CSE study on pollution of Bandi river by textile industries in Pali town

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Contents

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A. Background

This paper is the result of a study conducted at the request of Sri Kisan Paryavaran Sangarsh Samiti, which is spearheading the cause of the farmers against the pollution of the Bandi river and groundwater in and around the town of Pali, by textile dyeing and printing industries. The Samiti, formed in 2004 has members drawn from around 50 villages in and around Pali.

The key issue of concern is that the textile printing and dyeing industries located in Pali town are discharging industrial effluents into the river Bandi, a non-perennial river with no flow in the lean season, thus severely contaminating both the river as well as the groundwater. There are more than eight hundred textile units in the city. Effluents from Pali flow about 55 km downstream, making the groundwater in several riverbank villages unfit for irrigation or drinking.

Pali is one of the critically polluted areas identified by the Central Pollution Control Board in 1998. The industries here discharge a variety of chemicals, dyes, acids and alkalis besides heavy metals and other toxic compounds. Textile dyes are toxic, highly stable and do not degrade easily and are not removed by conventional wastewater treatment methods.[1] According to a survey conducted by the Central Groundwater Board in 2004, the groundwater has turned alkaline and total dissolved solids, chloride, sulphate, sodium are very high in the groundwater rendering wells in the area unfit for drinking and even for irrigation. The soil in this area has also become hard and unfertile. In many sites heavy metals were also found[2].

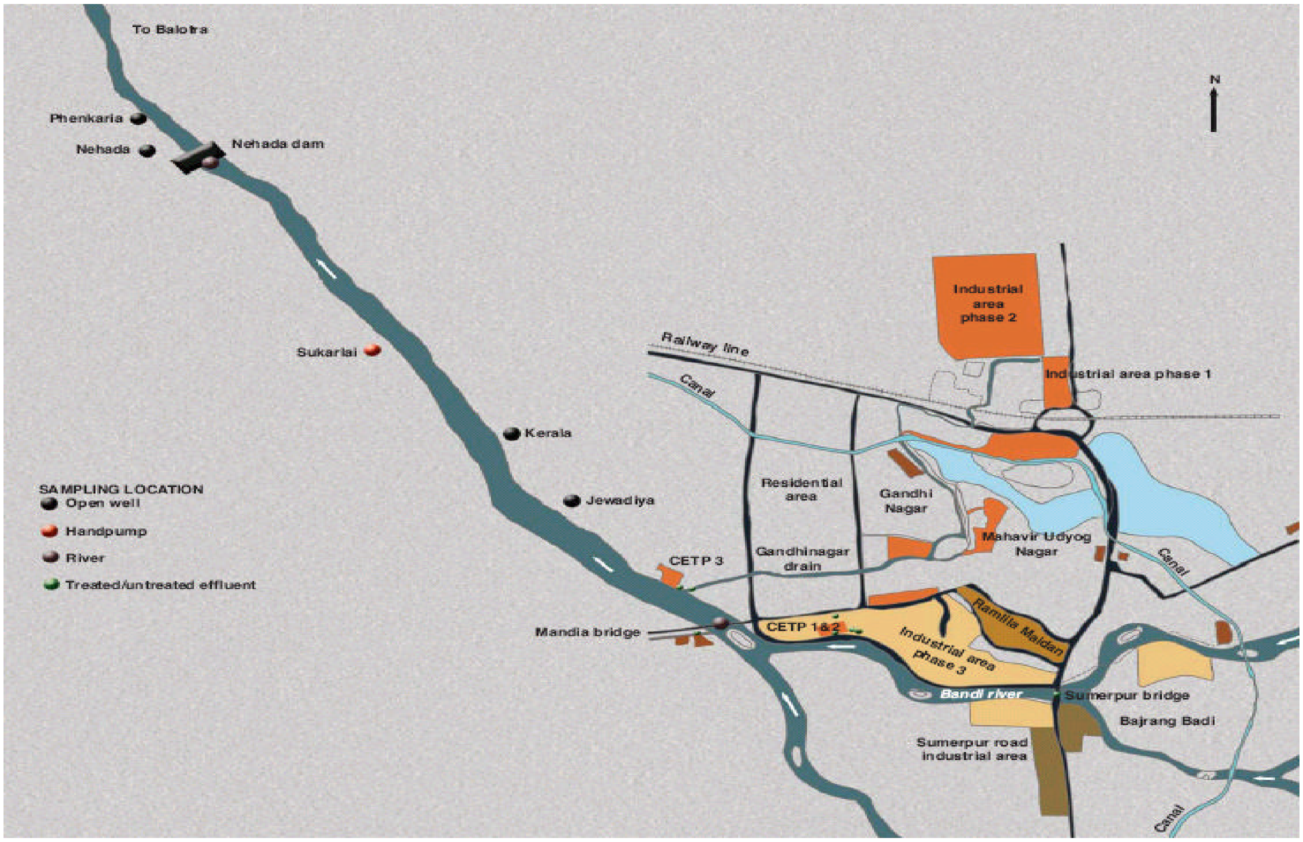
According to the Rajasthan State Pollution Control Board (RSPCB) these units discharge approximately 34 million litres per day (mld) today.[3] Since 1983, three common effluent treatment plants (CETPs) with a capacity to treat 22.5 mld of industrial effluent have been installed at the cost of Rs 8.13 crore. There are two units located at the Mandia road industrial area (CETP I and CETP II). These two CETPs receive wastewater from the Mandia road industrial area and the 130 units located at industrial area Phase I, Phase II, Mahaveer Udyog Nagar and Maharaja Shree Umaid mill and are connected to CETP III at Punayata Road.[4]

