar Panchayat three or four years back.
- Provided 17 000 litres of Kinley water in the Godavari flood affected areas in East Godavari, West Godavari and Khammam Districts. In addition, biscuit packets were also distributed in the villages of Aswaraopet Mandal along with water bottles.
- During the cyclone period in 2005, the plant provided drinking water to Sathupalle town following a request by the Panchayat.

Plant representatives also noted that it had undertaken to construct rainwater harvesting structures in and around Sathupalle to collect rainwater from 5000 sq. ft (464.5 m^2) of roof area in the course 2007. According to the plant, the objective of this initiative is to educate the public on rainwater harvesting and to improve groundwater levels.

Technical assessment

The technical assessment comprised both regional (ex situ) and in-plant (in situ) water quality assessment, and in-plant water audit.

Regional assessment of water quality

Water quality assessment for the selected villages has been undertaken with an aim to develop an insight into the quality of groundwater that is sourced and consumed by the SSSL plant at Sathupalle and the impact, if any, of the agricultural management practices such as the use of fertilizers and pesticides on the quality

of groundwater. The assessment here does not relate the regional groundwater quality to the operations of the Coca-Cola plant.

Selection of sampling location

Groundwater sampling was done in the four selected villages. The justification for selection of villages has been discussed in chapter on approach and methodology.

A total of eight sampling locations were selected for sample collection and analysis. Table 4F.10 gives the description of sampling location and Figure 4F.17 gives the location of these sampling points on the watershed map of the area.

Table 4F.10 Sampling locations

Village	*Location*	*Source*
Jagannathapuram	Mr O K Arjun, (Khammam, AP)	Open well
Jagannathapuram	Village well near school, (Khammam, AP)	Open well
Sathupalle	(Panchayat) 10, Gandhinagar, (Khammam, AP)	Handpump
Sathupalle	(Domestic bore well) Ramakrishna KVS, Sri Valetu Priatas, # 4355, Bypass Road, (Khammam, AP)	Bore well
Kakarlapalle	Public handpump, K-1, Near school, (Khammam, AP)	Handpump
Kakarlapalle	Mr Kauchala Ramesh, Kakarlapalle.(Bore on open well), (Khammam, AP)	Bore well
Bethupalle	Mr D Srinivasa Rao, (Khammam, AP)	Bore well
Bethupalle	Mr. M Pullaiya, (Khammam, AP)	Bore well

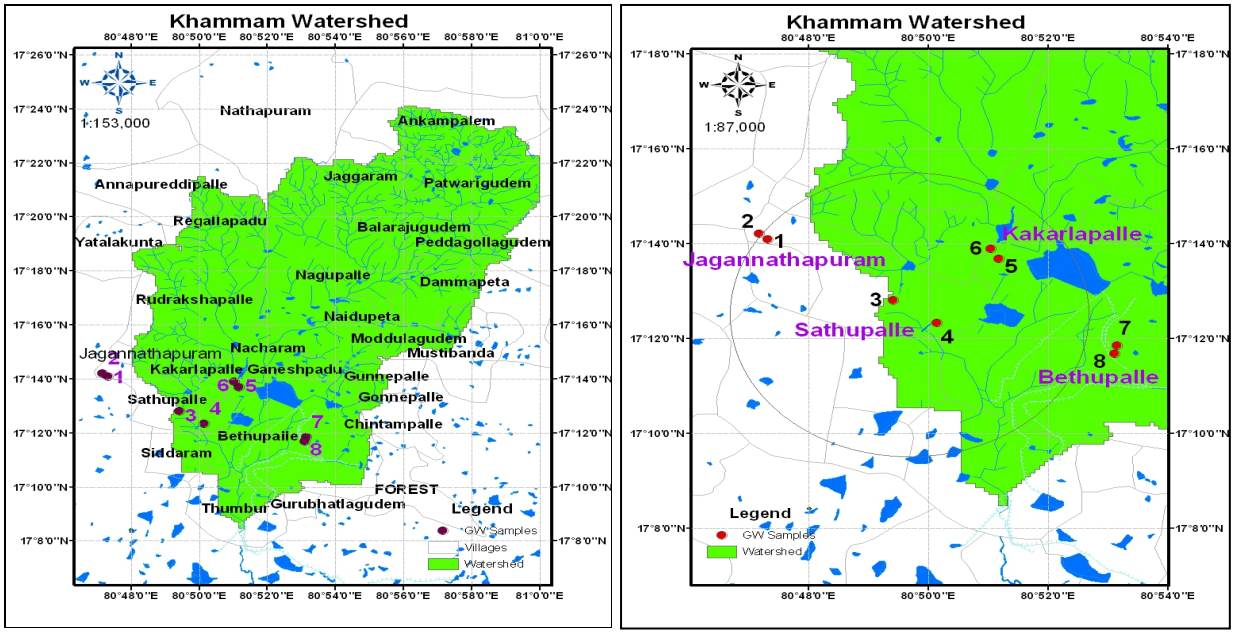


Figure 4F.17 Groundwater sampling locations at Sathupalle region

The samples were collected from the above locations on the following dates:

First round	5 April 2007 to 6 April 2007
Second round	23 April 2007 to 24 April 2007
Third round	14 May 2007 to 15 May2007

These samples were collected, preserved and transported to the designated laboratories as per the set protocols, the description of which is discussed in the chapter on approach and methodology.

Test results

The assessment of groundwater quality reveals that all of the monitored villages in the watershed show exceedance for total alkalinity, MPN coliform and faecal coliform as compared to IS 10500 standards along with heavy metals like lead and barium as compared to WHO guidelines. In addition to the above parameters, village Jagganathapuram (at the extreme upstream, U 2) showed exceedance for aluminium and *E.coli*. Village Bethupalle (D 2) showed exceedance for additional parameters TDS, calcium, fluoride, and *E. coli*.

Most exceedances for the water quality parameters were observed for Sathupalle (M 1). Exceedances were observed for pH (towards acidic side), TDS, calcium, nitrate, iron, fluoride, aluminium and chloride, along with nickel compared to IS 10500 and WHO guidelines. Similarly, another village Kakarlapalle (U 1) showed exceedances for TDS, calcium, nitrate, iron, fluoride, aluminium and *E. coli,* along with nickel (as per WHO guideline).

The assessment results for village Bethupalle (D 1) showed marginal exceedance for pesticide Atrazine as per IS 14543. However, none other monitored pesticides were detected in any of the monitored sources for the groundwater.

Figures 4F.18 (a to i) show the percentage of samples from each village that exceeded the desired/maximum permissible limits for different water quality parameters.

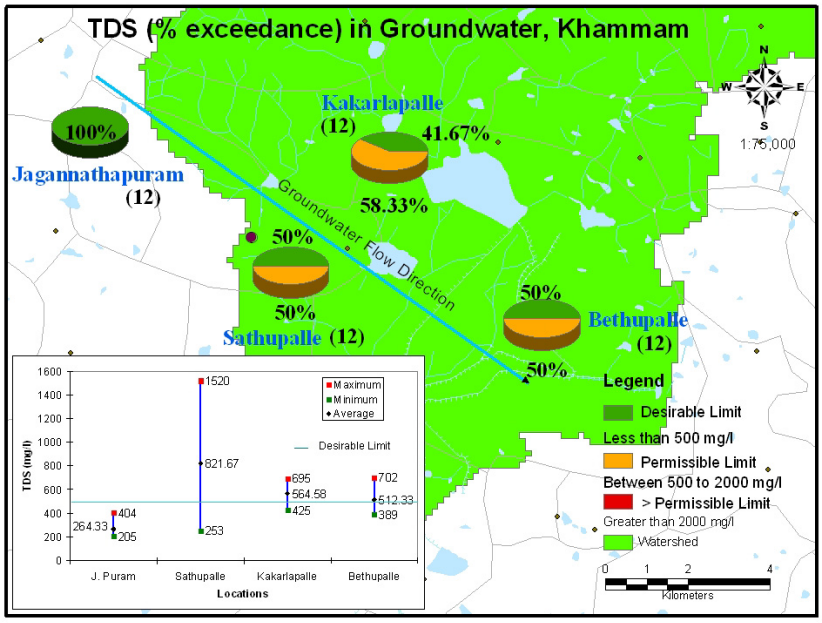


Figure 4F.18a Percent samples that exceeded limits for TDS (total dissolved solids) at different villages in Sathupalle region.

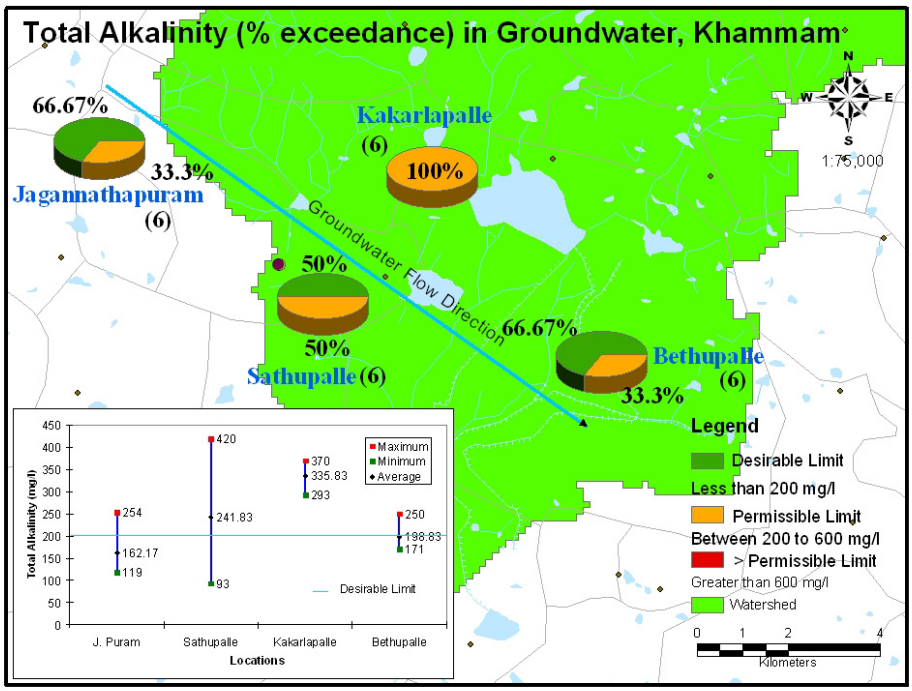


Figure 4F.18b Percent samples that exceeded limits for Total Alkalinity at different villages in Sathupalle region

