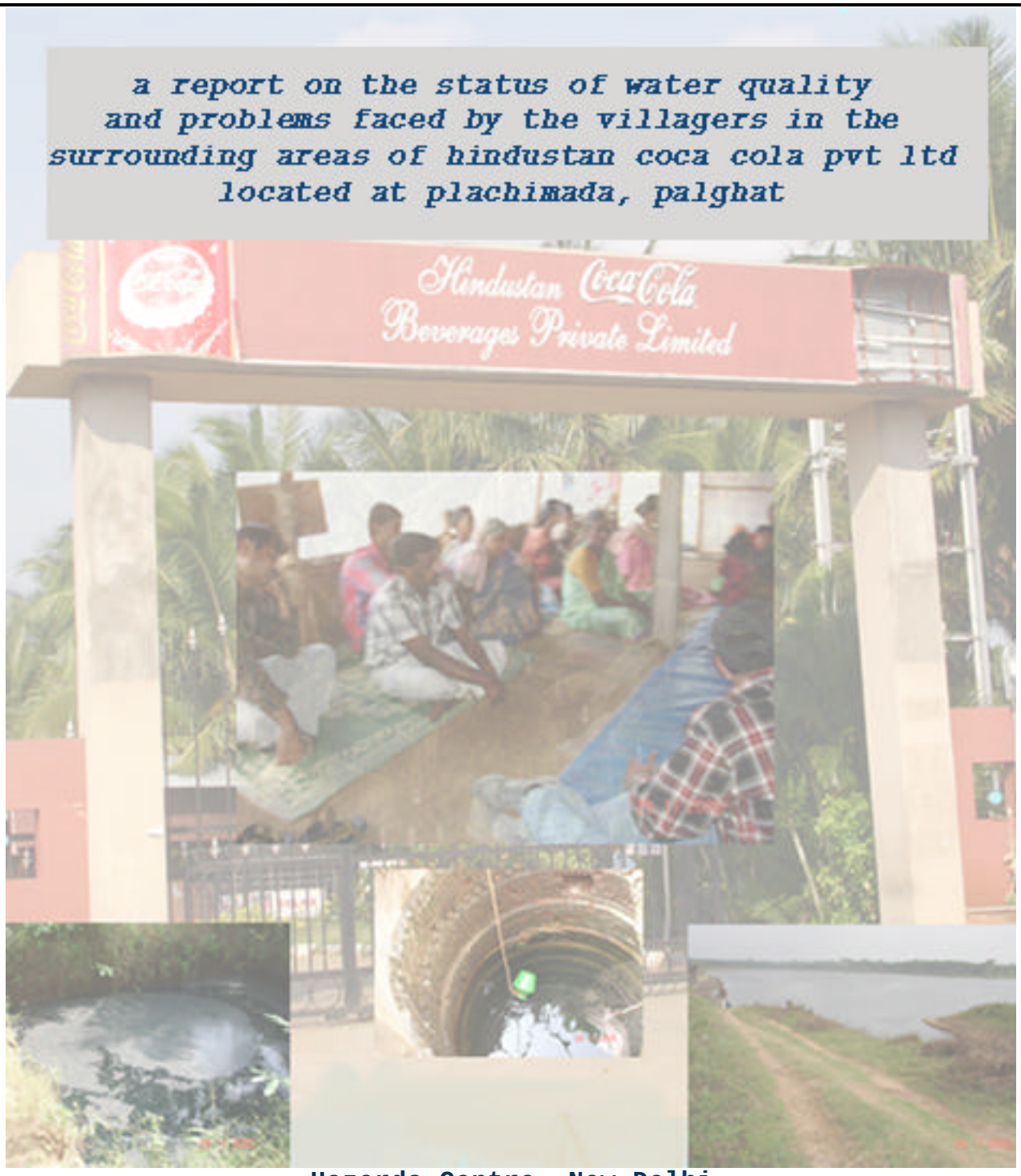
Ground Water Resources in Plachimada
Coca Cola stores toxics for future generations



Hazards Centre, New Delhi
People's Science Institute, Dehradun
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Visit Details:

A joint team from Hazards Centre and People's Science Institute visited the surrounding area of Coca Cola Plant in Plachimada, district-Palakkad on 28th and 29th of Nov'2005. Post-monsoon water samplings were done in the surrounding villages. The team investigated the soil and water environment of the surrounding area and interacted with the villagers to evaluate the post project and pre project environmental as well as health scenario of the villagers of the area.

