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Assessment of textile effluent dischage on soil quality in Pali district of Rajasthan

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■ **ABSTRACT :** Pali has the largest number of dyeing and printing units in the Bandi basin. According to joint survey of District Industries Centre (DIC), Pali and Pollution Revenue Association in the year of March 2008, 1325 registered units were engaged in cotton and synthetic textile processing operations. The dyeing and printing industry is the major source of livelihood in this region. These industries provide substantial contribution to the economy in the form of income and employment generation. The key issue of concern is that the textile dyeing and printing industries located in Pali town are discharging industrial effluents into the river Bandi, thus, severely contaminating both the river as well as the soil of nearby areas. Disposal of industrial waste is the major problem responsible for soil pollution. Textile effluents discharged from various textile processing units of Pali, flows about 55 kilometer downstream causing adverse effect on soil making it barren thus affecting crops productivity in those areas.

■ **KEY WORDS:** Soil, Pollution, Textile, Processing, Effluents

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Pali is the largest erstwhile hand processing clusters, now gradually moving to power processing machines. It is best known for dyeing and printing of cotton and synthetic fabrics. Pollution is the main accuse in the textile processing units. The effluents discharged from these units cause environmental pollution. Textile effluents discharged from various textile processing units of Pali, flow about 55 kilometer downstream, making the ground water in several riverbank villages unfit for drinking and irrigation and also cause adverse effect on crops productivity and health of people residing in those areas. Before disposal they need to be treated for certain acceptable tolerance limits since pollution control laws are strictly followed all over the world and captured worldwide attention.

The use of toxic chemicals in these units cause threat to the manpower employed in such units in a way directly resulting in occupational health hazards. Further to be in tune with the government restrictions to be connected to CETP, majority of textile processing houses/units of Pali district are now adjoined to CETP. Inspite of the installation of CETP, Bandi river still has enormous water and soil pollution adversely affecting the fertility of soil and purity of drinking water. The present paper is based on the result of one aspect of research work carried out to study the profile of textile processing units of Pali district and to assess the impact of textile effluents discharge on environment in terms of soil contamination in selected areas.

■ RESEARCH METHODS

The present study was conducted in Pali district of Rajasthan as it has the largest number of textile processing units in the Bandi basin. These textile industries provide substantial contribution to the economy in the form of income and employment generation. The key issue was that these industries are discharging effluents into the river Bandi and directly in to land in several riverbank villages making soil barren and infertile. The area of present investigation was kept within the periphery of 55 kilometer in and around

Bandi river for assessment of water contamination.

Locale of the study:

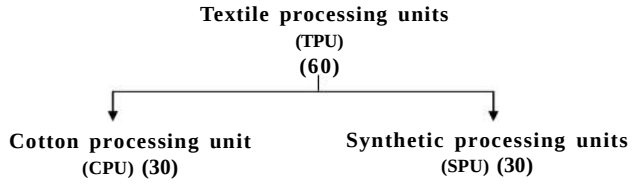
A list of textile processing units was procured from District Industries Centre (DIC) Pali, which were registered since last 20 years. Out of these, 30 units each among cotton textile processing and synthetic textile processing units connected with Common Effluent Treatment Plant was purposively identified and selected, whose effluent was directly or indirectly being discharged in Bandi river in order to assess the impact of effluent on environment in terms of soil contamination after being treated with CETP.

Selection of sample:

The sample selection was done as per the objectives of the study:

Sample I : Selection of textile processing units (TPU) :

A list of textile processing units was procured from District Industries Centre (DIC) Pali, which were registered since last 20 years. Out of these, 30 units each among cotton textile processing and synthetic textile processing units connected with Common Effluent Treatment Plant were purposively identified and selected, whose effluent was directly or indirectly being discharged in Bandi river in order to assess the impact of effluent on environment in terms of soil and water contamination after being treated with CETP. The respective heads of the selected TPU were interviewed to study the profile of the textile units.



Sample II : Selection of common effluent treatment plant (CETP):

In Pali district, four CETP units have been installed to treat the enormous textile effluents discharge from various cotton and synthetic textile processing units. CETP unit-I and II are situated at Mandia road, industrial area and unit-III and IV are situated at Punayata road, industrial area. The respective textile processing units of these areas are connected with these plants. Due to heavy concentration of TPU (approximately more than 500 units) in Mandia road industrial area, the researchers purposively selected CETP unit-I and II for the present investigation.

Sample III : Soil samples:

In order to assess the impact of textile effluents on environment in terms of soil contamination, the samples of soil were collected from:

-Nearby villages situated within the periphery of 55 kilometer of Bandi river.
-Those villages having a population of at least 1000 houses.
-Those villages, where land is being used for crop cultivation and ground water for irrigation and drinking purpose.

For this purpose, a total number of eight villages adjoining to Bandi river fulfilling the above criteria were selected purposively.