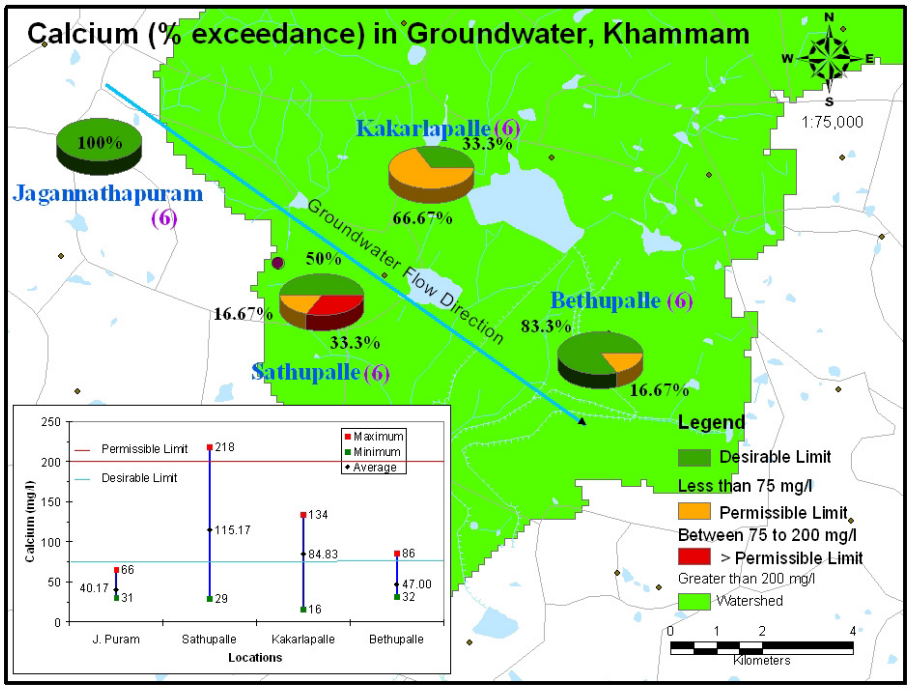


Figure 4F.18c Percent samples that exceeded limits for calcium at different villages in Sathupalle region

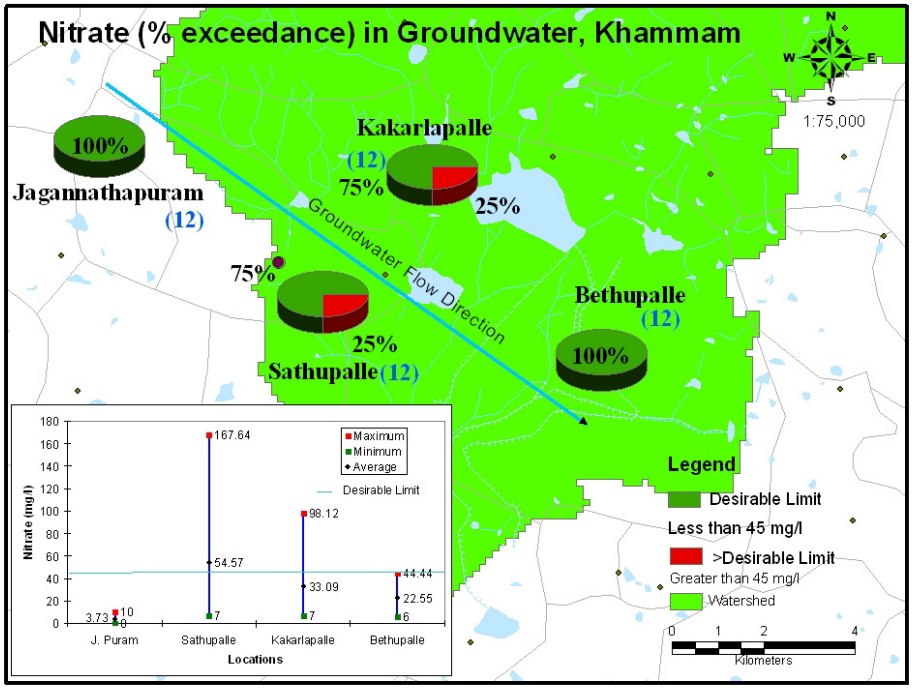


Figure 4F.18d Percent samples that exceeded limits for nitrate at different villages at Sathupalle region.

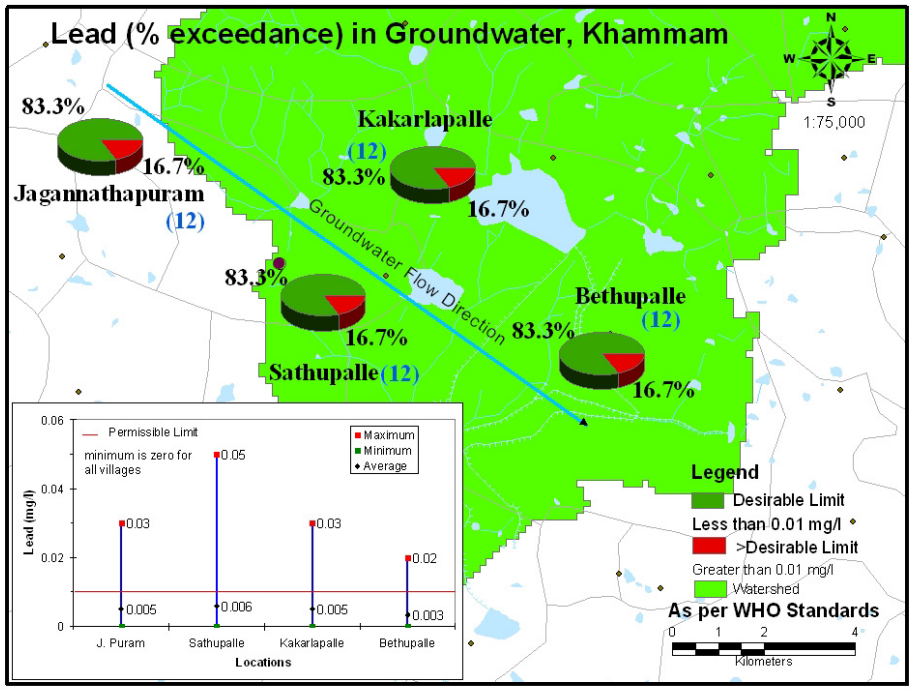


Figure 4F.18e Percent samples that exceeded limits for lead in Sathupalle region

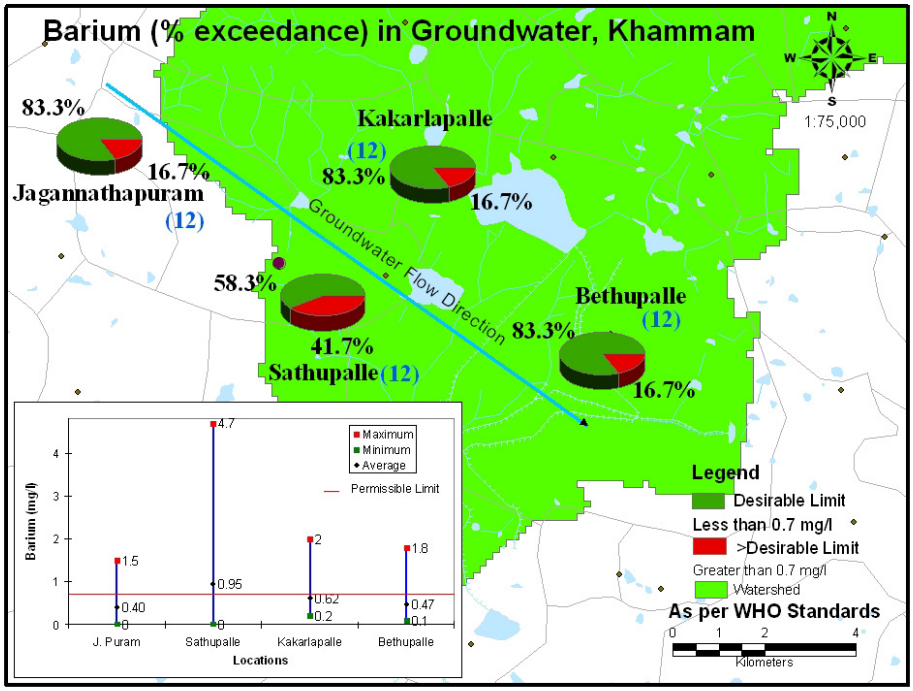


Figure 4F.18f Percent samples that exceeded limits for barium in Sathupalle region.

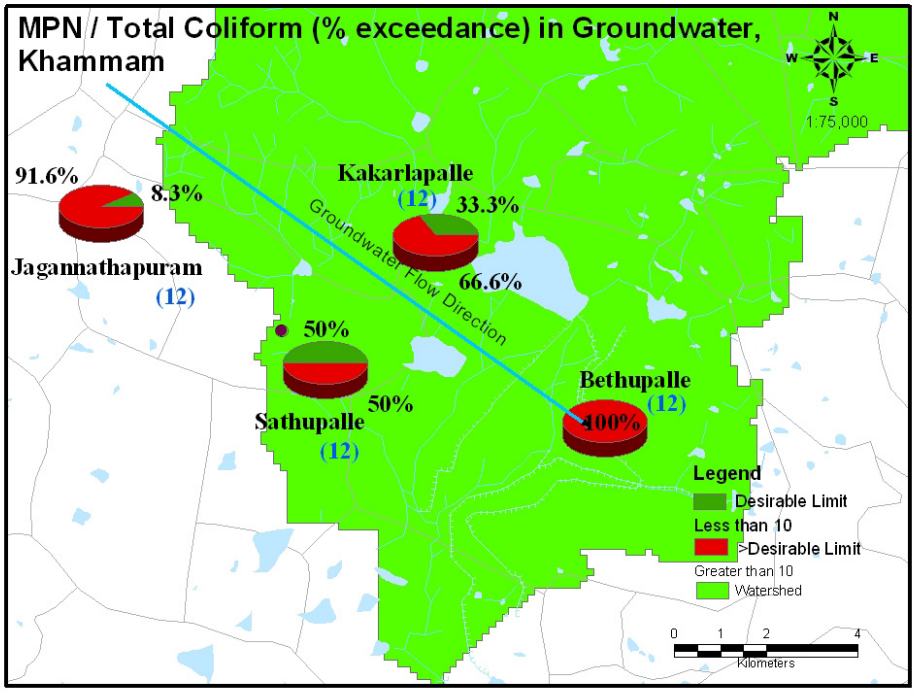


Figure 4F.18g Percent samples that exceeded limits for MPN (most probable number) coliform at Sathupalle region.

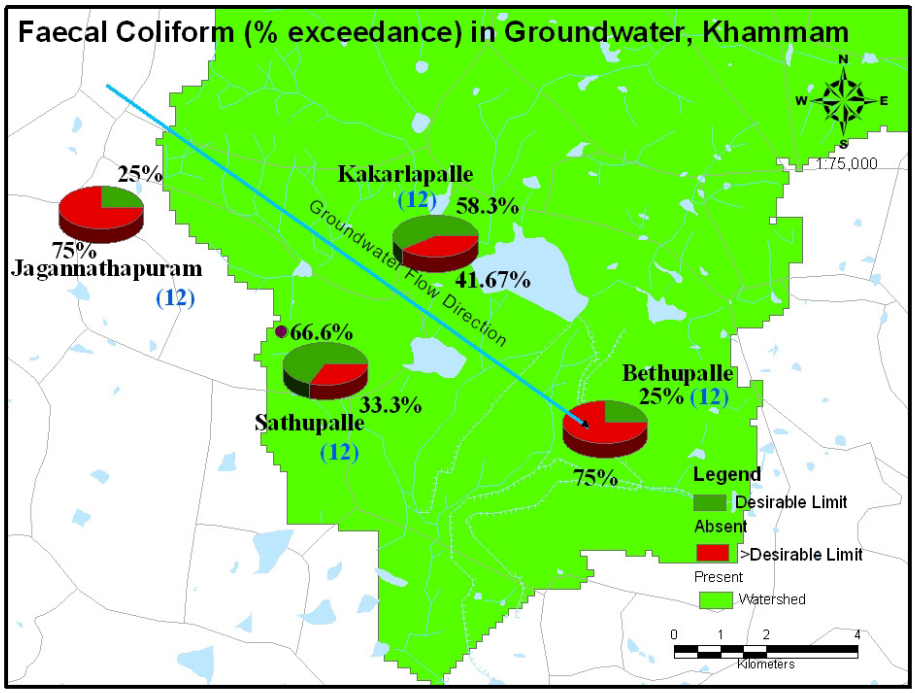


Figure 4F.18h Percent samples that exceeded limits for faecal coliform in Sathupalle region.