Water sampling:

Water samples were collected from different ground water sources including bore wells, hand pumps and open wells. The sampling sites were selected depending on their spatial distribution including both affected and unaffected sources. Electrical conductivity and pH was measured for all the samples and dissolved oxygen was estimated for the surface water source at the site of collection.

SAMPLE DETAILS:

Water Sample (1): Water was collected from an open well in Dhanraj's farm, Tottichelli village. The surface area of the well was 3m x 3m and the water level was 1.5m from the ground level. Blackish oily film was observed on the water surface. Banana, coconut trees and various species of herbs were observed in the surrounding area of the well. Distance from the plant is approximately 700m. The water is used for irrigation.

Open well from which sample (1) was collected.

Water Sample (2): The open well is located in a backyard of a household and surrounded with paddy and cowshed in Plachimada colony. It is at a distance of 400m from the plant. Water is used for drinking purpose.

Water Sample (3): The well is located in an open area of Perumatti panchayat in Vijaynagar Colony. It is about 100m from the premises of the plant, towards the eastern direction. At present the water is not used for drinking but used for other domestic purposes.

Water Sample (4): The water was collected from an open well in Debraj's house, Plachimada village. The distance of the site from the factory is approximately 70m. Water was used for drinking purpose before the Coca Cola factory was started. The taste of this bore well water was not good.

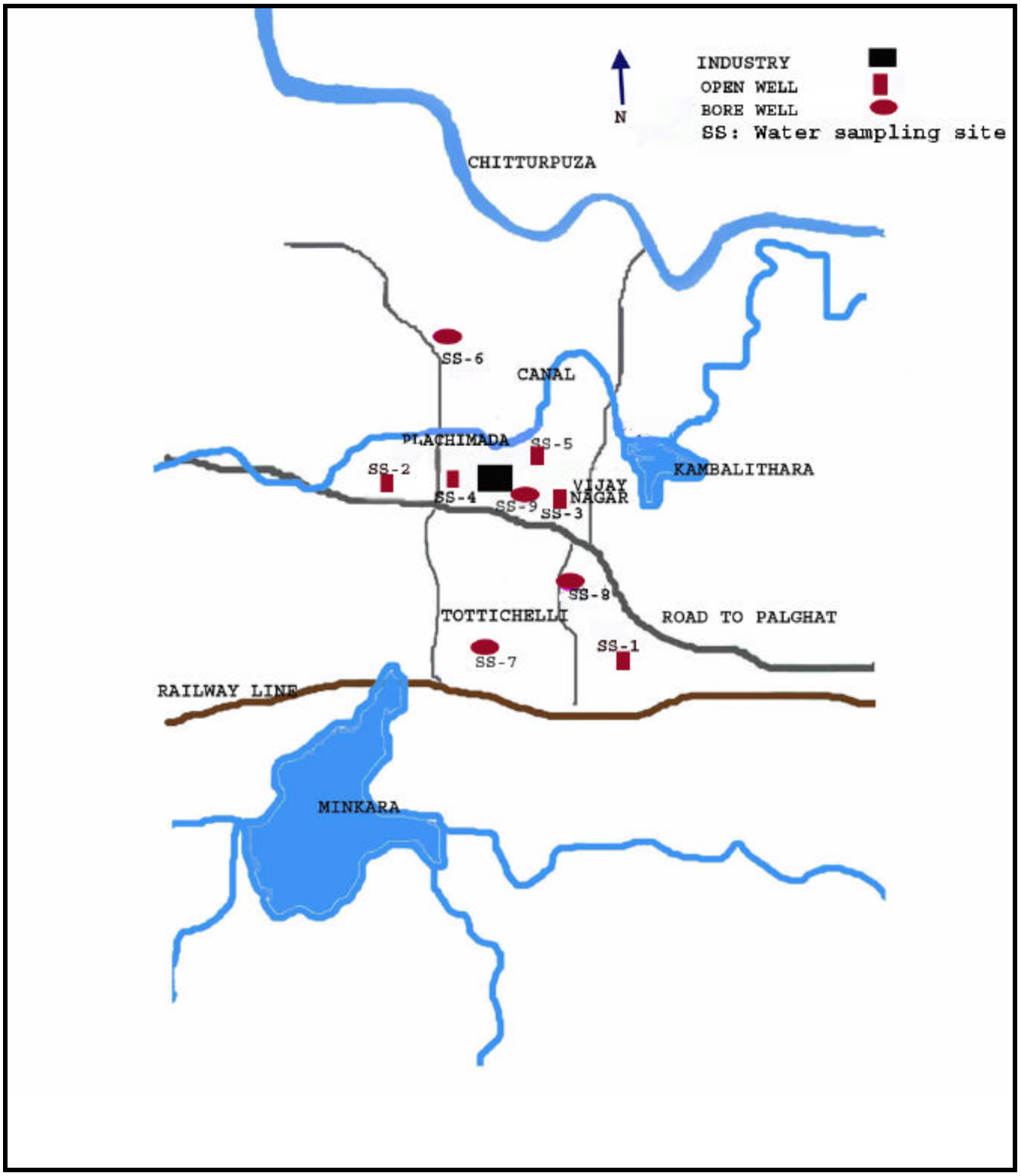
Water Sample (5): The open well is located in Krishnaswamy's farm, Kambalithara and is dominantly surrounded by coconut trees. There were some small fishes in the well. The well is approximately 15m from the boundary wall of the plant. The water is used for irrigation.

