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Impact Assessment of Textile Industry Effluent on Water Quality and Health - A Case Study of Hapur District, Western Uttar Pradesh

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Abstract: ***The developmental activities, industrialization and urbanization are responsible for contamination of soil and aquatic system. Textile industry is one of the important and largest industrial sector of India which is responsible for economic growth of nation. Textile industry effluent contain heavy metals, dye, inorganic and organic contaminants and show negative impact on environment and human health. In the present study, survey was conducted in the Pilkhuwa industrial area of Hapur district, western Uttar Pradesh and responses of local residents were collected through questionnaire after interview and group discussion. The local residents reported that water of the Pilkhuwa industrial area is not clean and safe for drinking and most of the people of the area are suffering from various health related disorders such as skin diseases, asthma, and typhoid etc. Hence, there is an urgent need of cost-effective, eco-friendly and sustainable technologies for decontamination of industrial effluent before its release into the environment.***
Keywords: Effluent, health, textile industry, water quality.

I. INTRODUCTION

Water is a basic need of human beings and essential for their survival on the earth. The population growth, urbanization and industrial development have contributed to significant increase in wastes in recent years which affected water quality [1,2]. It has been predicted that by the year 2030, around 47% of the global population will face severe water scarcity [3]. The medium or large-scale industries play a significant role in boosting nation's economy both at local and global level due to their ability to provide job opportunities and foreign exchange earnings [4,5]. Unfortunately, most of the textile industries do not follow the effluent discharge regulations properly and release huge amount of untreated or partially treated dye containing effluents directly into the environment [6]. Dye effluents released through smelting, printing, mining, petroleum refining, and car manufacturing industries have already become a worldwide environmental problem [7]. The industrial effluents are rich in persistent pollutants such as heavy metals, sulfur, nitrate, naphthol, soap, formaldehyde, coloring and chlorinated compounds [8,9]. Dyes are used for coloration of various materials used in textile, cosmetics, food, paint, tannery, leather, pharmaceutical, pulp and paper industries etc. [10,11]. Textile industries utilize huge quantity of water with various toxic chemicals during processing operations like sizing, softening, brightening and finishing etc [12,13].

Approximately 7 × 107 tonnes of synthetic dyes are generated annually at global level whereas > 28 x 104 tonnes of textile dyes are released into the environment via textile industry effluent [14,15]. It is challenging task to eliminate dyes from wastewater due to their aromatic structure, high stability against light, heat and oxidizing agents [16,17]. The continuous release of dye contaminated wastewater from industries without prior treatment show negative consequences on the environment, aquatic animals and human health [18–21]. The presence of dyes in water resources even in very less amount reduces passage for sunlight, increases biochemical and chemical oxygen demand, inhibits photosynthesis, adversely affects growth of aquatic flora and fauna [4,9]. Dyes remain in the water and soil for long duration and poses serious health risks to living organisms after their entry via food chain. Synthetic dyes are mutagenic and carcinogenic in nature [22]. Azo dyes cause allergies, dermatitis and DNA damage which results in the formation of malignant tumors [23]. The Sustainable Development Goal, United Nations aimed to ensure availability and sustainable management of water and sanitation for all by the year 2030 [24]. At global level, 780 million people live without access to safe water and approximately 2.5 billion people in the developing nations live without access to adequate sanitation [25]. The polluted water and poor sanitation practices expose large sections of the society to the health risks.

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Indian economy is dependent on agriculture as 65% population is directly or indirectly involved in agriculture and allied activities for their livelihood. It has been observed that most of the farmers irrigate their agricultural fields with wastewater containing untreated industrial effluents which show adverse effect on soil texture and crop growth [26,27]. Pilkhuwa industrial area of Hapur district in western Uttar Pradesh was selected for the present study. Pilkhuwa is a major hub of textile products as around 860 small and medium scale manufacturing units are located at Pilkhuwa region of western Uttar Pradesh. Pilkhuwa, also known as textile city, is famous for its cotton textiles, canvas and printing on khadi and handloom fabrics. More than twenty thousand residents of Pilkhuwa area are directly or indirectly involved in the textile production. In the present study, interview and group discussion were conducted with the residents of the nearby villages of Pilkhuwa industrial area to assess their socio-economic status and impact of textile industries on the agriculture, water quality and environment of the area. The earlier investigations have focused on the physico-chemical properties of river water and impact of seasonal variation on water quality. No information is available till date on the farmer's perception on the textile industry effluent and its impact on agricultural fields and health of residents. Hence, the present investigation was conducted to study the awareness and knowledge level of the residents of Pilkhuwa area about the impact of textile industry effluent on the environment.