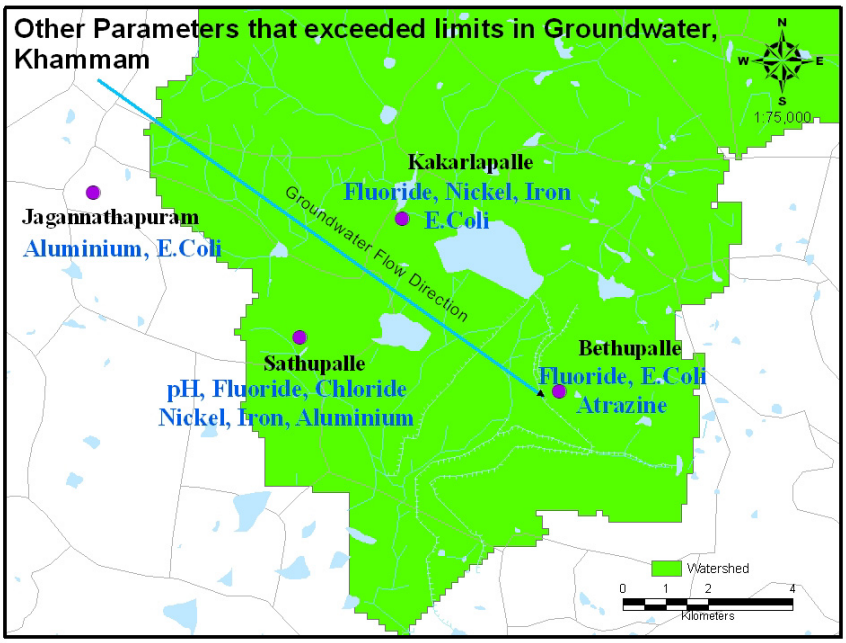


Figure 4F.18i Other parameters that marginally exceeded limits in Sathupalle region.

Apart from the parameters discussed above, most of the monitored parameters were found to meet the required IS 10500: 1991 drinking water specification and WHO guideline values. Table 4F.11 finally shows the non conformities in groundwater in the villages with respect to drinking water norms discussed in sections above.

Table 4F.11 WHO (World Health Organization) guideline values and IS 10500: 1991 drinking water specifications

WHO guidelines	*BIS (Bureau of Indian Standards) 10500: 1991 drinking water specifications*
(in addition to non-conforming parameters identified under IS 10500) Heavy metals Lead, nickel and barium	Physiochemical: TDS (total dissolved solids), pH, nitrate, fluoride, chloride, total alkalinity, calcium, Heavy metals: Iron and aluminium Microbiological: MPN (most probable number) coliform, E. coli and faecal coliform

Water with this quality needs to be treated to make it safe for drinking in the villages.

Plant level assessment of quality and practice

The Sathupalle plant sources its water from two bore wells, each of approximately 85 m depth. The water is pumped to a raw water storage tank, where all of it is chlorinated. The water is then sent to different sections of the facility and through different processes for respective treatment and usage in the packaged water production, domestic use and use in the boilers and cooling towers as shown in Figure 4F.19. Wastewater discharges from the production line, boilers and cooling towers, and domestic usages (except for domestic sewage) are finally collected into a common effluent treatment plant, from where it is used for horticultural uses on the plant property for gardening.

Water quality

Table 4F.12 gives the description of points of sample collection and the sampling details.

Table 4F.12 Details of the in situ sampling locations

Sample source	*Location of sampling*	*Quantity of sample* (litres)	*Type of sampling* (1 hourly for 22 hours)	*Number of samples (from each location in each sampling round)*	*Protocol/ guidelines for sampling and testing*
Raw intake water	Raw water inlet	20	Composite	1	APHA 20th ed. 1998/ IS 3025
	Treated water at clear well storage tank (raw water outlet)	20	Composite	1	APHA 20th ed. 1998/ IS 3025
Wastewater/ effluent	ETP (effluent treatment plant) Inlet	20	Composite	1	APHA 20th ed. 1998/ IS 3025
	ETP Outlet	20	Composite	1	APHA 20th ed. 1998/ IS 3025
Process water	• UV (ultra violet) treated water • After 0.22 micron filter outlet	20	Composite	2	APHA 20th ed. 1998/ IS 3025

Six in situ sampling locations were selected for water quality monitoring in the plant. These are as follows.

1 Plant raw water: raw water inlet (source of water)
2 Plant raw water outlet: treated water at clear well storage tank (source of water)
3 Plant process water: UV (ultra violet)-treated water: Treated water before 0.22-μ filter.
4 Plant process water: After 0.22 micron filter outlet: This goes to final PET (polyethylene terephthalate) bottle filling.
5 Wastewater: ETP inlet .
6 Wastewater: ETP outlet.

The results observed have been compared, for compliance, to the relevant guidelines/ limits/requirements as follows.

- For wastewater discharge: relevant local regulation, CPCB/APPCB guidelines, and TCCC internal quality guidelines
- For process water: relevant national standard for drinking water (BIS [Bureau of Indian Standards] 10500: 1991, IS 14543: 2004), international guideline (WHO guidelines for drinking water), and TCCC internal specification for treated water
- For raw water: relevant national standard for drinking water (BIS 10500: 1991) and international guideline (WHO guidelines for drinking water).

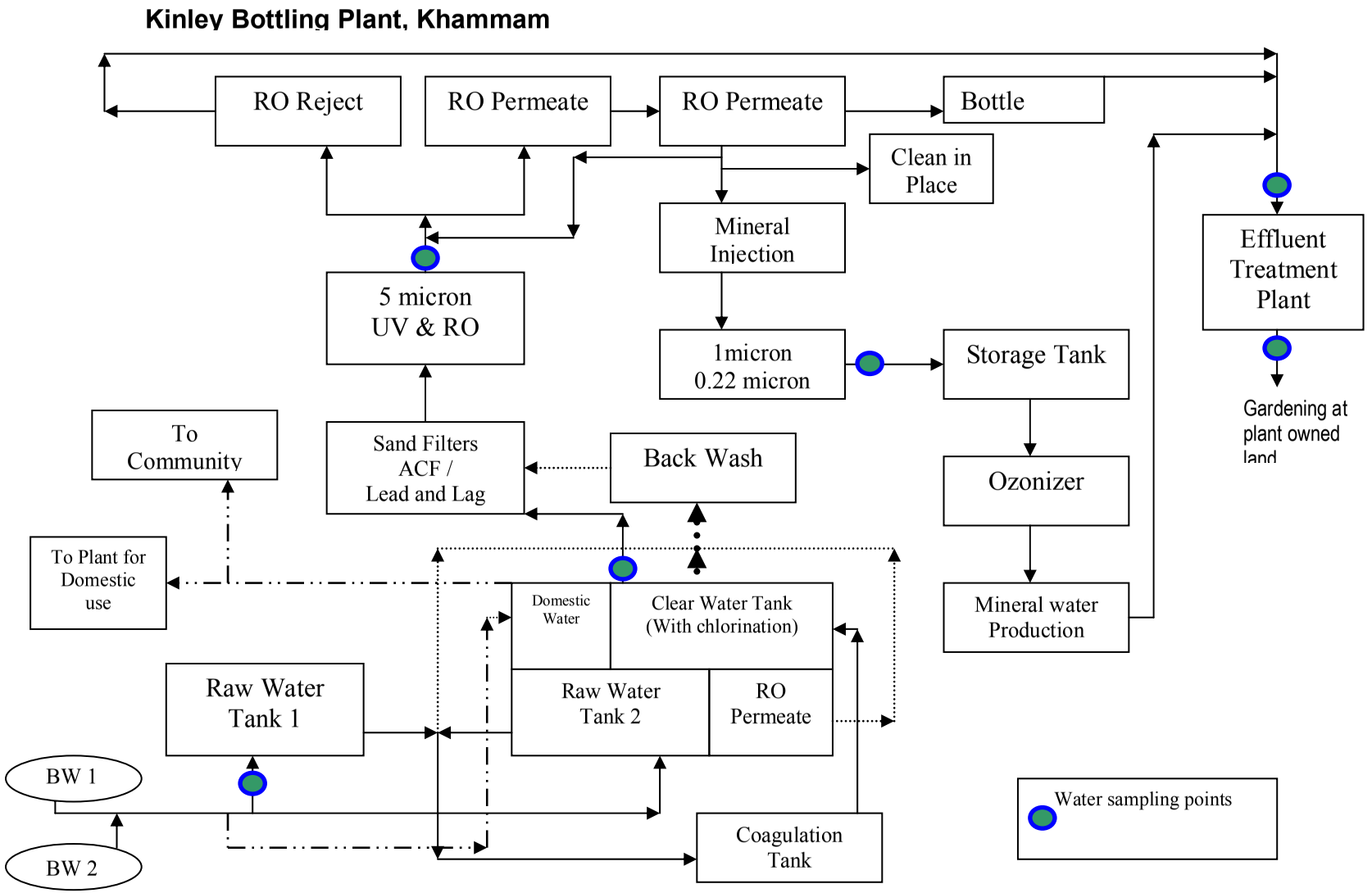


Figure 4F.19 Sri Sarvaraya Sugars Ltd, Sathupalle plant process flow diagram and sampling locations.

Sample collection, preservation, and transportation

For all the selected locations composite sampling was carried out from 5 April 2007 to 6 April 2007 in the first round; 23 April 2007 to 24 April 2007 in the second round; and 14 May 2007 to 15 May 2007 in the third round. Protocols for sample collection, preservation, and transportation to designated laboratories have been discussed in the chapter on approach and methodology.

Test results

In situ water quality assessment shows that, in the plant raw intake water, nitrate and iron exceeded the desired limits of drinking water specification (IS 10500). pH was additionally found exceeding the IS 10500 limits in the raw water outlet.

In the plant process water, pH was found to be showing marginal exceedance after 0.22 μ filter outlet, found slightly in excess (towards acidic side) to IS 10500 limits. The pH of ultra-pure water in Sathupalle plant can drop a little below 6.5 as it may absorb carbon dioxide (CO_2) from the atmosphere during grab sample collection or pH measurement, but this does not mean that the water is now grossly contaminated; just a fraction of a ppm of CO_2 will cause the pH to fall. The pH values found in samples range between 6.0 – 6.3 which is possible for reason stated above (ref: American Society of Testing of Materials, ASTM-D 5464-93 (2001)). Rest all of the monitored parameters including pesticides were found well below the specified standards/limits/guidelines for raw and process water.