The CETPs are managed and maintained by the Pali Water Pollution Control Research Foundation (PWPCRF) Trust, which is one of the very first co-operative pollution control measures in the country, and initiated by the industry itself. To run these plants, a pollution cess is levied on all industries. [a]

[a] A pollution cess of Rs. 65 per bale/100 kg cloth is levied and an average of Rs. 35 lakh per month is paid to the district administration. The cost of effluent treatment by the plants works out to Rs 67/1000 litre of industrial effluent. There is a proposal to increase the pollution cess to Rs 90 per bale.

CSE staff visited the city and met officials from the pollution control board, industrialists other government officials. CSE staff also visited several villages along the river, downstream of Pali and met with farmers and common people to get a firsthand understanding of the problems of the farmers. CSE staff took samples of water from several points, ranging from CETPs, drains from industries, wells and hand pumps in villages downstream. These samples were tested for heavy metals in the CSE pollution monitoring laboratory.

Map 1: Pali: its river, drains and villages, from where samples were collected



B. What we have found

1. Currently less than 45 per cent of the generated effluents are treated before disposal into the river.

Based on the data provided by the state pollution control board, industries discharge 34 mld into the Bandi river. The existing capacity of the three CETPs is 22.5 mld. If the CETPs were working at full capacity, these would treat roughly 66 per cent of the generated waste. However, currently, the CETPs operate at only 70% of their full capacity.

Table 1: Capacity utilisation at the three Pali CETPs (September 2004-August 2005)

CETP	Volume of effluent treated (mld)	Percentage of capacity utilised
CETP I	4.65	87
CETP II	5.12	63
CETP III	4.62	51
Total	14.39	67

Source: Compiled from CETP analysis report of the PWPCRF Trust during 2004-05

In other words, even assuming that the CETPs were designed and operated to treat the effluents before discharge into the dry river, the fact is that at the current rate, the 3 plants treat only 42 per cent of the generated effluent of the city. As much as 20 million litres per day is discharged untreated into the river.

The reasons for this are as follows:

a. **Inadequate and poorly maintained system to convey waste**: There is no sewerage system in Pali to convey the entire waste to the treatment plants. There are only lined (Gandhinagar drain) or unlined drains that carry waste which are at places connected through pipes to the CETPs. For instance, the drain near Sumerpur bridge and the one near Parvati textiles lead to wastewater sumps, which are in turn connected through pipelines to the CETP inlet. However, the sumps as well as the pipelines are broken and thus leaking waste into the river.

b. **Industries are not connected to the treatment plants**: Currently, there is no system to connect the unregulated industries to the common effluent treatment plant. According to RSPCB, out of the 860 textile units in Pali, 193 are not functional as on date and 151 industrial units are not connected to CETPs. These industries discharge the waste to the drains and to the river.