II. EXPERIMENTAL DESIGN

A. Study Area

Pilkhuwa industrial area of Hapur district in western Uttar Pradesh was selected for the present study. The villages nearby the Pilkhuwa industrial area were selected for survey study to assess the knowledge level of the local residents about the impact of textile industry effluent on the water quality, agriculture and health of the residents of area etc.

B. Selection Criteria of the Respondents

Total two hundred local residents from villages of Pilkhuwa industrial area between the age - group of 18 - 65 years were randomly selected for the interview and discussion. During the survey, respondents were identified mainly on the basis of the following criteria: (1). a person who was resident of Pilkhuwa industrial area (2). willingness of the residents for participation in the study.

C. Interview and Discussion with the Respondents

The investigation was based on the personal interview and group discussion with the local residents of villages of Pilkhuwa industrial area to assess their knowledge and awareness about the impact of textile industry effluent on environment. The brief group discussion was made with the local participants prior to data collection to get their consent and to explain them that their cooperation is a valuable contribution for the documentation of their knowledge about the impact of textile industry on environment. The questionnaire was formulated in non-scientific language after consultation with scientists and researchers to ensure that the questions would be understood by the local respondents.

The standardized questionnaire was used for the study and it was divided into four parts:

1) Socio-demographic characteristics with personal information of respondents such as age, gender, education, occupation, land holdings, farming experience.
2) Water quality in the villages of Pilkhuwa industrial area
3) Effect of textile industry effluent on agriculture
4) Effect of textile industry effluent on the health of local residents.

The questionnaires were collected and response of the participants were summarized in form of the Tables (1 - 5).

D. Focused Group Discussion with the Respondents

During the group discussion, several questions were raised by the local residents of Pilkhuwa industrial area from our research team such as (i). Which type of contaminants are present in textile effluent? (ii). Why textile industries do not treat properly the contaminated effluent prior to release into the environment? (iii). What are the cost-effective techniques by which they can make water reusable? Therefore, to address all the above-mentioned queries of the participants, one follow-up session was conducted by our research team in which detailed information on the adverse impact of water pollution and use of cost-effective technologies for water purification was given to the local residents via presentation.

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III. RESULTS AND DISCUSSION

For the present study, total two hundred respondents were selected for the interview and group discussion from different villages of Pilkhuwa industrial area, western Uttar Pradesh. Agriculture was the main occupation of the rural communities of Pilkhuwa industrial area. The respondents revealed that their main occupation was agriculture and they used to grow cereal crops such as wheat, rice and vegetables. After the establishment of textile industries, most of the residents and their family members left farming occupation and are working in textile industries of Pilkhuwa area. They said the reason behind leaving agriculture was less productivity in farming sector and high salinity of the soil of Pilkhuwa area.

A. Socio-demographic Characteristics of the Respondents

During interview and group discussion, majority of the respondents 85% were selected in between 18-55 years of age whereas 15% respondents belong to 55-65 age group. Most of the respondents, 44% who were involved in agriculture related work, had no formal education and they were illiterate. 31% had primary school level education up to 5th standard, 11 and 9% had secondary and higher secondary level education and only 5% of the respondents had college level education (Table -1).

Table I. Educational status of the residents in Pilkhuwa industrial area, western Uttar Pradesh.

S. No.	Educational status of the respondents	Number of respondents
1.	Illiterate	88 ± 0.41 (44)
2.	Primary level	62 ± 0.71 (31)
3.	Secondary level	22 ± 1.1 (11)
4.	Higher secondary level	18 ± 0.32 (9)
5.	Graduation	10 ± 0.14 (5)

Values are mean of three replicates ± sem
Data in parentheses show percentage of respondents.

B. Land - Holdings and Farming Experience of the Respondents

In Pilkhuwa industrial area, maximum number of farmers, 31% had small - land holdings whereas 12 and 3% had medium and large - land holdings, respectively (Table-2). Approximately 33% farmers had more than twenty years of farming experience whereas only 4% farmers were involved in agriculture from last ten years (Table -3).

Table II. Land - holdings of the respondents in Pilkhuwa industrial area, western Uttar Pradesh.