The quality of the ETP discharge water indicates that the plant meets all the requirements as specified by the CPCB for discharge on land for irrigation.

As compared to TCCC's own treated wastewater quality standards for discharge into natural waterbodies, TKN was found to exceed the prescribed limits.

Pesticides were not detected in any of the monitored in situ sources for all the rounds.

Plant level water audit

Water auditing exercise at SSSL, Sathupalle, Khammam, involved an examination of water flows at inlet and outlet of unit processes with the following objectives.

- Establish water balance of the facility for the monitoring period.
- Assess ETP/WTP (water treatment plant) inlet and discharge.

Details of plant operations

The plant operations with respect to water balance can be divided into three broad segments namely, RW (raw water), PW (process water) and effluent. As the plant produces only Kinley water, RO (reverse osmosis) water after treatment is used for bottle rinsing. Figure 4F.20 is a schematic diagram of the WTP and locations of meters for three rounds of auditing.

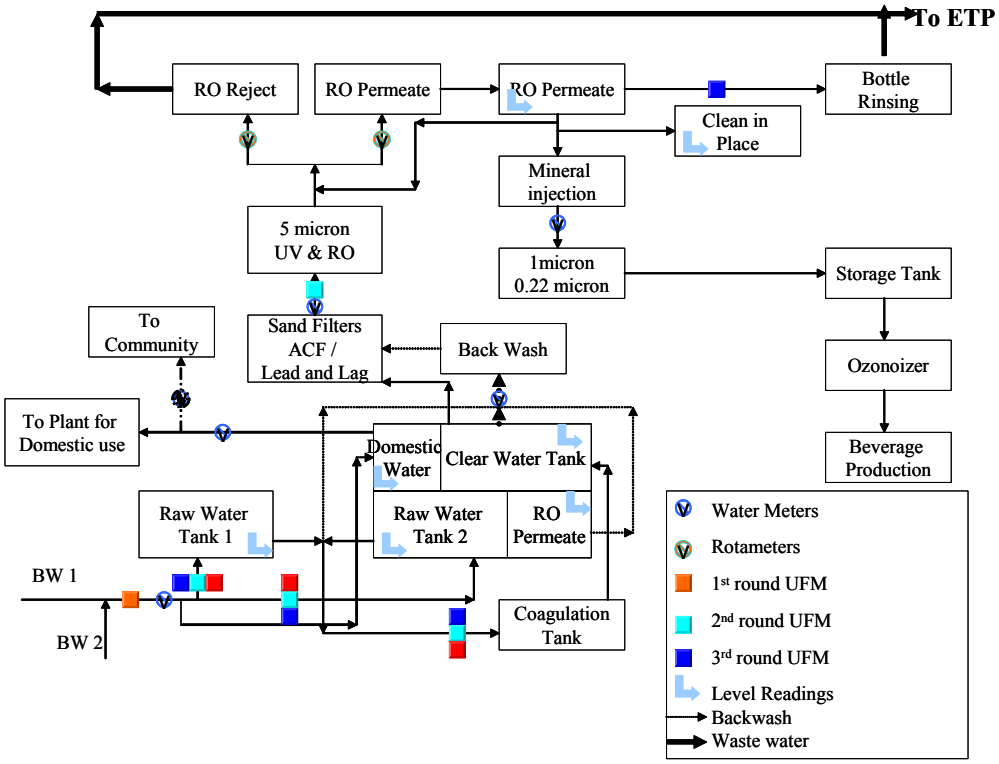


Figure 4F.20 Schematic diagram of the plant showing water meter locations

Water balance

The water balance of individual storage unit for the entire plant was carried out to assess the inflow and out flow of water in the plant and to estimate water usage for beverage production. Figure 4F.21 shows schematic diagram of water balance of the plant. Table 4F.13 gives a water balance compiled for the RW tank from the three rounds of plant level water balancing.

Table 4F.13 Raw water balance during three rounds of water auditing

Water balance component	*First round*	*Second round*	*Third round*
Inlet			
Raw Water Intake (m^3)	203.27	197.65	244.17
Total intlet (m^3)	203.27	197.65	244.17
Outlet			
To coagulation tank (m^3)	185.65	195.69	244.11
To backwash (m^3)	1.01	0	0
To domestic (m^3)	2.545	0.09	20.86
Total outlet (m^3)	189.205	195.78	264.95
Storage			
Measured (inlet–outlet in m^3)*	14.065	1.855	(-) 20.86
Observed (m^3)**	11.144	2.065	22.95
Percent error in balancing	1.43	0.11	0.88

*Measured change in storage is change calculated based on the meter readings at inlet and outlet by applying continuity equation.

** Observed change in storage is storage change based on the difference of tanks water level.

Note Negative tank storage shows net outflow from the tank, that is, reduction in water storage level of tank.

The plant water balance derived from the audit shows that the components of the continuity equation (inlet, outlet, and change in storages) are in conformation with each other. The percentage of agreement between observed change (from level gauge readings taken by the audit team) and measured change (from installed digital and mechanical flow meters) in storage with respect to inflow is in the range of approximately 98 – 99 percent.

In addition to water balance, water usages for different unit processes were also calculated. Table 4F.14 presents an overview of observations from three rounds of water auditing;

Table 4F.14 Volume of water/effluent used in various units during three rounds of water auditing

Water use	*First round*	*Second round*	*Third round*
Date of Monitoring	5–6 April 2007	23–24 April 2007	14–15 June 2007
Monitoring hours	21.5	21	21
Total inlet (m^3)	203.27	197.65	244.17
Process water(m^3)	161.5	207.47	238.24
Domestic water (m^3)	11.29	8.55	15.77
Production (m^3)	83.304	105.18	111.34
WUR (water utilization ratio) treated water (daily)	2.074	2.054	2.281
ETP (effluent treatment plant) outlet (m^3)	48	53	60

Water use	*First round*	*Second round*	*Third round*
Production	1 litre of Kinley water PET bottles	1 litre of Kinley water PET bottles	1 litre of Kinley water PET bottles

Annual WUR reported by the plant ranges from 2.26 to 3.7 for the last five years till 2005, while daily WUR calculated from auditing are 2.074, 2.054 and 2.281 for first, second, and third round respectively.

Level gauges were not installed in raw water, and domestic water tanks. All measurements for water levels in the storage tanks were carried out using plumb bob and tape.

The inlet and outlet of ETP could not be linked dynamically (given large storages in the treatment plant with wastewater being mechanically lifted through pumps from one process tank to another) since there was no provision of flow measurement at the inlet. As a result of this non-continuity in flow measurement it is not possible to measure pollution load discharged from ETP in relation to the inflow for that day.

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CHAPTER 5 Recommendations

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CHAPTER 5 Recommendations

General recommendations

Based on the assessment conducted as well as TERI's organizational experience in the areas of community and sustainable development, water management, and corporate social responsibility and practices, we offer the following recommendations to TCCC (The Coca-Cola Company) for their consideration and possible action.

Plant siting

- The company's assessment of water availability in the vicinity of a bottling operation should be from a perspective that is wider than business continuity. Operating in India for Coca-Cola could mean operating in many water-stressed localities. Even if each Coca-Cola facility can become water neutral, there will be other economic activities (that is, other industries and intensive agricultural production) that will characterize the regional context in which they would operate and which will generate other environmental and water stresses (for example, water drawdown and water contamination) that are beyond Coca-Cola's control. Therefore, while establishing a plant, water availability should be assessed from a long-term and ecosystem point of view, keeping in mind risks arising out of present and future (potential) competing demands in the area. Detailed investigations should be conducted prior to the siting of a bottling operation. The investigations, taking watershed as a unit of planning, should include comprehensive hydrological and groundwater modelling along with consultations with all the relevant stakeholders including government agencies like groundwater boards, water resources department, pollution control board, communities and so on.
- Siting policies need to recognize and respect the existing (formal and informal) riparian rights. For instance, the informal rights of the farmers to extract groundwater for irrigation need to be respected. This has also been acknowledged in the national and most state water policies that give precedence to domestic and agriculture demands vis-à-vis industrial demand for water. This aspect is relevant particularly in case of areas that are critical or overexploited (as per the norms defined by the Central Ground Water Board,

Government of India) and/or have been experiencing irregular and low rainfall.

- TCCC and CCI should consider transitioning its current advisory committees on environment to include a broader focus on sustainable development. This should mirror a corporate evolution that allows it to integrate environment with social and economic development in its activities in a tangible, measurable, and accountable manner.

Water quality

- The plants generally meet the government regulatory standards but they need to also ensure full compliance with the existing wastewater requirements specified by TCCC. This compliance should be ensured at the earliest.
- It is also suggested that TCCC should also specifically develop and adopt criteria for the quality of treated wastewater applied on land within the plant premises. TCCC and CCI need to develop additional requirements (standards) covering treated wastewater quality. For instance, the presence of faecal coliform and several other physico-chemical pollutants in the treated wastewater in almost all the plants calls for an urgent and stringent definition (and implementation) of standards and practices as well as source identification. Absent or weak governmental regulations and norms should be countered by strong Company policies and self regulated norms. Apart from good stewardship, this is necessary to safeguard soil, groundwater, and water bodies in the vicinity of the plant operations from getting adversely impacted in the future and affecting business.
- Hydraulic loading rates as prescribed by the state pollution control boards for land application of treated effluent could not be verified at any of the sites as mentioned in the site-specific reports. Hence, the ETPs need to be redesigned/ modified and flow-measuring devices need to be installed both at the inlet and outlet of the ETP for all the plants.

Audits and reviews

- A system of annual social audits needs to be established to monitor in a transparent manner the corporate efforts for improving the quality of life in the areas surrounding the plant.
- Coca-Cola's senior executives should ensure that the company's business managers become responsible and accountable for corporate- and facility- water, environmental, and sustainable development goals as

well as government and company compliance programmes. One possible mechanism to accomplish this could be to integrate these expectations into business managers' annual performance reviews.

Corporate social responsibility

- CSR initiatives need to be both sensitive to community needs and concerns. They also need to be able to better anticipate challenges that may arise in the future. In this context, a comprehensive, clear, and corporate policy on CSR needs to be enforced. This may require drawing upon a new framework for CSR in India to establish measurable benchmarks for facility, national, and perhaps global CSR. In conjunction with this, the company should establish a facility and national-level audit of these activities every three years and consider forming a special external advisory group to advise, assess, and review the programme and its components.
- CSR interventions designed for the benefit of the local communities must lead to the development of sustainable physical and social infrastructure. Stand-alone, periodic activities will make very little impact. For instance, the plant could focus on major long-terms programmes (in coordination with local governments) for provision of safe drinking water to rural communities. Similarly, the linkage of health and water could be addressed by focusing on the regional water quality results. In brief, the company should: (1) make its water programme more transparent to local communities and interested stakeholders, and accountable at the facility and country level; and (2) serve as an important catalyst for greater awareness and activities within the eco-region and watersheds within which it is operating. Appreciating the fact that wider regional issues cannot be the responsibility of a single company, TCCC may wish to consider catalysing public-private-community initiatives around such issues.
- The company needs to strengthen its reputation with local communities by taking local economic, social, and cultural norms and aspirations into account in its business, environment, and CSR programmes. Greater participation by facility managers in local community social networks, for example, might sensitise managers about special needs that could differ from one village to the next. Locating plant managers in communities where they speak the same language as the villages, for example, can enhance opportunities for communication and mutual understanding.