2. The faulty design of the inlets to the CETPs means that there is no guarantee that even the 14.4 mld of waste is actually conveyed and treated

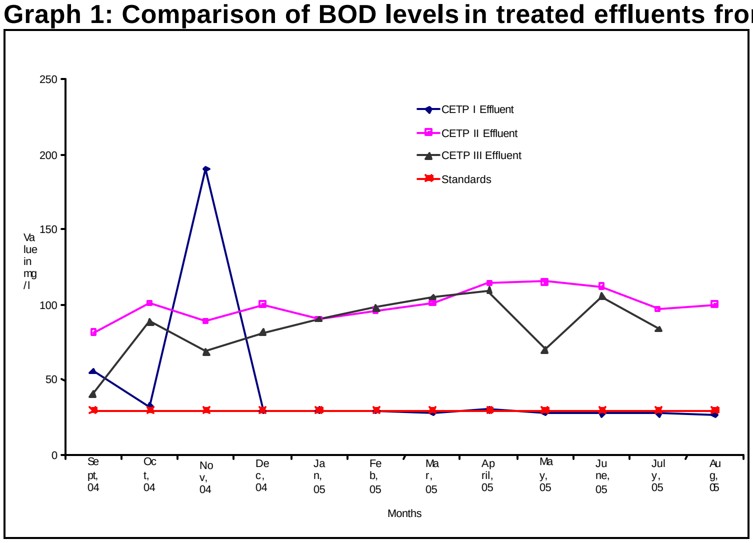
The design of the inlet is such that it allows untreated waste to be bypassed into the river without being treated. For instance, at CETP III, effluent goes into the treatment plant through a gated intake point and a check-dam. However, the inlet is so poorly designed that whether the CETP works or not, untreated waste always find its way easily into the river. Again at the Mandia Road CETP, the inlet has a gate towards the river, allowing untreated waste to be bypassed, as happens whenever there is a power shut down for load shedding.

Figure: Gandhinagar drain being partially tapped into CETP III and rest bypassed

3. Even if all the waste is conveyed to the treatment plant, the efficiency of treatment is very poor

a. **Analysis of BOD values:** Analysis of the data provided by CETP officials for September 2004-August 2005 shows that the BOD, COD and TSS values of the CETP II and CETP III are much higher than the norms set by the RSPCB. The tables given below show that the BOD values were in the range of 80-110 mg/l in CETP II and 40-110 mg/l in CETP III as against the norm of 30mg/l. This means the BOD values are between 2.5 to 4 times the norm in both these CETPs. However, average BOD values in treated effluents at the CETP I was within 30 mg/l except for the month of September and November 2004.

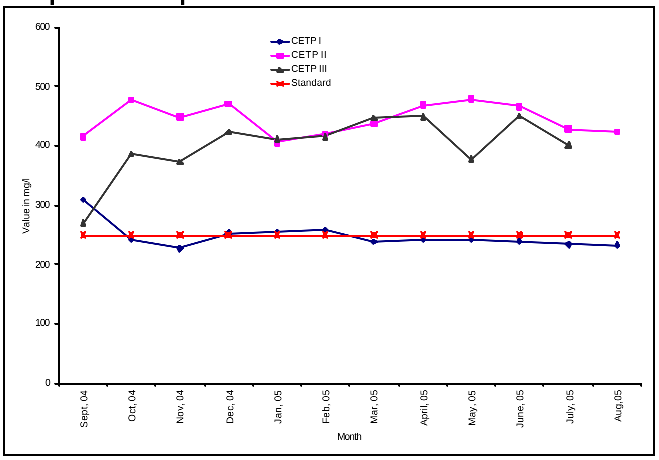
Graph 1: Comparison of BOD levels in treated effluents from CETPs



Source: Compiled from CETP analysis report of the PWPCRF Trust during 2004-05

b. **Analysis of COD values**: COD values were in the range of 420-480 mg/l in CETP II and 270-450 mg/l in CETP III as against the norm of 250mg/l. The COD values were above the norms by 1.1-2.0 times in these CETPs. Again, CETP I was found to release effluents with COD in the range of 226-310 mg/l, mostly within the norms.