For the analysis of soil, 8 soil samples were collected from the farmer's field of selected eight villages- Jawadia, Kerala, Gadwada, Sukarlai, Jetpur, Dholaria, Nehd and Phankaria. Sampling site in each field was identified by specific signs and 8-10 spots were taken depending upon the size of the field. The samples were collected by scraping away from the surface litter approximately 1.5 centimeter thick slices were taken out from all around the spot of sampling and pooled together in a clear bucket. The samples were mixed thoroughly and subsamples were drawn by dividing each into four parts rejecting two opposite parts. The rest of samples were again mixed to obtain one bulk sample per field. The bags were properly marked to identify the sample. Detailed information was written on the label. A tag was kept inside the bags and label was tied up on the mouth of bags. After labeling the samples were tested in laboratory for analysis.

Analysis of physio-chemical characteristics of soil samples:

In order to assess the quality of collected soil samples from selected village, these were analyzed on different parameters such as pH, electrical conductivity (EC), nitrogen (N) phosphorus (P), organic carbon (C), potassium (K) and under heavy metals – zinc (Zn) copper (Cu), iron (Fe) and manganese (Mn) by using standard test methods.

Data collection:

Personal interview method was used for collecting the data regarding profile of textile processing units of Pali district. Before conducting interview the purpose of study was explained to the respondents. Probing was done to get clear and complete information. The interview was conducted in Hindi or when needed in local language. This helped them to understand the questions more clearly.

Analysis of data:

After collecting the data, the same were coded, according to preplanned format. It became necessary to analysis it in order to arrive at some conclusions. The data were statistically analyzed through frequencies and percentages.

Statistical measured used:

Categorization:

When the data were completely collected they were

categorized. This was done in order to make coding simpler.

Coding:

After categorization, coding was done as per the determined code characteristics for response through coding sheet.

Tabulation:

The coded data were decoded by transforming them form code sheet to comprehensive tables.

■ RESEARCH FINDINGS AND DISCUSSION

The results of the present study as well as relevant discussions have been presented under following sub heads:

Profile of textile processing units:

At present in Pali, 867 textiles industrial units are in operation at small scale due to lack of capital. There are about four RIICO developed industrial area in the city. Mandia Road industrial area- phase III alone has about 525 small scale textile units, which is 60.55 per cent of the total dyeing and printing industries. Majority of textile processing units were selected from Mandia Road Industrial area due to higher concentration in that area.It was found that majority (66.66%) of textile processing units were established between year 1990-2000 followed by 25 per cent sample units in year 1980-1990. Majority (35%) of textile processing units covered the area between 2000-3000 square feet while 26 per cent textile processing units were spread between 3000-4000 square feet area. Total capital investment was found between 3 to 4 crores by 36.66 per cent followed 30 per cent between 2 to 3 crore. Data on production per month were found in between 10 to 15 lac meters; that means average production of approximately 300 'than'for dyeing and 150 'than for printing per day. One 'than' is equal to near about 130 meters. 40 per cent of responding units had yearly turnover between 20-30 crore, 31.66 per cent between 30-40 crore and only 10 per cent had 40-50 crore. All the respondents used synthetic dyes for dyeing and printing. Very few respondents (16.66%) also used eco-friendly dyes, for fabric coloration as per the export order procured. Mainly two types of fabrics were used for dyeing and printing *i.e.* cotton and polyester. For cotton, mainly Reactive, Ramazol, High exhaustive dyes, Azoic dyes, Vat dyes and Sulphur dyes were used. Disperse dye was applied on most of the synthetic fabric. For polyester, it is only for colouring. Procion and pigment dyes were used for printing of cotton fabric and disperse dyes for polyester printing.

Environment hazards:

The waste water when discharged into land without proper treatment can bring about irreversible changes.

Discharge on land cause soil pollution:

The disposal of contaminated water without proper treatment takes place on the ground which acts as sand bed. The sandy soil percolates almost all the contents of waste water to the ground water. Such percolation imparts alkalinity of the soil and makes it unfertile. The soil character in the study area where this contaminated water deposits have changed. Bandi river is turned into barren land. Excessive dissolved salts are also creating osmotic pressure and therefore preventing growth of plants which require more energy for using water for their growth.

Association with common effluent treatment plant (CETP):

Each textile processing unit in the study area was connected with the CETP and very few (25%) were satisfied with the functioning of CETP.

Physio-chemical analysis of soil samples:

Textile effluent on being discharged is also absorbed by soil by making it unhealthy and unfit for growing vegetables and crops. In order to assess the quality of soil, samples, were collected from the farms of eight selected

Table 1 : Physio-chemical analysis of soil samples collected from selected villages in and around Bandi river, Pali