Water conservation

- The company should accord high priority to conservation of water and its enhancement in all its activities. It should ensure that all water conservation/enhancement measures are relevant to the perspectives and needs of the region in which they are located and that their effectiveness is sustainable over the life of the plant. There is a need to promote efficient use of water and conservation practices in joint collaboration with other stakeholders in the region such as irrigation and local government.
- In general, TCCC should try to be net water positive with respect to its own operations from a watershed perspective, especially in water stressed areas.
- It was obvious during the assessments across various plant sites that the state governments in India have not been able to value their water resources appropriately. The water use charges levied by various state governments render this important input into the production process virtually free. This fact too is resented by the communities that believe that the setting up of water intensive units, such as a Coca-Cola plant, does not add value to the local area. TCCC should define a strategy wherein it is able to offset this anomaly through appropriate and commensurate interventions that should, ideally, result in a stream of benefit flows to the community.

Plant-specific recommendations

Kaladera

From the detailed assessment undertaken in the Kaladera watershed, it is obvious that the area is overexploited and it is highly unlikely that the water situation would improve to a level as to make its availability a non-issue. The reasons for this may be many and contributing factors may include, apart from the HCCBPL's operations, the existence of other industries, changes in cropping patterns, and rainfall. It was beyond the scope of this study to look at contributions, or indeed the chronology of establishment, of these other industries. Nor was it in the sprit of the assessment to attribute the issue to other stakeholders.

What emerges, however, is that the plant's operations in this area would continue to be one of the contributors to a worsening water situation and a source of stress to the communities around.

Water contingency measures as adopted by the plant seem to rely heavily on rainwater recharge structures, which in turn depend on rainfall in the region. Since the rainfall is scanty, the recharge achieved through such structures is unlikely to be meaningful.

In such a scenario, TCCC has to evaluate its options for HCCBPL, Kaladera, such as:

- Transport water from the nearest aquifer that may not be stressed (could be at quite a distance from the existing plant)
- Store water from low-stress seasons (may not exist!)
- Relocate the plant to a water-surplus area
- Shut down this facility

Mehndiganj and Nabipur

In addition to the general recommendations, there is a need to take note of the fact that while in Mehndiganj, the water tables have been depleting and the aquifer may move from a safe to semi-critical situation, in Nabipur, the state of the aquifer has already moved from critical to overexploited condition (refer Chapter 4B and 4C). In both the areas, water-intensive crops such as rice are predominantly cultivated for a major part of the year and riparian rights need to be respected.

Since the movement towards water-stress situation is fairly recent, it may be prudent that the company focuses on proactively joining hands with farmers, local governments, and other stakeholders to develop and implement measures for improving the water scenario. Most state governments in India are today open to the public–private partnership model to implement infrastructure development projects. This model may be explored for options such as supplying piped drinking water to communities (the Pirangut example clearly demonstrates the impact such an initiative has on perceived stress release); setting up of water-harvesting structures; establishing sprinkler and drip irrigations systems; as also setting up social infrastructure such as educational or health institutions.

Annexe 5.1 Summary of water results quality

Water quality assessment results for Kaladera

(A) Regional water quality[1] (The table provides exceedence against standards and not an exposure assessment)

Test parameter	*Desired value (as per BIS 10500: 1991)*	*Villages in which the values exceeded*	*Implications*
Total dissolved solids; mg/l	500	Khannipura, Disan, Durga ka Bas, Kaladera	Beyond this palatability decreases and may cause gastrointestinal irritation
Fluoride; mg/l	1.0	Khannipura, Disan, Kaladera, Durga ka Bas	High fluoride may cause fluorosis (deformation of bone and teeth) in long term
Chloride; mg/l	250	Disan	Beyond this limit, taste and palatability are affected
Total alkalinity; mg/l	200	Khannipura, Disan, Kaladera, Durga ka Bas	Beyond this limit taste becomes unpleasant
Nitrate; mg/l	45	Kaladera	Affects pregnant women more, as beyond the desirable limit methaemoglobinaemia (blue baby syndrome) may take place
Iron; mg/l	0.3	Khannipura, Disan, Kaladera, Durga Ka Bas	Beyond this limit, taste/ appearance are affected, imparts yellowish colour to water on oxidation
Turbidity; NTU	5	Khannipura, Disan, Kaladera	Above 5, consumer acceptance decreases
Lead; mg/l	0.05 (IS 10500); 0.01 (WHO guideline)	Kaladera, Disan, Khannipura	Beyond this limit, water becomes toxic
2,4-DDE; µg/l	0.1	Durga ka Bas	Beyond this limit, water becomes toxic
2,4-DDT; µg/l	0.1	Durga ka Bas	Beyond this limit, water becomes toxic
Most probable number coliform/total coliform per 100ml	10	Khannipura, Kaladera, Disan, Durga ka Bas	Can cause water-borne diseases such as diarrhoea, cholera, typhoid, paratyphoid fever, bacillary dysentery, jaundice, and poliomyelitis
Escherichia coli	Absent	Durga ka Bas	Causes gastrointestinal disorder and dysentery
Faecal coliform/100 ml	Absent	Durga ka Bas, Khannipura, Disan, Kaladera	Some water-borne pathogenic diseases include ear infections, dysentery, typhoid fever, viral, and bacterial gastroenteritis
Nitrite; mg/l	3	Disan, Kaladera	Toxic effects of nitrite are methaemoglobinaemia and fall of blood pressure
Barium; mg/l	0.7	Disan, Kaladera, Khannipura	Can cause developmental toxicity, neurotoxicity, reproductive toxicity, and respiratory toxicity

Red: Extremely widespread (> 50 percent samples + > 75 percent villages)
Orange: Moderately widespread (> 50 percent samples + 40–75 percent villages; < 50 percent samples + > 75 percent villages)
Yellow: Thinly widespread (one-time exceedance/ marginal exceedance)

[1] The intake raw water is treated by the plants (as processed water) before it goes into beverage production

(B) In-plant water quality: treated effluent (Treated effluent quality results have been compared to existing PCB [Pollution Control Board] norms for discharge on land for irrigation and TCCC's [The Coca-Cola Company] requirements for discharge into natural waterbodies)

Test parameter	*Permissible value*	*Implications*
Bioassay test	90 (as per CPCB)	Indicates toxicity of water to survival of fishes
Most probable number coliform per 100 ml	–	Can cause water-borne diseases such as diarrhoea, cholera, typhoid, paratyphoid fever, bacillary dysentery, jaundice, poliomyelitis
Faecal coliform per 100 ml	–	Some water-borne pathogenic diseases include ear infections, dysentery, typhoid fever, viral, and bacterial gastroenteritis
Escherichia coli	–	Causes gastrointestinal disorder and dysentery
TDS; mg/l	<2000 (TCCC requirements)	Beyond this, palatability decreases and may cause gastrointestinal irritation
Anionic Surfactants; mg/l	<0.5 (TCCC requirements)	Environmental implication: beyond this limit, it causes light froth in water
Total Kjeldahl nitrogen; mg/l	<5 (TCCC requirements)	Gets oxidized to nitrates and nitrites in the presence of oxygen and due to other microbial reactions
Cadmium; mg/l	<0.02 (TCCC requirements)	Environmental implication: might leach into groundwater

Red: Large number of exceedances (detected in all rounds) (> 75 percent samples)
Orange: Moderate number of exceedances (40–75 percent samples)
Yellow: One-time exceedance/marginal exceedance (< 40 percent samples)

Note: a) In absence of any specific individual standards for land application by TCCC, the quality of treated effluent for all the plants has been compared in the table above with the TCCC specific standards for discharge into natural waterbodies.
b) Coliforms (total coliforms, faecal coliforms, and E.Coli) have been reported with respect to their presence or absence in each of the three sampling rounds. There are no specific standards prescribed either by the Central/State Pollution Control Board or by TCCC for coliforms in treated wastewater.

Water quality assessment results for Mehndiganj

(A) Regional water quality[2] (The table provides exceedence against standards and not an exposure assessment)

Test parameter	*Desired value (As per BIS 10500: 1991)*	*Villages in which the values exceeded*	*Implications*
Total dissolved solids; mg/l	500	Chhoti Khajuri, Mehndiganj, Kachnar, Bhikharipur	Beyond this, palatability decreases and may cause gastrointestinal irritation
Fluoride; mg/l	1.0	Bhikharipur	High fluoride may cause fluorosis (deformation of bone and teeth) in long term
Chloride; mg/l	250	Kachnar	Beyond this limit, taste and palatability are affected
Total alkalinity; mg/l	200	All the villages	Beyond this limit, taste becomes unpleasant
Nitrate; mg/l	45	Kachnar	Affects pregnant women more, as beyond the desirable limit, methaemoglobinaemia (blue baby syndrome) may take place
Iron; mg/l	0.3	All the villages	Beyond this limit, taste/ appearance are affected, imparts yellowish colour to water on oxidation
Lead; mg/l	0.05 (IS 10500); 0.01 (WHO guideline)	All villages	Beyond this limit, water becomes toxic
Manganese; mg/l	0.1	Mehndiganj, Kachnar,	Beyond this limit, water becomes toxic
Calcium; mg/l	75	Kachnar, Bhikharipur, Karnadadi	Contributes to hardness of water; palatability decreases
Most probable number coliform/total coliform per 100 ml	10	All the villages	Can cause water-borne diseases such as diarrhoea, cholera, typhoid, paratyphoid fever, bacillary dysentery, jaundice, and poliomyelitis
Escherichia coli	Absent	Khajuri, Mehndiganj, Kachnar Bhkharipur	Causes gastrointestinal disorder and dysentery
Faecal coliform/100 ml	Absent	All the villages	Some water-borne pathogenic diseases include ear infections, dysentery, typhoid fever, and viral and bacterial gastroenteritis
Barium; mg/l	0.7 (as per WHO)	Mehndiganj, Kachnar	Can cause developmental toxicity, neurotoxicity, reproductive toxicity, and respiratory toxicity
Turbidity; NTU	5	Mehndiganj, Khajuri, Kachnar Bhkharipur, Karnadadi	Above 5, consumer acceptance decreases

Red: Extremely widespread (> 50 percent samples + > 75 percent villages)
Orange: Moderately widespread (> 50 percent samples + 40–75 percent villages; < 50 percent samples + > 75 percent villages)
Yellow: Thinly widespread (one time exceedance/ marginal exceedance)

[2] The intake raw water is treated by the plants (as processed water) before it goes into beverage production