S. No.	Land holdings of the respondents	Number of respondents
1.	Small	62 ± 0.37 (31)
2.	Medium	23 ± 0.70 (11.5)
3.	Large	6 ± 0.25 (3)

Values are mean of three replicates ± sem.
Data in parentheses show percentage of respondents.

Table III: Farming experience of the respondents in Pilkhuwa industrial area, western Uttar Pradesh.

S. No.	Farming experience (Years)	Number of respondents
1.	1- 10	7 ± 0.12 (3.5)
2.	11 - 20	19 ± 0.29 (9.5)
3.	21 - 30	65 ± 0.36 (32.5)

Values are mean of three replicates ± sem
Data in parentheses show percentage of respondents.

C. Effect of Textile Industry Effluent on Environment

Groundwater plays a pivotal role in the economy as a water resource for irrigation of agricultural fields and utilization by industries. Groundwater quality can be affected by hydrogeochemical process and anthropogenic activities such as urbanization and industrial development [28]. Farmers of Pilkhuwa area use groundwater for the irrigation of their agricultural fields. However, they revealed that water table has been dropped in the area as huge amount of water is consumed by the textile industries and under such conditions farming has become difficult [29]. Most of the respondents 98% reported that textile industries of Pilkhuwa industrial area generate huge amount of wastewater. 96% respondents observed that effluent released from textile industries is dark in colour with foul odour and 88% stated that effluent adversely affects aquatic flora and fauna. 62% respondents reported that after the establishment of textile industries in Pilkhuwa area, there is frequent reduction in soil fertility and soil of the agricultural field has become saline. Approximately 79% of respondents revealed that after establishment of textile industries, there was significant decline in crop productivity.

Table IV. Knowledge level of respondents about the effect of textile industry effluent on the environment of Pilkhuwa industrial area, western Uttar Pradesh.

S. No.	Knowledge about the effect of textile industry effluent on environment	Number of respondents
1.	Textile industry generate huge amount of wastewater	195 ± 0.60 (97.5)
2.	Textile industry do not treat effluent properly before its release into the environment	181 ± 0.41 (90.5)
3.	Effluent released from textile industries is dark in colour with foul odour	192 ± 0.36 (96)
4.	Textile industry effluent mixes with ground water, rivers and deteriorates water quality	169 ± 0.82 (84.5)
5.	Textile effluent adversely affect aquatic flora and fauna	175 ± 0.64 (87.5)
6.	After establishment of textile industries in Pilkhuwa area, there is frequent reduction in soil fertility and soil have become more saline	123 ± 1.08 (61.5)
7.	Textile industry effluent adversely affect soil microbial diversity	114 ± 0.67 (57)
8.	Reduction in crop productivity after establishment of textile industries in Pilkhuwa industrial area	158 ± 0.74 (79)

Values are mean of three replicates ± sem
Data in parentheses show percentage of respondents.

D. Effect of Textile Industry Effluent on Health Aspects of Respondents

Approximately 99% respondents reported that textile industry effluent deteriorates quality of ground as well as surface water of the Pilkhuwa region. 84% respondents claimed that they are suffering from various health related disorders after establishment of textile industries in the past few years. 71% respondents reported significant population of mosquito and housefly whereas more prevalence of water borne diseases in Pilkhuwa industrial area was stated by 78% of the respondents. Around 47% people working in the textile industries were suffering from occupational health related disorders. Respondents said that most of the people of the Pilkhuwa industrial area are suffering with skin allergies, falling of hairs, stomach-ache, typhoid, asthma, tumour and neurological disorders etc. The health concern of the rural population requires urgent attention as rural people use untreated water for a wide range of domestic purposes. Therefore, health authorities should make the public aware about the potential danger in using contaminated water as a source of drinking water and also explain easy treatment procedures for the untreated water.

Table V. Knowledge level of the respondents about the effect of textile industry effluent on health of the residents of Pilkhuwa industrial area, western Uttar Pradesh.

S. No.	Knowledge about the impact of textile effluent on the health aspects	Number of respondents
1.	Textile industry effluent deteriorates quality of ground and surface water of the Pilkhuwa area	198 ± 0.40 (99)
2.	More prevalence of water borne diseases in Pilkhuwa industrial area	156 ± 1.1 (78)
3.	Population of mosquito and housefly is more in the study area	142 ± 0.82 (71)
4.	People working in the textile industries are suffering from occupational health related ailments	93 ± 0.64 (46.5)
5.	Residents of the Pilkhuwa industrial area are suffering from various health related disorders, after the establishment of textile industries in the area	168 ± 0.35 (84)

Values are mean of three replicates ± sem
Data in parentheses show percentage of respondents.