Water Sample (6): Description: The bore well of depth 40ft is located in a farm of trees like Areca, Mango, Jackfruit, coconut etc. in Plachimada village. Water was collected from a tap in the bathroom.

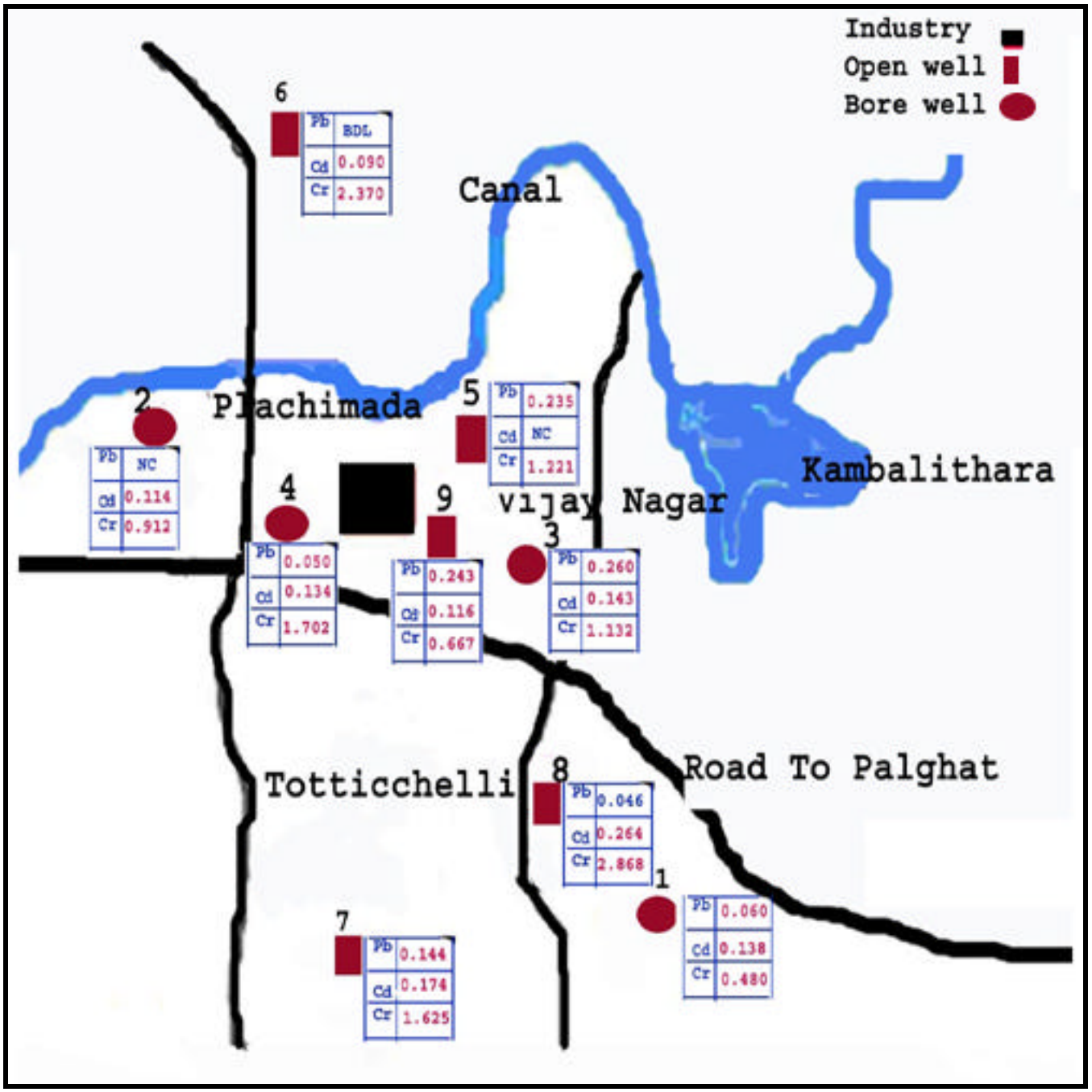
Water Sample (7): Water was collected from a bore well of depth 300ft in Tottichelli village which is located at a distance of 750m from the factory premises. Water of the borewell is used for all purposes.

Water Sample (8): The hand pump is located on the roadside in Tottichelli village, which is at a distance of 500 m from the plant. The depth of the hand pump is more than 75m.

Water Sample (9): The bore well is located in a backyard farm of Natrarajan in Vijaynagar colony and the sample was collected from a tap 60-70m from the boring. The bore well is just 10m from the boundary wall of the factory and has a depth of 115m. Water is used for drinking and irrigation.



Map showing the water sampling sites in the surrounding areas of Coca Cola Plant located at Plachimada, Palghat district in Kerala.