(B) In-plant water quality: process water

Test parameter	*Desired value (As per BIS 10500: 1991)*	*Implications*
Nitrite; mg/l	0.02 (As per IS 14543:2004 specification for packaged drinking water	Toxic effects of nitrite are methaemoglobinaemia and fall of blood pressure

Red: Large number of exceedances (> 75 percent)
Orange: Moderate number of exceedances (40–75 percent)
Yellow: One time exceedance/marginal exceedance (< 40 percent)

(C) In-plant water quality: treated effluent (Treated effluent quality results have been compared to existing PCB [Pollution Control Board] norms for discharge into inland surface waterbody and TCCC's [The Coca-Cola Company] requirements for discharge into natural waterbodies)

Test parameter	*Permissible value*	*Implications*
Most probable number coliform per 100 ml	–	Can cause water-borne diseases such as diarrohea, cholera, typhoid, paratyphoid fever, bacillary dysentery, jaundice, and poliomyelitis
Faecal coliform per 100 ml	–	Some water-borne pathogenic diseases include ear infections, dysentery, typhoid fever, viral, and bacterial gastroenteritis
Escherichia coli	–	Causes gastrointestinal disorder and dysentery
Giardia lamblia	–	Causes diarrohea
Total dissolved solids; mg/l	<2000 (TCCC requirements)	Beyond this, palatability decreases and may cause gastrointestinal irritation
Anionic surfactants; mg/l	<0.5 (TCCC requirements)	Environmental implication: beyond this limit, it causes light froth in water
Total Kjeldahl nitrogen; mg/l	<5 (TCCC requirements)	Gets oxidized to nitrates and nitrites in presence of oxygen and due to other microbial reactions
Total suspended solid; mg/l	<50 (TCCC requirements)	Reduces aesthetic acceptance ad can harbor pathogenic micro-organisms

Red: Large number of exceedances (detected in all rounds) (> 75 percent samples)
Orange: Moderate number of exceedances (4075 percent samples)
Yellow: One-time exceedance/ marginal exceedance (< 40 percent samples)

Note: Coliforms (total coliforms, faecal coliforms, and *E.Coli*) have been reported with respect to their presence or absence in each of the three sampling rounds. There are no specific standards prescribed either by the Central/State Pollution Control Board or by TCCC for coliforms in treated wastewater.

Water quality assessment results for Nabipur

(A) Regional water quality[3] (The table provides exceedence against standards and not an exposure assessment)

Test parameter	*Desired value (As per BIS 10500: 1991)*	*Villages in which the values exceeded*	*Implications*
Total dissolved solids; mg/l	500	Nabipur, Kharodi, Jalberi Galan	Beyond this, palatability decreases and water may cause gastrointestinal irritation
Total alkalinity; mg/l	200	All the monitored sources	Beyond this limit, taste becomes unpleasant
Fluoride; mg/l	1.0	Kharodi	High fluoride may cause fluorosis (deformation of bone and teeth) in long term
Calcium; mg/l	75	Nabipur, Kharodi	Contributes to hardness of water; palatability decreases
Manganese; mg/l	0.1	Nabipur, Saidpura Kharodi	Beyond this limit, water becomes toxic
Selenium; mg/l	0.01	Jalberi Galan	Beyond this limit, water becomes toxic
Aluminium; mg/l	0.03	Kharodi, Jalberi Galan	Beyond this limit, water becomes toxic
Faecal coliform	Absent	Kharodi	Some water-borne pathogenic diseases include ear infections, dysentery, typhoid fever, viral, and bacterial gastroenteritis
Barium; mg/l	0.7	All the villages	Can cause developmental toxicity, neurotoxicity, reproductive toxicity, and respiratory toxicity
Lead; mg/l	0.01	All the villages	Beyond this limit, water becomes toxic

Red: Extremely widespread (> 50 percent samples + > 75 percent villages)
Orange: Moderately widespread (> 50 percent samples + 40–75 percent villages; < 50 percent samples + > 75 percent villages)
Yellow: Thinly widespread (one-time exceedance/ marginal exceedance)

(B) In-plant water quality: process water

Test parameter	*Desired value*	*Implications*
Nitrite; mg/l	0.02 (As per IS 14543:2004)	Toxic effects of nitrite are methaemoglobinaemia and fall of blood pressure

Red: Large number of exceedances (> 75 percent)
Orange: Moderate number of exceedances (40–75 percent)
Yellow: One-time exceedance/ marginal exceedance (< 40 percent)

[3] The intake raw water is treated by the plants (as processed water) before it goes into beverage production

(C) In-plant water quality: treated effluent (Treated effluent quality results have been compared to existing PCB [Pollution Control Board] norms for discharge on land for irrigation and TCCC's [The Coca-Cola Company] requirements for discharge into natural waterbodies)

Test parameter	*Permissible value*	*Implications*
Most probable number coliform per 100 ml	–	Can cause water-borne diseases such as diarrohea, cholera, typhoid, paratyphoid fever, bacillary dysentery, jaundice, and poliomyelitis
Faecal coliform per 100 ml	–	Some water-borne pathogenic diseases include ear infections, dysentery, typhoid fever, viral, and bacterial gastroenteritis
Escherichia coli	–	Beyond this, palatability decreases and may cause gastrointestinal irritation.
Total Kjeldahl nitrogen; mg/l	<5 (TCCC [The Coca-Cola Company] requirements)	Gets oxidized to nitrates and nitrites in presence of oxygen and due to other microbial reactions
Biochemical oxygen demand; mg/l	30 as per CPCB and < 50 as per TCCC	Causes organic pollution in the environment
Total suspended solids; mg/l	100 as per CPCB, and < 50 as per TCCC	Reduces aesthetic acceptance and can harbour pathogenic microorganisms
Iron; mg/l	< 1.0 as per TCCC requirements	Affects groundwater
Bioassay test	90 percent	Indicates toxicity of water to survival of fishes.

Red: Large number of exceedances (detected in all rounds) (> 75 percent samples)
Orange: Moderate number of exceedances (40–75 percent samples)
Yellow: One-time exceedance/ marginal exceedance (< 40 percent samples)

Note: a) In absence of any specific individual standards for land application by TCCC, the quality of treated effluent for all the plants has been compared in the table above with the TCCC specific standards for discharge into natural waterbodies.
b) Coliforms (total coliforms, faecal coliforms, and E.Coli) have been reported with respect to their presence or absence in each of the three sampling rounds. There are no specific standards prescribed either by the Central/State Pollution Control Board or by TCCC for coliforms in treated wastewater.

Water quality assessment results for Nemam

(A) Regional water quality[4] (The table provides exceedence against standards and not an exposure assessment)

Test parameter	*Desired value (As per BIS 10500: 1991)*	*Villages in which the values exceeded*	*Implications*
Total dissolved solids; mg/l	500	All villages	Beyond this, palatability decreases and may cause gastrointestinal irritation
Total alkalinity; mg/l	200	Vellavedu, Korattur, Nochimedu	Beyond this limit, taste becomes unpleasant
Turbidity; NTU	5	Nochimedu	Above 5, consumer acceptance decreases
Chloride; mg/l	250	Gudapakkam	Beyond this limit, taste and palatability are affected
Fluoride; mg/l	1.0	Korattur, Nochimedu	High fluoride may cause fluorosis (deformation of bone and teeth) in long term
Sulphate; mg/l	200	Korattur, Nochimedu	Beyond this limit, water causes gastrointestinal irritation when magnesium or sodium are present
Nitrate; mg/l	45	Gudapakkam	Affects pregnant women more, as beyond the desirable limit methaemoglobinaemia (blue baby syndrome) may take place
Iron; mg/l	0.3	Nemam, Korattur, Nochimedu	Beyond this limit, taste/ appearance are affected, imparts yellowish colour to water on oxidation
Manganese; mg/l	0.1	Nochimedu	Beyond this limit, taste / appearance are affected
Calcium; mg/l	75	Korattur, Nochimedu, Gudapakkam	Contributes to hardness of water; palatability decreases
Most probable number coliform/total coliform	10	Nemam, Vellavedu, Korattur, Gudapakkam	Can cause water-borne diseases such as diarrhoea, cholera, typhoid, paratyphoid fever, bacillary dysentery, jaundice, and poliomyelitis
Escherichia coli	Absent	Gudapakkam	Causes gastrointestinal disorder and dysentery
Faecal coliform/100ml	Absent	Vellavedu, Korattur, Gudapakkam	Some water-borne pathogenic diseases include ear infections, dysentery, typhoid fever, viral, and bacterial gastroenteritis
Endosulfan 1; µg/l	0.1 (IS 14543-2004)	Gudapakkam	Beyond this limit, water becomes toxic
Endosulfan 2; µg/l	0.1 (IS 14543-2004)	Gudapakkam	Beyond this limit, water becomes toxic
Barium; mg/l	0.7 (As per WHO guidelines)	All villages	Can cause developmental toxicity, neurotoxicity, reproductive toxicity, and respiratory toxicity
Nickel; mg/l	0.07 As per WHO guidelines)	Gudapakkam	Affects lungs, respiratory system, allergic reaction
Alluminium; mg/l	0.03	All sources	
Lead; mg/l	0.05 (IS 10500); 0.01 (WHO guideline	Nemam, Korattur, Gudapakkam	

Red: Extremely widespread (> 50 percent samples + > 75 percent villages), Orange: Moderately widespread (> 50 percent samples + 40–75 percent villages; < 50 percent samples + > 75 percent villages), Yellow: Thinly widespread (one-time exceedance/ marginal exceedance)

[4] The intake raw water is treated by the plants (as processed water) before it goes into beverage production

(B) In-plant water quality: treated effluent (Treated effluent quality results have been compared to existing PCB [Pollution Control Board] norms for discharge on land for irrigation and TCCC's [The Coca-Cola Company] requirements for discharge into natural waterbodies)

Test parameter	*Permissible value (As per the CPCB [Central Pollution Control Board]/TNPCB [Tamil Nadu Pollution Control Board] standards for discharge into inland surface water)*	*Implications*
Fluoride; mg/l	2 (as per TNPCB)	High fluoride may cause fluorosis (deformation of bone and teeth) in long term. High levels also cause yellowing of leaves in plant with growth retardation.
Most probable number coliform/Total coliform	–	Can cause water-borne diseases such as diarrhoea, cholera, typhoid, paratyphoid fever, bacillary dysentery, jaundice, and poliomyelitis
Escherichia coli	–	Causes gastrointestinal disorder and dysentery
Faecal coliform	–	Some water-borne pathogenic diseases include ear infections, dysentery, typhoid fever, viral, and bacterial gastroenteritis
Total Kjeldahl nitrogen; mg/l	<5 (As per TCCC [The Coca-Cola Company])	Gets oxidized to nitrates and nitrites in presence of oxygen

Red: Large number of exceedances (> 75 percent)

Orange: Moderate number of exceedances (40–75 percent)

Yellow: One-time exceedance/ marginal exceedance (< 40 percent)

Note: a) In absence of any specific individual standards for land application by TCCC, the quality of treated effluent for all the plants has been compared in the table above with the TCCC specific standards for discharge into natural waterbodies.
b) Coliforms (total coliforms, faecal coliforms, and *E.Coli*) have been reported with respect to their presence or absence in each of the three sampling rounds. There are no specific standards prescribed either by the Central/State Pollution Control Board or by TCCC for coliforms in treated wastewater.