Graph 2: Comparison of COD levels in treated effluents from CETPs



Source: Compiled from CETP analysis report of the PWPCRF Trust during 2004-05

As you can see the BOD levels are higher than norms even when the plant is operating below capacity. In other words, not only do the CETPs treat less than half the waste generated, but the CETPs do not treat this waste adequately. The BOD limit met by the CETP could go high as 100 mg/l, which is much above the standard of 30 mg/l for discharge into a flowing water body.

Why is CETP I better than the rest?

The PWPCRF Trust explains the difference in performance due to the fact that fixed aerators are better in performance over floating aerators. Fixed aerators achieve better aeration and are easier to operate. The CETP II and III have floating aerators, perhaps due to the fact that floating aerators are more cost effective. However, their operation needs to be carefully controlled in order to get a good performance. Moreover, the CETP I has been designed to handle higher concentrations of BOD and COD.

Why are the CETPs not functioning optimally?

1. **Outdated technologies and poor maintenance:** The CETPs are operating on outdated technologies. At present, the CETPs are based on physico-chemical treatment followed by extended aeration and sedimentation. Lime, ferrous sulphate and polyelectrolyte are added to flocculate and coagulate the contaminants and finally these pollutants are trapped in sludge which is dried and disposed off in the nearby areas unscientifically. The only difference between CETP II and III and CETP I is the type of aerators. CETP II and III are fitted with floating aerators as compared to fixed aerator in CETP I. This technology is different from that adopted in CETPs operating in Delhi where dual media filters and activated carbon are used to remove organic and heavy metal pollution in industrial waste. The overall maintenance is also poor and most of the civil and mechanical infrastructure is in a bad state. Similarly there is no system available

at CETP III to monitor and regulate the dosage of chemicals. It was also found that none of the CETPs have a power back up and hence at least 4 hours a day it remains non-functional.

What does the PWPCRF Trust say?
However, the PWPCRF Trust says that one of the main reasons for the failure of the CETPS in treating the waste adequately is the fact that the textile industry has recently changed its processing technologies, moving from processing cottons to synthetics and the nature of the dyes used, moving from alkaline dyes to acid and azo dyes. The CETPs, originally designed for alkaline dye removal, have not kept pace with this change and are thus unable to treat the wastewater effectively.

But an analysis of data during September 2004- August 2005, showed that;

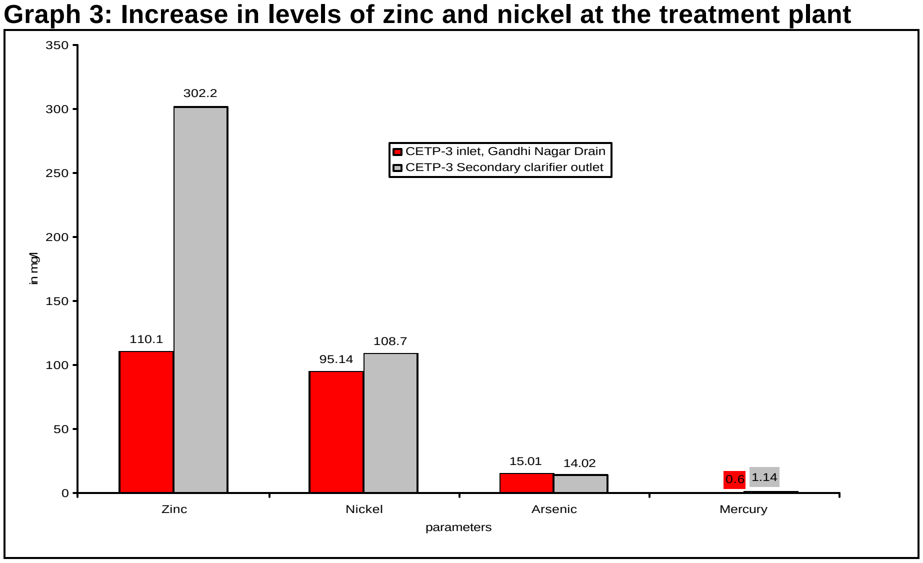
- ♣ Influent pH was found to be well within design limits in all CETPs;
- ♣ Influent BOD values were well within the design limits in CETP I;