IV. CONCLUSION

The present study clearly indicate that discharge of textile effluent has shown undesirable and detrimental consequences on the environment and human health. The industries should strictly follow the guidelines of state and central pollution control board for treatment of effluent prior to its release into the environment. Awareness programmes must be conducted by the government for industry workers. The present investigation may be important for policymakers and environmentalists in shaping policies which may assist different stakeholders and people of the industry to eliminate toxic dye and other contaminants with minimal by-products towards better groundwater management under the Swachh Bharat Mission in India.

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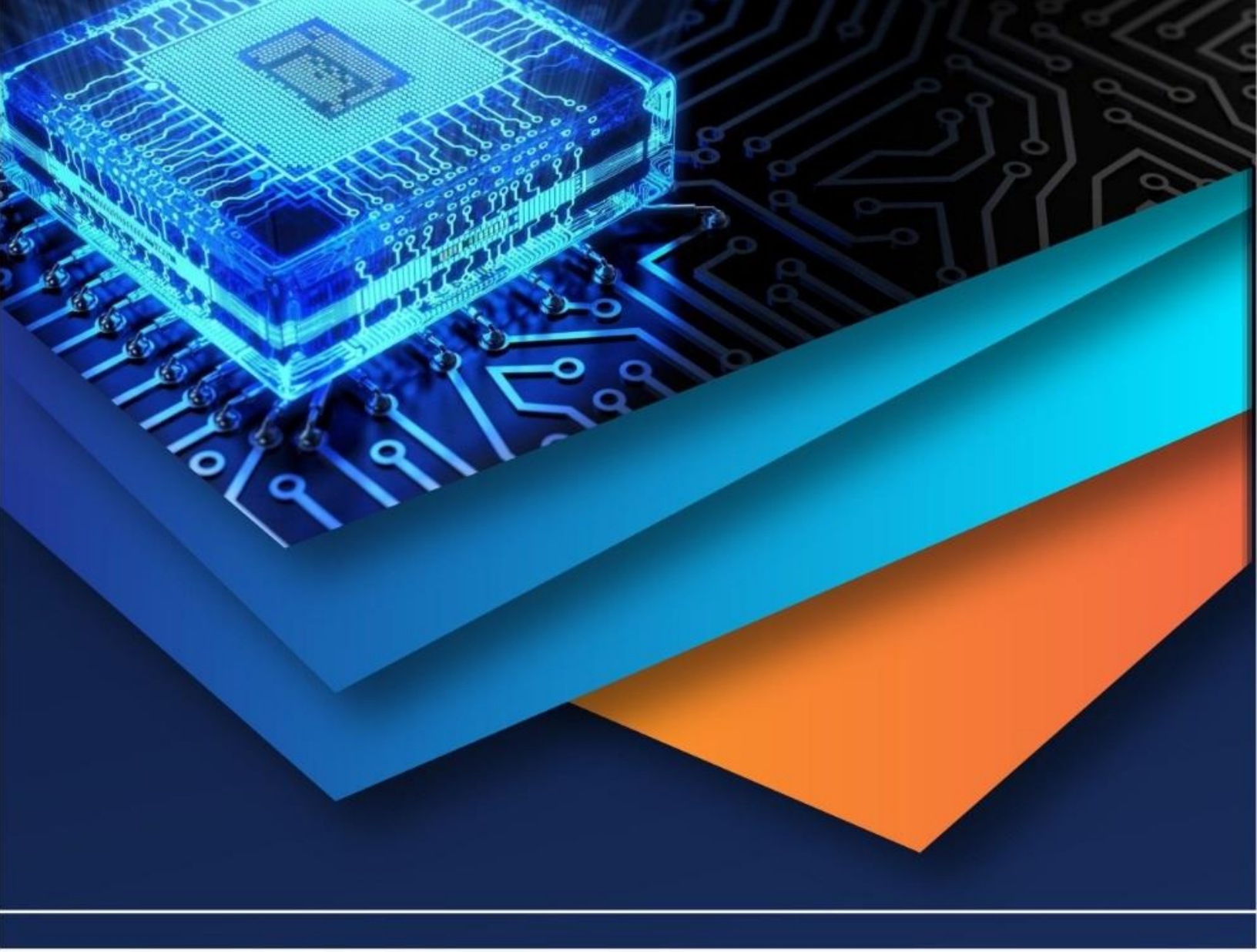

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