Water quality assessment results for Pirangut

(A) Regional water quality[5] (The table provides exceedence against standards and not an exposure assessment)

Test parameter	*Desired value (As per BIS 10500: 1991)*	*Villages in which the values exceeded*	*Implications*
Total alkalinity; mg/l	200	Coke infiltration well, private Infiltration well	Beyond this limit, taste becomes unpleasant
Turbidity; NTU	5	All sources like coke infiltration well, private infiltration well, and Urawade reservoir	Above 5, consumer acceptance decreases
Iron; mg/l	0.3	Urawade Reservoir	Beyond this limit, taste/ appearance are affected, imparts yellowish colour to water on oxidation
Most probable number coliform/total coliform per 100 ml	10	(Private Infiltration well & Urawade Reservoir	Can cause water-borne diseases such as diarrhoea, cholera, typhoid, paratyphoid fever, bacillary dysentery, jaundice, and poliomyelitis
Escherichia coli	Absent	Urawade Reservoir	Causes gastrointestinal disorder and dysentery
Faecal coliform/100 ml	Absent	Urawade Reservoir	Some water-borne pathogenic diseases include ear infections, dysentery, typhoid fever, viral, and bacterial gastroenteritis
Lead; mg/l	0.01	All sources like coke infiltration well, private infiltration well, and Urawade reservoir	Beyond this limit, water becomes toxic

Red: Extremely widespread (> 50 percent samples + > 75 percent villages)
Orange: Moderately widespread (> 50 percent samples + 40 –75 percent villages; < 50 percent samples + > 75 percent villages)
Yellow: Thinly widespread (one-time exceedance/ marginal exceedance)

[5] The intake raw water is treated by the plants (as processed water) before it goes into beverage production

(B) In-plant water quality: treated effluent (Treated effluent quality results have been compared to existing PCB [Pollution Control Board] norms for discharge on land for irrigation and TCCC's [The Coca-Cola Company] requirements for discharge into natural waterbodies)

Test parameter	*Permissible value (as per the CPCB [Central Pollution Control Board] /MPCB [Maharashtra Pollution Control Board] standards and TCCC [The Coca-Cola Company] requirements for discharge into inland surface water)*	*Implications*
Chloride; mg/l	600 (as per MPCB)	Environmental implication: might leach into groundwater
Biochemical oxygen demand; mg/l	100 as per MPCB; < 50 as per TCCC	Indicates organic pollution with adverse effects on plant and animal
Chemical oxygen demand; mg/l	250 (as per MPCB)	Indicates inorganic pollution with adverse effects on plant and animal
Most probable number coliform per 100 ml	–	Can cause water-borne diseases such as diarrhoea, cholera, typhoid, paratyphoid fever, bacillary dysentery, jaundice, and poliomyelitis
Faecal coliform per 100 ml	-	Some water-borne pathogenic diseases include ear infections, dysentery, typhoid fever, viral, and bacterial gastroenteritis
Escherichia coli	–	Causes gastrointestinal disorder and dysentery
Iron; mg/l	<1 (TCCC requirements)	Environmental implication: might leach into groundwater
Cadmium; mg/l	<0.02 (TCCC requirements)	Environmental implication: might leach into groundwater
Total Kjeldahl nitrogen; mg/l	<5 (TCCC requirements)	Gets oxidized to nitrates and nitrites in presence of oxygen and due to microbial reactions

Red: Large number of exceedances (detected in all rounds) (> 75 percent samples)
Orange: Moderate number of exceedances (40–75 percent samples)
Yellow: One-time exceedance/ marginal exceedance (< 40 percent samples)

Note: a) In absence of any specific individual standards for land application by TCCC, the quality of treated effluent for all the plants has been compared in the table above with the TCCC specific standards for discharge into natural waterbodies.
b) Coliforms (total coliforms, faecal coliforms, and *E.Coli*) have been reported with respect to their presence or absence in each of the three sampling rounds. There are no specific standards prescribed either by the Central/State Pollution Control Board or by TCCC for coliforms in treated wastewater.

Water quality assessment results for Sathupalle

(A) Regional water quality[6] (The table provides exceedence against standards and not an exposure assessment)

Test parameter	*Desired value (As per BIS 10500: 1991)*	*Villages in which the values exceeded*	*Implications*
Total dissolved solids; mg/l	500	Sathupalle, Kakarlapalle, Bethupalle	Beyond this, palatability decreases and may cause gastrointestinal irritation
pH	6.5 to 8.5	Sathupalle	Low pH increases acidity in water, no direct health effects (as per WHO)
Nitrate; mg/l	45	Sathupalle, Kakarlapalle	Affects pregnant women more, as beyond the desirable limit methaemoglobinaemia (blue baby syndrome) may take place
Fluoride; mg/l	1.0	Sathupalle, Kakarlapalle, Bethupalle	High fluoride may cause fluorosis (deformation of bone and teeth) in long term
Chloride; mg/l	250	Sathupalle	Beyond this limit, taste and palatability are affected
Total alkalinity; mg/l	200	Jagannathapuram, Sathupalle, Kakarlapalle, Bethupalle	Beyond this limit, taste becomes unpleasant
Calcium; mg/l	75	Sathupalle, Kakarlapalle, Bethupalle	Contributes to hardness of water; palatability decreases
Iron; mg/l	0.3	Sathupalle, Kakarlapalle	Beyond this limit, taste/ appearance are affected, imparts yellowish colour to water on oxidation
Most probable number coliform/total coliform per 100 ml	10	Jagannathapuram, Sathupalle, Kakarlapalle, Bethupalle	Can cause water-borne diseases such as diarrhoea, cholera, typhoid, paratyphoid fever, bacillary dysentery, jaundice, and poliomyelitis
Escerichia coli	Absent	Jagannathapuram, Kakarlapalle,Bethupalle	Causes gastrointestinal disorder and dysentery
Faecal coliform/100 ml	Absent	Jagannathapuram, Sathupalle, Kakarlapalle, Bethupalle	Some water-borne pathogenic diseases include ear infections, dysentery, typhoid fever, viral and bacterial gastroenteritis
Atrazine; µg/l	0.1 (IS 14543:2004)	Bethupalle	Beyond this limit, water becomes toxic
Lead; mg/l	0.05 (IS 10500); 0.01 (WHO guideline	All the villages	Beyond this limit, water becomes toxic
Nickel; mg/l	0.07	Sathupalle, Kakarlapalle	Affects lungs, respiratory system, and causes allergic reaction
Barium	0.7	All the villages	Can cause developmental toxicity, neurotoxicity, reproductive toxicity, and respiratory toxicity

Red: Extremely widespread (> 50 percent samples + > 75 percent villages)
Orange: Moderately widespread (> 50 percent samples + 40–75 percent villages; < 50 percent samples + > 75 percent villages)
Yellow: Thinly widespread (one-time exceedance/ marginal exceedance)

[6] The intake raw water is treated by the plants (as processed water) before it goes into beverage production

(B) In-plant water quality: process water

Test parameter	*Desired value*	*Implications*
pH	6.5–8.5 (as per BIS 10500: 1991; 14543: 2004)	Low pH increases acidity in water, no direct health effects (as per WHO)

Red: Large number of exceedances (> 75 percent)
Orange: Moderate number of exceedances (40–75 percent)
Yellow: One-time exceedance/ marginal exceedance (< 40 percent)

Note: The pH of ultra-pure water in Sathupalle plant can drop a little below 6.5 as it may absorb carbon dioxide (CO2) from the atmosphere during grab sample collection or pH measurement, but this does not mean that the water is now grossly contaminated; just a fraction of a ppm of CO2 will cause the pH to fall. The pH values found in samples range between 6.0 – 6.3 which is possible for reason stated above (ref: American Society of Testing of Materials, ASTM-D 5464-93 (2001)).

(B) In-plant water quality: treated effluent (Treated effluent quality results have been compared to existing PCB [Pollution Control Board] norms for discharge on land for irrigation and TCCC's [The Coca-Cola Company] requirements for discharge into natural waterbodies)

Test parameter	*Permissible value (as per CPCB [Central Pollution Control Board/APPCB [Andhra Pradesh Pollution Control Board] standards)*	*Implications*
Most probable number coliform per 100 ml	–	Can cause water-borne diseases such as diarrohea, cholera, typhoid, paratyphoid fever, bacillary dysentery, jaundice, and poliomyelitis
Faecal coliform per 100 ml	–	Some water-borne pathogenic diseases include ear infections, dysentery, typhoid fever, viral, and bacterial gastroenteritis
Total Kjeldahl nitrogen; mg/l	<5 (TCCC requirements)	Gets oxidized to nitrates and nitrites in presence of oxygen and due to microbial reactions

Red: Large number of exceedances (detected in all rounds) (> 75 percent samples)
Orange: Moderate number of exceedances (40–75 percent samples)
Yellow: One-time exceedance/ marginal exceedance (< 40 percent samples)

Note: a) In absence of any specific individual standards for land application by TCCC, the quality of treated effluent for all the plants has been compared in the table above with the TCCC specific standards for discharge into natural waterbodies.
b) Coliforms (total coliforms, faecal coliforms, and *E.Coli*) have been reported with respect to their presence or absence in each of the three sampling rounds. There are no specific standards prescribed either by the Central/State Pollution Control Board or by TCCC for coliforms in treated wastewater.

Annexe 2.1

Questionnaire for secondary data collection for Coca-Cola plants from CCI

General

1. Plant name and location _____
2. Year of establishment_____
3. Pease provide the flow diagram of the entire manufacturing plant, indicating all water feed and effluent lines along with the flow rates_____
4. Types of products produced_____
5. Number of operating days of the plant and operating hours in a year

	2005-06			2004-05			2003-04		
	Number of Operating days	Operating hours per day	Number of workers	Number of Operating days	Operating hours per day	Number of workers	Number of Operating days	Operating hours per day	Number of workers
April									
May									
June									
July									
August									
September									
October									
November									
December									
January									
February									
March									

Product details

6. Total sales of products in different months over the last five years (Rs/month)

	2005-06					2004-05					2003-04				
	RGB	PET	Water	Juice	Other	RGB	PET	Water	Juice	Other	RGB	PET	Water	Juice	Other
April															
May															
June															
July															
August															
September															
October															
November															
December															
January															
February															
March															

7. Volume of products sold annually in the last three years (in volumetric units like KL or cubic meters)

Size	2005-06				2004-05				2003-04			
	RGB	Water	Juice	Others	RGB	Water	Juice	Others	RGB	Water	Juice	Others
200 ml												
300 ml												
500 ml												
1 l												
5 l												
10 l												
Any other												

8. Installed capacity and actual capacity utilization of the plant

	2005-06					2004-05					2003-04				
	RGB	PET	Water	Juice	Other	RGB	PET	Water	Juice	Other	RGB	PET	Water	Juice	Other
Rated or installed capacity															
Number of lines															
BPM/ MI/ JPH/ CPM															
Utilization capacity															
Number of lines															
BPM/ MI/ JPH/ CPM															

9. Quantity of water required to produce 1 litre of different products produced in the plant _____

	2000	2001	2002	2003	2004	2005	2006
RGB							
PET							
Water							
Other							

Raw water intake: quantity and quality

10. Details of groundwater table fluctuation or ground water draw down in and around plant area over the past 10 years in different seasons

11. Please give the discharge – drawdown details i.e. amount of water withdrawn and changes in water tables observed for your own extraction/ observation wells for the latest year available

	Well 1		Well 2		Well 3		Well 4		Well 5		Well 6	
	pumpage	drawdown	pumpage	drawdown	pumpage	drawdown	pumpage	drawdown	pumpage	drawdown	pumpage	drawdown
April												
May												
June												
July												
August												
September												
October												
November												
December												
January												
February												
March												

12. What are the sources of raw water intake?

13. Number of pumpsets used for pumping raw water _____

14. Average HP of pumpsets?_____

15. Total hours of operation of pumpsets_____

16. Average height of the ground water table

    14.1 Current year_____ 16.2 Two years back_____ 16.3 Five years back_____.

    State any changes that you might have observed ?