Influent values were not within limits in CETP II and III because the design values were fixed lower than for CETP I based on a pre feasibility study by the National Environmental Engineering Research Institute (NEERI), Nagpur.

4. CETPs are not designed to treat the key pollutant, which is present in the waste namely heavy metals.

Considering that textile industrial effluents are known to have toxic organic chemicals and metals like chromium, mercury and copper, they need to be properly treated at the CETP. Whereas, the CETPs in Pali have not been designed to monitor or treat heavy metals before they are let into the river. CSE also collected groundwater samples from villages of Jewadiya, Kerla, Sukarlai, Nehada dam and Phikaria village. (See map: location of sample wells/handpumps)

Graph 3: Increase in levels of zinc and nickel at the treatment plant



Source: Pollution Monitoring Lab, CSE, New Delhi, April 2006

CSE's analysis shows that there is an increase in concentration of zinc (174 per cent) and nickel (14 per cent) and mercury by 90 per cent in the effluent of the CETP III as compared to the influents. This is because there is no treatment process for heavy metals and it is clear that heavy metal contamination is leaching from the accumulated sludge into the effluent.

5. Even if all treatment is done, the standards for discharge are too lax as these have been designed for discharge of effluents into a flowing water body, not into a dry and seasonal river like Bandi

The standard setting mechanism for discharge of industrial effluents set by the Central Pollution Control Board is meant for discharge into surface water where further dilution of the treated waste would take place. However, in the case of Pali, the Bandi river is a non-perennial river, which gets water only during the rains. Therefore, during the rest of the year, the river becomes a river of industrial effluent, directly polluting the groundwater table. As the CETPs are working towards the norms set by CPCB, there is an urgent need to revise the norms taking into account this issue.

6. There is a lack of data, which impedes further action on policy design and implementation

There is no accurate data available on the present water consumption, wastewater generation and quality of industrial effluents generated from the industries. The data on wastewater generation provided by the RSPCB is 34.5 mld in 2005, which is hardly 3 mld higher than what was estimated by the Central Pollution Control Board in 1991[5].

According to a NEERI study (1993)[6], there are ten drains that crisscross the city and scavenge all the waste into the river. There is neither sewerage nor treatment system for domestic sewage. As a result part of sewage travels through Gandhinagar drain and gets into the CETPs, whereas the rest flow various drains into the river. (Map: Drainage system of Pali). Most of the drains end up directly in the river, whereas others are tapped into the CETP.

7. Long term and persistent contamination has lead to the extensive poisoning of groundwater in the area

CSE monitored the heavy metal contamination in the river up to Nehada dam, 50 km downstream of the town. It also tested samples from wells and handpumps in the villages of Jewadiya, Kerla, Sukarlai, Nehada and Phikaria along the river. The aim of the study was to see if the river and groundwater were contaminated with heavy metals and if so, how widespread was the contamination.

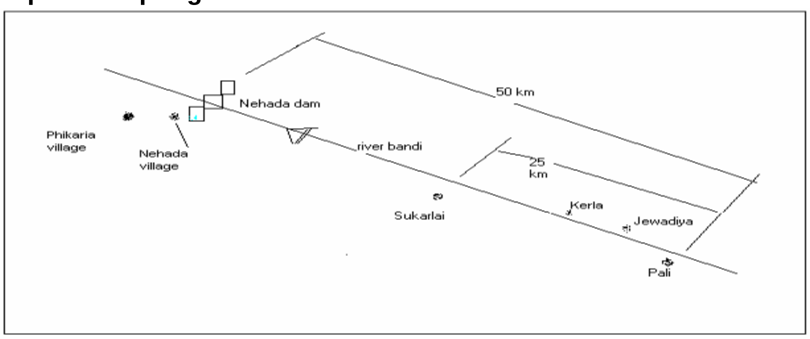
a. **River water**: CSE took samples of river water from Mandia road bridge and from Nehada dam, 50 km downstream and tested for heavy metals. As can be seen from the table below, river water samples show presence of heavy metals even at Nehada. The Central Pollution Control Board has not specified any standard for heavy metals in river water, except for boron, for various uses. This therefore means that the standard is zero for heavy metals in river water and thus, any amount of heavy metal found in the river water is a violation of the standard.