Map showing heavy metals (Lead, Cadmium and Chromium) concentrations (in ppm) in water samples collected from the surrounding areas of Coca Cola Factory at Plachimada, Palghat

Water sample analysis results: (analysis was done in PSI lab)

Sample number	Source, location	Distance	Parameters (pink coloured values are above permissible value)					
			pH	EC	Total Fe	Pb	Cd	Cr
(1)	Open Well, Tottichelli	700m	8.1	860	0.024	0.060	0.138	0.480
(2)	Open well, Plachimada Colony	400m	8	1023	0.090	NC	0.114	0.912
(3)	Open well, Vijaynagar	100m	7.8	865	0.196	0.260	0.143	1.132
(4)	Open well, Plachimada Colony	50m	8.6	2800	-	0.050	0.134	1.702
(5)	Open well, Kambalithara	15m	7.7	967	0.018	0.235	NC	1.221
(6)	Bore well, Plachimada village (40ft)	750m	7.6	1439	-	BDL	0.090	2.370
(7)	Bore well, Tottichelli (300ft)	750m	8.2	1106	0.027	0.144	0.174	1.625
(8)	Hand pump, Tottichelli (250ft)	500m	8.5	956	6.284	0.046	0.264	2.868
(9)	Bore well, Vijaynagar (380ft)	10m	9	1958	0.109	0.243	0.116	0.667

NC: Not completed (Sample needs further treatment and digestion for the particular parameter), BDL: Below detectable limit

Notes: 1. pH and Electrical Conductivity was measured on-site.