17. Quantity of raw water intake daily-average (m3/day)_____

	2005-06					2004-05					2003-04				
	Ground water	Surface water	Municipal water	Any other	Total	Ground water	Surface water	Municipal water	Any other	Total	Ground water	Surface water	Municipal water	Any other	Total
April															
May															
June															
July															
August															
September															
October															
November															
December															
January															
February															
March															

Also please provide actual daily intake for last 3 years. Kindly provide it as a separate annexure.

18. What is the quality of water intake from each source? Attach separate sheets if necessary_____

Process water: Treated water used inside for plant processes

19. What is the process followed in ensuring water quality by treating water intake during production of finished product? Kindly give a schematic of the raw water treatment plant along with unit process specifications for each operation _____

    _____

20. Adherence to discharge norms (national/ international); any benchmarking ?_____

    _____

Please provide the quality of treated water before used into the manufacturing process (attach separate sheets)

Effluent discharge

	Summer months	Winter months	Annually
21. Type and nature of discharge			
22. Number of days of operation of the entire treatment system - full capacity operation days - partial capacity operation days - no operation days			
23. Quantity of discharge - right after the treatment plant - quantity used for any peripheral/ green belt use, if any - quantity finally discharged			
24. Quality of discharge			
25. Point of discharge			
26. Any recycle/ reuse system (brief description)			

Water balance

27. Establish a water balance at the facility level	
28. Please provide a detailed flow diagram of the plant showing water intakes along with pipe diameters and flow amount at various stages of manufacturing	
29. Any efforts for rainwater harvesting	
29.1 Designed capacity/size	
29.2 Operating capacity/size	
29.3 Purpose of rwh	
29.4 Is it mandatory/requirement of PCB/state govt etc?	
30. Any water management/ water reuse/ recycle/ conservation/ efficiency improvement systems in place – where and what is the performance	

Unit of conversion

31. What is the normative capacity of BPM? MI? JPH? CPM?

Supporting documents

Please provide the following documents for the last three years.:

- Sales tax receipts
- Water cess reports
- Consent letters from the pollution control board

Please provide details of villages surrounding the plant. Also include documents related to household survey reports, social assessments, EIA reports etc that have been done in the past (say in last 3-5 years)

Census figures and documents available with the plant for villages surrounding the plant

Progress reports and data on community initiatives taken up by Coca Cola plant

Annexe 2.2

Questionnaire for secondary data collection for the study regions

Name of the Plant and Location: Hindustan Coca-Cola Beverages Pvt Ltd., SP 39-40, RIICO Industrial Area, Kaladhera, Pin 303801

State: …….. District: …….. Tehsil/Taluka: …….. Village: ……..

1. District level [District Administration]			
1.1	**From different departments in the district**		
	1.1.1	Name of the Block where the Plant is located	
	1.1.2	Distance of the Block from District	
	1.1.3	Pl. provide map of the district with reference to the plant location (showing Tehsil/Block/Towns/Village boundaries)	
	1.1.4	Economics and Statistics Office: District Statistical Handbooks for three years: latest, 2001, 1991	
	1.1.5	District Panchayat Office: Information on different programmes	
	1.1.6	District State Tubewell/Canal office: Irrigation charges, average ground water levels, no. of state tubewells	
	1.1.7	District Minor Irrigation Office: Irrigation related and water levels data	
	1.1.8	Jal Nigam: Water supply data	
	1.1.9	Meteorological Department: Monthly rainfall data over the last 30 years	

	1.1.10 Pollution Control Board: Ground water quality data; any studies on water pollution load; water laws (for extraction/ usage, pricing and waste water disposal) applicable for industrial activity	
	1.1.11 State Industrial Development Corporation: Industrial siting policy and parameters considered for siting	
	1.1.12 Local NGOs: Issues and their major activities	
1.2.	**Water related conflicts if any? Public Interest Litigations (PILs) etc.**	
	1.2.1 What kind?	
	1.2.2 Why?	
	1.2.3 Any specific action taken or pending, pl. elaborate	

Annexe 2.2

2. Block Level [From BDO's office]		
2.1.	**Socio-economic data**	
	2.1.1 Map of the block with reference to 5 km radius from the plant location (showing towns/village boundaries)	
	2.1.2 Total pulation of the block	
	2.1.3 Total urban population	
	2.1.4 Total rural population	
	2.1.5 Major occupation at the block level (%): Agriculture:Industry:Services	
	2.1.6 Pl. provide Block level socio-economic published statistics for the recent year, 2001 and 1991	
2.2.	**Plant location and information within 5 km radius from the plant**	
	2.2.1 Is the plant located in an urban or a rural area?	
	2.2.2 Number of towns around the plant	
	2.2.3 Name of the nearest town from the plant	
	2.2.4 Distance from the nearest town	
	2.2.5 Name of the Panchayat/Municipality where the plant is located	
	2.2.6 Number of Nyay Panchayats	
	2.2.7 Number of Gram Panchayats	
	2.2.8 Number of Gram Panchayats under each Naya Panchayat	
	2.2.9 Number of villages under each Gram Panchayat	
	2.2.10 Number of towns in 5 km radius from the plant	
	2.2.11 Major source of drinking water in the area (ground, surface, municipal piped water supply, etc.)	
	2.2.12 Major source of irrigation in the area (ground, surface, municipal piped water supply, etc.)	

	2.2.13 Type of water intensive industries in the block	
2.3.	**Village level information within 5 km radius from the plant**	
	2.3.1 Number of villages and their geographical area	
	2.3.2 Population size in each village	
	2.3.3 Number of households in each village and their occupation status	
	2.3.4 Land use classification for each village	
	2.3.5 Number of hand pumps, wells, pond/tank, tubewells, diesel and electric pumpsets etc. in each village	
	2.3.6 Rabi season: Principal crops grown and area under cultivation: present and 10 years back	
	2.3.7 Kharif season: Principal crops grown and area under cultivation: present and 10 years back	
	2.3.8 Zaid season: Principal crops grown and area under cultivation: present and 10 years back	
	2.3.9 Type and quantity of fertilizers used in different crops	
	2.3.10 Type and quantity of pesticides used in different crops	
	2.3.11 Cropwise water consumption pattern per acre per season	
	2.3.12 Any government run water programmes, like Water and Sanitation, Watershed etc.	
	2.3.13 Average annual rainfall pattern over the last 30 years	
	2.3.14 Average annual Rainfall pattern over the last 30 years	

Annexe 2.2

3. Ground water [State Ground Water Board]		
	3.1 Number of lithologs/ borelogs in the area (with location on a map) – Please attach the strata charts with latitude and longitude and the location details	
	3.2 Number of observation wells for monitoring ground water elevation	
	3.3 Groundwater elevation data (height above the mean sea level) – last 20 - 30 years (time series) – pre- and post-monsoon data (for various observation points marked on a map) – Please attach relevant data.	
	3.4 Aquifer map – hydrogeological map of the area – Please attach the map	
	3.5 Groundwater pumpage and recharge data for the area (time series) for last 20 – 30 years	
	3.6 Groundwater quality data: last 20 – 30 years (time series)- pre- and post-monsoon data (for various observation points marked on a map)	
	3.7 Groundwater withdrawal laws and bylaws	
	3.8 Any analysis of the impact of industrial activities on groundwater situation in the area	

4. Surface water [Department of Water Resources]		
	4.1 Stream flow data (monthly average) for last 20 – 30 years (for a station on the stream with its position marked on a map)	
	4.2 Surface water quality for rivers streams – Please provide the water quality monitoring stations on a map and attach the datasheet.	

Annexe 2.2

5. Lakes/ tanks/ surface irrigation systems [Department of Irrigation]		
	5.1 Live storage of the system (time series) – last 20 – 30 years	
	5.2 Please provide details on storage related parameters – tank size, MRL, designed live storage, sluice gate levels, command area map	
	5.3 Rate of silt deposition	
	5.4 Surface water quality for lakes	
	5.5 Water quality data (for various locations on the stream and marked on a map) - time series for last 20 – 30 years	
	5.6 Any analysis of the impact of industrial activities on water situation in the area including Coca Cola operations	
	5.7 Quality of water – time series for last 20 – 30 years	
	5.8 Any analysis of the impact of industrial activities on water situation including Coca Cola operations	

6. Agriculture [Department of Agriculture and Irrigation]		
	6.1 Types of irrigation systems (ground water, canals, river streams etc.)	
	6.2 Study of agricultural practices in and around plant area:	
	6.2.1 cropping pattern,	
	6.2.2 land use pattern etc	
	6.3 Usage of agricultural input	
	6.3.1 Fertilizer usage (5 years back)	
	6.3.2 Fertilizer usage (present)	
	6.3.3 Pesticide usage (5 years back)	
	6.3.4 Pesticide usage (present)	
	6.4 Irrigation	
	6.4.1 Source (groundwater (shallow, deep, borewell, tubewell), surface water (canal, stream, tanks), traditional water harvesting system, rainfed)	
	6.4.2 Any change in the source in last 5 years	
	6.4.3 Type of irrigation (drip, sprinkler, flood, etc)	
	6.4.3.1 Now	
	6.4.3.2 5 years back	
	6.4.4 Reason for change in irrigation type	
	6.5 Average Crop-water consumption	
	6.5.1 Now	
	6.5.2 5 years back	

	6.6 Change in land use for agriculture in last 5 years	
	6.6.1 Area under cultivation	
	6.6.1.1 Now	
	6.6.1.2 5 years back	
	6.6.2 Yield per unit	
	6.6.2.1 Now	
	6.6.2.2 5 years back	
	6.6.3 Principal crops grown	
	6.6.3.1 Now	
	6.6.3.2 5 years back	
	6.7 Any water conservation/ augmentation practices followed for agriculture. If yes provide a brief	
	6.8 Water scarcity	
	6.8.1 Has there been any scarcity in water availability?	
	6.8.2 If yes, give a brief on when, how long and why?	
	6.8.3 What were the coping mechanisms during scarcity?	
	6.8.4 What did the scarcity impact most on? (irrigation, crops, yield etc)	