Table 2: Heavy metal pollution profile of the river

Metals	Date	Copper ppm	Zinc ppm	Lead ppm	Nickel ppm	Cromium ppm	Cadmium ppm	Arsenic ppm
River water quality criteria of CPCB		Not specified						
River Bandi at Mandia Road Bridge	Nov 05	0.52	0.18	0.04	0.1	0.26	ND	0.05
River Bandi at Nehada dam (50 km downstream from Pali town)	Nov 05	0.24	0.15	0.04	0.21	0.16	ND	0.12

Note: ND- Not detected; Source: Pollution Monitoring Lab, CSE, New Delhi, April 2006

Map 2: Sampling locations



b. Groundwater: CSE found heavy metals in all samples and compared it with Bureau of Indian Standards(BIS) specifications for drinking water, IS 10500:1991. As you can see from the table below, copper is above the drinking water standards in all the wells; Lead is high in Kerla, Sukarlai and Jewadiya; chromium level is high in Kerla, Sukarlai and Phikaria; arsenic is high in Jewadiya, Kerla and Phikaria. Nickel, for which there is no standard, was detected in all villages.

Table 3: Heavy metal pollution in groundwater in select villages around Pali

	Date	Copper ppm	Zinc ppm	Lead ppm	Nickel ppm	Cromium ppm	Cadmium ppm	Arsenic ppm
Drinking water standards		**0.05**	**5**	**0.05**	**No standard**	**0.05**	**0.01**	**0.1**
JEWADIYA	Nov-05	**0.17**	0.07	0.03	**0.25**	0.04	ND	**0.28**
KERLA	Nov-05	**0.5**	0.12	**0.56**	**1.42**	**0.11**	0.01	**0.49**
SUKARLAI	Nov-05	**0.05**	**22.16**	**0.08**	**0.78**	**0.27**	ND	0.003
NEHADA	Nov-05	**0.07**	0.02	**0.08**	**0.16**	0.03	ND	0.01
PHIKARIA	Nov-05	**0.13**	0.03	0.02	**0.22**	**0.05**	ND	**0.13**

Note: ND-Not detected
Source: Pollution Monitoring Lab, CSE, New Delhi, April 2006

C. What needs to be done?

It is clear that the situation in Pali is bad and its impact on the surrounding villages and people is clearly devastating. The key findings are:

a. The currently installed CETPs are not designed to treat all the waste generated;
b. Worse, these plants treat less than what they are designed for;
c. There is no guarantee that the waste is diverted for treatment as the inlet is designed for bypass;
d. Even if the waste is treated at capacity, the plants do not work effectively as the effluent is above standard in most cases;
e. The plants are not even designed to treat heavy metal contamination;
f. Even if all the above was fixed, the problem is that Bandi is a dry river and the standards for discharge have been designed for a river with dilution. In other words, the effluents from the effluent treatment plants, will have to be substantially cleaner in this case.
g. The Nehada dam built for storing water, has now become a storage point for industrial effluent and is thus directly leading to groundwater contamination.

In this scenario, the following has to be done urgently:

Action 1. Divert and treat all waste from the drains in the CETPs
Currently, the plants operate at roughly 70 per cent efficiency. Also as stated above, the inlet is designed for bypass. It is imperative that firstly, the inlet is redesigned so that the bypass is not possible. Secondly, the plants are operated at 100 per cent capacity. Ensure that meters are fixed at the inlets and outlets to check on the quantity treated.

