

## REVIEW

## IMPACT OF TANNERY EFFLUENTS ON SOIL OF KANPUR CITY

Kiran Pal<sup>1\*</sup>, Hasmet Ali<sup>2</sup>, Madhuri Yadav<sup>3</sup> and Javed Ahmad Siddiqui<sup>4</sup><sup>1,3</sup>Department of Zoology, D.B.S P.G College, C.S.J.M University, Kanpur<sup>2,4</sup>Department of Botany, DA-V (PG) College, C.S.J.M University, Kanpur[Email: prof.kiranpal1009@gmail.com](mailto:prof.kiranpal1009@gmail.com)

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**Abstract:** The primary polluter of the environment is the tannery industry and there is a strong possibility of water and soil pollution due to discharge of informal wastes. More than 250 chemicals are used in the production of leather and other toxins like toxic organic chlorinated phenols, toxic CrVI and other toxic pollutants such as sulphide, phenolic compound, magnesium, sodium, potassium, lead, zinc, pesticide residues, mineral salt, dye releases a complex mixture of pollutants. CrVI and chlorinated phenol toxic to human as well as biota or ecosystem or environment is the basic major sewage. Chromium is the most dangerous. It is very popular in the tanning industry because it strengthens leather. Its waste from is hexavalent chromium or CrVI- people have to face diseases like lung cancer, headache, dizziness, allergic reaction, asthma and liver failure etc. Tannery water contain hazardous pollutants with mainly dark brown colour, foul smell and dangerous pollution with some waste material and persistent organic compounds in various quantities. Excess amount of this water mix with the soil and has adverse effect on the plants and vegetables growing it. The waste material generated from tannery industries can be treated in many ways- there is a need to upgrade the CETP (common effluent treatment plant) in industrial area so that the higher quantity of effluents can be treated. CETP (common effluent treatment plant) plant should be checked monthly. Instead of giving the responsibility of monitoring the treatment plants to the water corporation, cooperative societies themselves should be formed and they can manage the process of sewage treatment. Most of the tanneries in industrial area are chrome tannery, hence chrome recovery plant should be set up.

**Keyword:** Tannery effluent, Treatment plant, Toxic pollutants, Tannery industry

## INTRODUCTION

One of the major problems of the world is environmental pollution which is increasing day by day due to industrialization and urbanization. The current pattern of industrial activity disrupts the natural flow of material and introduces novel chemical into the environment consisting of soil, water bodies, plants, humans, vegetables and various living organisms. Soil pollution has become a serious problem due to the growing industrial area of Kanpur. Soil is seen as the final sink for organic and inorganic pollutants released from industrial waste into the environment (Tadesse and Guya, 2017). Tannery industry is one of the oldest among the many industries in Kanpur. This is a long legacy of Kanpur. The industry which is associated with pollution is helpful in flower cultivation. The solid matter present in the waste is filtered and also diluted with Ganga water. This process was followed in the past when there were very few leather factories. The leather industry of Kanpur is one of the major export sectors of the country, but this industry has polluted the city of Kanpur, a lot, due to which people are facing a lot of difficulties, that is, even their life has become difficult. A place called jajmau located

near Ganga is one of the industrial centers of Kanpur city. It is also called leather cluster of Kanpur. There are four major drains in jajmau area of Kanpur. It has many small drains which are the catchment area of the entire tannery cluster of Kanpur and all the water bodies flowing in and around jajmau. Out of many industries in jajmau area, 400 industries are only leather factories. Most of the factory has chrome tanning industry. A solution of chrome coloring chemicals like chromium, sulphate, cadmium etc, are used for coloring which is very harmful for human health. Water bodies are filled with methane, ammonia and hydrogen sulphide. Local people living near tanneries observe the color of water bodies changing due to the dyes used in the factory. The smell of sewage in any place is similar to that of the material released from the industry there which flows everywhere. The city of Kanpur, just on the banks of the Ganges, has become a huge tannery complex with 450 tanneries. The environment around there has become very bad due to the leather factory. Water and soil pollution due to discharge of factory effluents is causing serious problems. Soil pollution affects the farming around there and due to water pollution the local people have to face serious diseases. The pollutants