Sr. No.	Soil parameters	Unit	Standard	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8
1.	pH		6.5-7.5	9.31	10.18	8.24	8.67	9.72	7.82	9.25	10.33
2.	Ec at 25°C	μ mho/cm^2	>1	1.03	1.0	0.34	1.25	1.42	1.07	1.33	1.82
3.	Nitrogen	kg/ha	250-00	185	190	175	160	177	184	179	186
4.	Phosphorus	Kg/ha	23-56	8.3	26.55	15.07	18.22	29.52	12.56	18.77	21.24
5.	Organic carbon	%	0.5-0.75	0.44	0.19	0.41	0.39	0.29	0.36	0.42	0.22
6.	Potassium	kg/ha	150-300	743.9	372.0	206.6	425.32	625.21	815.13	723.70	620.24
7.	Zinc (Zn)	mg/kg	0.6-1.2	0.458	0.442	0.548	0.432	0.562	0.444	0.437	0.456
8.	Copper (Cu)	mg/kg	0.2	0.618	0.922	0.876	0.726	0.928	0.8621	1.726	0.989
9.	Iron (Fe)	mg/kg	4.5	4.821	2.780	4.714	4.358	4.628	4.812	4.989	4.52
10.	Maganese (Mn)	mg/kg	1.0	10.83	5.88	6.23	7.48	8.62	7.22	6.48	8.81

villages adjoining the Bandi river and analyzed on different parameters such as pH, EC, available nitrogen, phosphorus, potash, organic carbon and heavy metals like Zn, Cu, Fe and Mn. The results of the analysis are presented in Table 1.

pH:

Soil pH is one of the most indicative measurements of chemical properties of soil. It indicates acidic, neutral or alkaline nature of soil. The pH values in the study area varied from 7.82 to 10.33 suggesting the alkaline nature of soil. All the soil samples except S_3 and S_6 were found above the permissible limit of 8.5.

Electrical conductivity (EC):

Table 1 clearly indicates that EC in soil samples varied from 1 to 1.82 m mho/cm^2. All the soil samples except S_3 showed higher EC rating as compared to standard (>1m mho/cm^2). Hence, these samples are highly unsuitable and injurious for proper growth of plants.

Available nitrogen:

Available nitrogen is the amount of nitrogen present as either nitrate or ammonium forms which can be readily take up by plant.

Subbiah and Asija (1956) have established the following rating for the classification of soil test values of available nitrogen:

Low : < 250 kg/ha
Medium : 250-500 kg/ha
High : > 500 kg/ha.

On the basis of these limits, the available nitrogen was found in low range in all the soil sample, which indicates the need of using nitrogen based fertilizers.

Available phosphorus:

The following rating has been suggested for classifying the available phosphorus content into low, medium and high categories (Muhr *et al*., 1965).

Low : Below 20 kg P_2O_5/ ha
Medium : 20 to 50 kg P_2O_5/ ha
High : Above 50 kg. P_2O_5/ ha.

On the basis of these limits, sample S_1, S_3, S_4, S_6, and S_7 fell in low range of available phosphorous and samples S_2, S_5 and S_8 came under medium range, which also suggest application of phosphate fertilizer to maintain desired level of phosphorus in the soil.

Organic carbon:

Organic carbon serves as an efficient index of availability of nitrogen to plants. Therefore, organic carbon has been used for evaluating fertility status of soil. The range of organic carbon in the soil is 0.5 to 0.75 per cent. In the study area, organic carbon varied between 0.19 to 0.44 per cent. It shows that the soil is unfertile for production due to which, the plants can not absorb all the available nutrients. Hence, addition of organic manure or FYM (farm yard manure) is necessary to all the soil samples to improve the soil fertility.

Available potash:

The following rating is being used for classifying the available potash content into low, medium and high categories (Muhr *et al*., 1965).

Low : <125 kg K_2O /ha
Medium : 125-300 kg K_2O / ha
High : > 300 kg K_2O /ha.

On the basis of these limits, all the soil samples except S_4 were falling in the high range of available potassium.

Heavy metals:

Table 1 further depicts the content of different heavy metals in selected soil samples. Takkar and Mann (1975) suggested limits of available Zn as <0.6, >.12 mg/kg and 1.2 mg/kg of DTPA extractable in for deficient, marginal and sufficient classes, respectively. Considering these limits soil sample, S_1, S_3, S_7, S_8 were found deficient in Zn supply, sample S_2, S_4, S_6 were found marginal in Zn supply. Lindasay and Norvell (1978) suggested 0.2mg/kg of DTPA extractable Cu is critical limit of variable copper. Considering these limits all the soils were found to be high in available copper.

Lindasey and Norvell (1978) suggested 4.5 mg/ha of DTPA extractable iron (Fe) as critical limit of available iron. Considering these critical limits all sample except S_1, S_7, and S_8 found sufficient in available iron. Considering 1.0 mg/kg of DTPA extractable Mn is critical limit for available manganese, all soil samples were found to have high in manganese content.

Nickel is a transition metal and found in natural soils at trace concentrations. Nickel was not detected (ND) in all the soil samples.

Conclusion:

The major problem threatening the textile processing units of Pali is the environmental pollution arising out of wet processing of textiles. Huge amount of water and chemicals are used in different processes which are discharged as waste water that are high in COD, BOD, TDS and toxic chemicals. In spite of the installation of CETP, the Bandi river still has enormous soil pollution adversely affecting the soil fertility. Thus, it can be concluded that soils are quite alkaline in nature due to high pH. EC was also found high than the standard value. Organic carbon, N, P, K were also not found in satisfactory range. Hence, application of specific fertilizers and manures are required for improving soil fertility. Heavy metal like, Cu, Mn and were found higher than permissible limits which cause hindrance in plant growth.

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