2. Lead and Cadmium concentration in water was measured by using the Air-Acetylene flame Atomic Absorption Spectrometer method**.**

3. Total Iron was measured by the 1,10 Phenanthroline method using the Visible range spectrophotometer.

Results and discussion:

[Background: M/s Hindustan Coca-Cola beverages Private Ltd. applied for consent of the Board in June 1999 to establish a factory on a 31 acre plot at Plachimada in Palakkad district for manufacturing 5,61,000 litres of soft drinks (Coca Cola, Limca, Fanta, Thums Up, Sprite, Kinley soda and Maaza) per day. The raw materials include 15,00,000 litres of water, soft drink concentrate, carbon dioxide, sugar, mango pulp, preservatives, water treatment chemicals, etc. The factory was discharging more than 8,00,000 litres of water per day and provided the sludge to the villagers to use as fertilizers, as those are not considered to be hazardous waste under Hazardous Waste Rule, 1989.]

Presence of heavy metals in the samples:

Samples from open wells: Total 5 samples were collected from 5 different open wells. The open wells are fed by the shallow aquifers and the chances of getting contaminated from surface runoff and sub-surface movement of pollutants is very easy. The concentrations of Cr show a clear trend of increasing concentrations with the decrease of distance from the plant. All the samples contain Cr above permissible limit (ie. 0.05mg/l). All the 4 samples analysed for Cd and Pb show their concentrations above 0.01mg/l and 0.05mg/l respectively, which are the permissible limit for drinking water quality as prescribed by BIS. Though the sample no-7 is at a distance of 700m from the factory, the contamination may be because of the use of sludge as fertilizers in that area.

Samples from bore well: Bore wells yield water from the deeper aquifer systems depending on their depths. Though contamination of bore well water from surface pollutants depends on the distance from the source of pollution but the key factor is the depth from which the well is withdrawing water. Lithological composition determines the infiltration and percolation rates thus influences the rate at which pollutants sink into the well water. The results of Cr concentrations in the 4 bore well samples are above the permissible limit and the concentrations vary with the depth of the bore wells (lowest depth ie.40ft has highest concentration of 2.370mg/l). This indicates that the contaminants have been leaching towards deep aquifers also. All

the bore well samples have Cd concentration above permissible limit and 2 of those samples have Pb concentration above permissible limit.

Contaminants in groundwater meet their ultimate fate in the confined aquifers, which are generally considered as the clean water sources. It is seen from the results that the bore well samples have more concentration of heavy metals than the open well samples which are shallower part of groundwater. It may be concluded that the contaminants have leached into the deep aquifer systems and polluted the groundwater, which meet the major part of water need of the villagers.

The results depict that the total natural water sources surrounding the Coca Cola Plant in Plachimada are contaminated. All the groundwater samples within 1 km radius analysed were found contaminated. One sample contains pH above permissible limit and is unfit to be used for drinking purposes. Though electrical conductivity doesn't have a standard for drinking water quality, it indicates the presence of ions and thus the extent of chemical contamination. The samples at a distance of less than 100m from the factory show high level of conductivity.

Pb, Cr and Cd are not anticipated in industries like soft drink production, and there is no standard mentioned in the Environmental Protection Act 1986 for these chemicals discharged by this type of industry. The results show that Pb, Cr and Cd contamination is present in the samples collected from more than 700m distances. Samples were collected from the Tottichelli village where the sludge of the factory was used as fertilizer. Both the samples collected from this area show high Cd, Cr and Pb concentrations. So the processes of soft drink manufacturing, which are not considered as the user of these metals in their processes, is questionable as these metals are detected above permissible limit in each and every type of water sources in the area.