Action 2: Monitor the effluents at the inlet and outlet of each CETP on regular intervals.
It is clear that whatever the plant that is designed, it must be operated. The city and pollution control authorities have to enforce this stringently and take punitive actions. If the CETP is not meeting the laid down standards for discharge, penalties must be imposed and strictest action taken.

Action 3: Redesign (not just upgrade) the CETP so that it can treat chemical including heavy metal contamination.
CSE has reviewed the plan for upgrading the CETPs[b], which is being undertaken by the industry association. It is clear that this plan will only spend more money and it will be

[b] The key drawbacks of this new Rs 21 crore upgradation project are:

a. No pre-treatability studies have been conducted. The design parameters for which upgradation is done is limited to BOD, COD, TSS, pH and oil and grease;
b. The upgradation is to accommodate higher levels of incoming pollutants listed above and does not look at cleaning the effluents to a much better quality than what it does now or to better quality than the prescribed discharge standards. The whole upgradation scheme is about building equalisation tank and enhancing aeration. Once the new system is in place, the treatment cost will be Rs 9.5 per kl as compared to the present cost of Rs 6-7 /kl. Even after spending a huge capital and O&M cost, the CETP will not be able to remove all pollutants.
c. Even after upgrading there is no guarantee that the CETPs will be fully utilised. This necessitates a plan for optimal capacity utilisation of al CETPs and has to be an integral part of the upgradation plan.
d. Reuse of treated effluents: Although the tender invitation document for upgradation mentioned about a 5 mld pilot reuse plant, no such plan seems to be under way. Given the water stress in the

more money down the drain. This is because the plan does not even begin to take into account the need to treat chemical and heavy metal contamination. This has to be seriously worked upon.

Action 4: Based on the redesign, ensure that the CETP is upgraded in capacity, so that it can treat the complete waste from the effluent drain.

Action 5: Treat wastewater to such levels that it can be reused by the industry itself.
It is clear that the river does not have the assimilative capacity for diluting waste, even if it is discharged at the stipulated standards. It is also clear that Pali town faces an acute water shortage. Industry representatives informed CSE that they were forced to buy water or to extract groundwater, which is depleting each year. During CSE team's visit to the industrial area, it was learnt that groundwater is bought by industries from as far away as 30 km downstream at Rs. 50 per kilolitre (kl). Also, larger industries spend as much as Rs. 40 lakh per year in just buying water. The answer will be in finding treatment systems to treat the effluents for reuse in the industry itself.

Action 6: CPCB and the Rajasthan Pollution Control Board must revise norms so that these are designed for discharge into dry rivers.
The effluent standards for discharge of industrial effluents set by the Central Pollution Control Board is meant for discharge into surface waterbodies anticipating dilution. However, in the case of Pali, the Bandi river remains dry for remaining most part of the year and has no provision for dilution. As a result the river has become an industrial wastewater drain directly polluting the groundwater table. In the absence of dilution, the effluent discharge standards need to be revised and the CETPs should be upgraded to these standards.

Action 7: Rework the management structure of the CETP trust to make it effective.
The Pali Water Pollution Control, Treatment & Research Foundation Trust has been set up to run the CETP plants. The Chairman of the Trust is the district collector, while the pollution control authorities report to the collector. The state pollution control board has the responsibility to monitor the functioning of the CETP plants but as it reports to the Trust (through the collector) it is unable to play an effective and independent role. The CETP society should be restructured so that it is handed over to the enforcement agencies to oversee.

Action 8: Stop storage of effluents at Nehada dam.
The Nehada dam was built for storing monsoon run-off to enhance irrigation of that area. Today, the dam has rung the death-knell for agriculture for the villagers in and around Nehada because of the accumulation of industrial effluents at the dam. The district administration should ensure that no effluents get accumulated at the Nehada dam and the wastewater stored at the dam site today must be immediately flushed out.

Pali district (groundwater levels falling at the rate of almost two feet a year[b] the CETPs should be directed to treat the wastewater to reusable levels. Hence the designs and the standards need to be reassessed.

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