Effects on Human Health:

Cadmium, Chromium and Lead: All chemicals have adverse effects on human health above a certain level of exposure. Some elements like Cu and Zn are essential for

human health and human can consume a comparatively more dose of those chemicals than the elements, which are not necessary for human survival. Cd and Pb are not essential elements and very low concentration those are harmful to human health. The routes of entry to body also play an important rule in determining the target organs and extent of hazards.

Presence of Cd and Pb in water samples will get easy way to human body. If human does not consume the contaminated water, the hazardous chemicals will enter human body through food chain and will be biomagnified, which will become more precarious in long run. Ingestion effects of Cd are more severe than the inhalation effects.

Effects of Cd: Humans generally have a daily intake of cadmium from ingestion and inhalation, which is around 20 to 40 µg per day, but only 5 to 10% of this is absorbed. It is taken up by the liver, and, due to its similarity to zinc, causes this organ to induce the synthesis of the protein metallotheionin to which it binds. The cadmium-metallotheionin complex then becomes transported to the kidneys. In chronic exposure, it also accumulates in the body, particularly in the kidneys and the liver. Short-term effects include nausea, vomiting, diarrhoea, muscle cramps, salivation, sensory disturbances, liver injury, convulsions, shock and renal failure. Long-term exposure to Cd has the potential to cause effects like kidney dysfunction, damage to bone, and liver and blood.

Effects of Pb: Pb is easily up taken by green leafy vegetables and thus enter the food web and reach Severe poisonings are indicated by the presence of convulsions and coma, and death may result from generalised cerebral oedema or from renal failure. Young children are particularly affected by lead poisonings as they absorb greater amounts from the GI tract. Severe poisoning results in mental retardation, and selective deficits in language, cognitive function, balance, and effects on behaviour and school performance. Human organs and systems vulnerable to Pb poisoning are Central Nervous System, Kidney, Blood and cardiovascular system.

Effects of Cr: Chromium is an essential nutrient in the human diet, possibly involved in sugar metabolism. But chromium in overdose is toxic to human health.

High doses of chromium cause skin, eye and mucous membrane irritation. If the exposure is short-term at a high level, then irritation and ulcers develop at the site of

contact. It also has adverse effects on the kidneys and liver. Chromium is a likely carcinogen, particularly of the lungs.

Iron: Tough iron is an essential element, ingestion of iron above the permissible limit cause many gastrointestinal disturbances with symptoms vomiting, diarrhoea and abdominal pain. Prolonged intake of high dose causes liver damage, kidney failure etc.

Outcomes of the community interaction:

A meeting was held with the nearby village community. The experience of the community in the pre and post project periods as articulated by them can be summarised as:

Community people briefing their problems

- There was no problem with the quality and quantity of water in the pre project time. After 6 months of establishment of the Coca Cola plant they noticed deterioration of water quality with observable differences like taste, odour, colour etc. There was no visible change of water level in the open wells in the surrounding area. Various health problems like abdominal discomfort, drowsiness, convulsions, fatigue and headache were seen among the villagers. The food prepared with that water decayed soon and the cooking took prolonged time.
- The dominant wind direction in the area is from east to west. People residing in the north-west direction within 500 meters stated that there was bad smell coming from the industry side for the whole day while the factory was running.
- The yield of paddy decreased approximately 50%, growth of coconut plants retarded and size of the coconuts became smaller.

- Farmers had itching in limbs while they were working in the fields where sludge was used as fertilizer. Cases of mental retardation, bleeding from nose, patches on skin in children were noticed. Spontaneous abortion and stillbirths were noticed among the women.
- Workers working in the plant suffered from headache, drowsiness.
- Three types of solid wastes were dumped near Kambalathara reservoir during the operation of the Coca Cola Plant. One type was paste like, clay coloured and one type was dry and yellow coloured. All the wastes had foul odour. Waste was loaded in trucks and transported to the fields and somewhere else. Wastewater was treated and reused in the maintenance of the garden and there was rumour of putting waste underground inside the plant premise.
- After closure of the factory in 2004, there was no visible change in terms of quality of water, crop productivity and health.

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