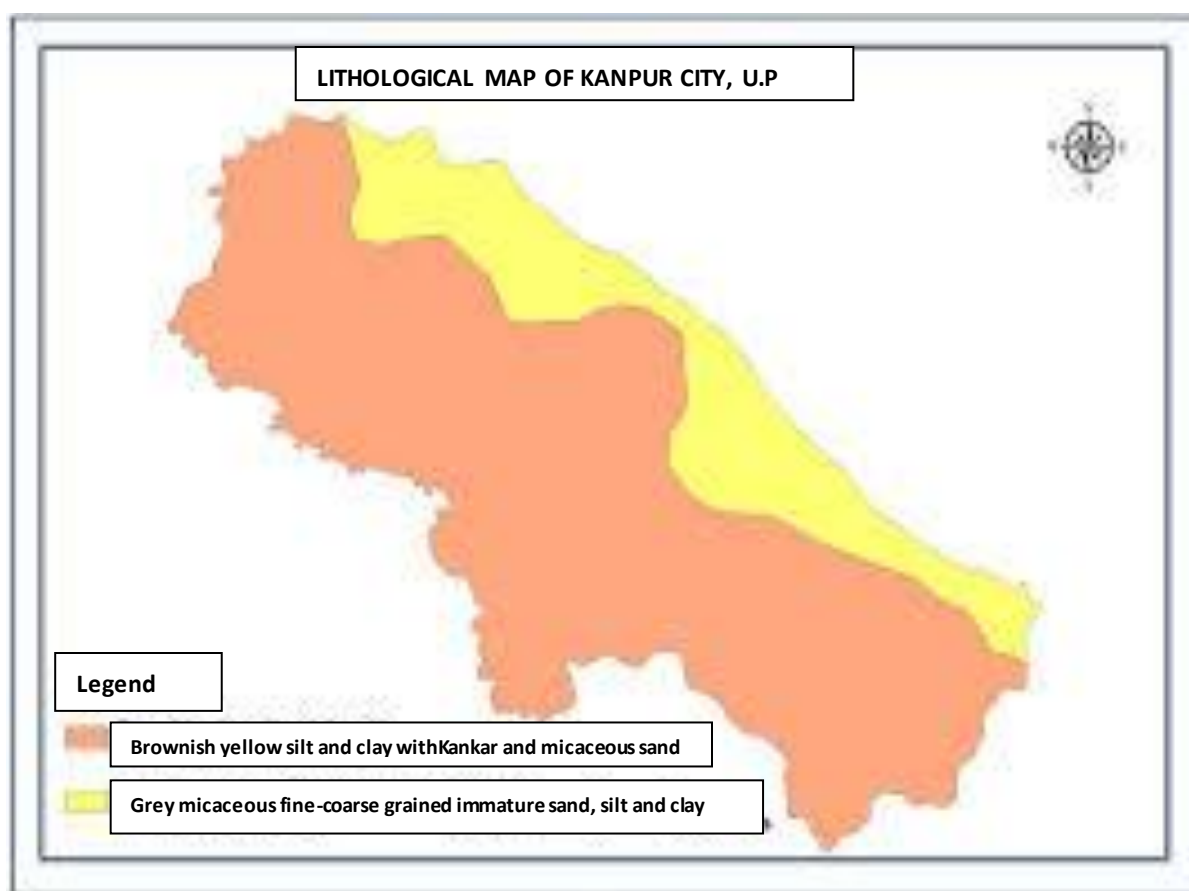
\*Corresponding Author

present in the soil include, Cd, Mn, Zn, Ar, Cr, Pb and Hg, which are considered toxic. Heavy metals present in soil play a major role in their nutrient and fertility status. Many metals like Zn and Cu are essential elements for the normal growth of living organisms and plants but if their deficiency or excess occurs in the soil, it gives rise to many disorders (Agrawal and Singh, 2016). Kanpur is the oldest and largest industrial city of India's most industries in the city, the process of tanning animal hides and treating leather. There are 100 of small, medium and large tanneries in the area around Kanpur, which make leather by hides and their hides and produce leather product including shoes, belts, clothes and bags which are exported to foreign countries. Toxic chemicals are used in the tanning process. When tannery waste is released

without treatment it contaminates soil and groundwater and contaminates waterways, including the nearby river Ganga.

#### Soil of Kanpur

Kanpur Nagar district is a part of indo-genetic scheme. Different categories of soil, gravel and grades are the main sedimentary component. The soil of the district exhibits a great variety of form and composition. The major part of the district has ordinary soil, locally known as Bhur and clay soil in the depressions, sand on the mountain ranges and loam in the plains. 'Reh' prevails in clayed areas. Kanpur city generally has sandy- and clay soil. This area falls in the plains and indo-Ganga and in most part of Kanpur district, ordinary soil is found, which is known as Bhur in the local language.



**Source:** IJCRT.ORG- Identifying the impact of landuse/land Cover on groundwater using GIS: Case study of Kanpur city, Uttar Pradesh.

#### Water of Kanpur

Kanpur city is the 9<sup>th</sup> largest and one of the most seriously polluted cities of India. There are about 350 industrial tanneries in the eastern district of the city, the effluents from which flow into the local ground water basin and the Ganges River. Pollution from leather factories includes toxic metals such as Mercury, chromium and Arsenic (Pure earth, 2020-2023). Chromium is the most dangerous. It is very popular in the tanning industry because it

strengthens leather. Its waste from is hexavalent chromium or Cr VI- people have to face diseases like lung cancer and liver failure etc (Ahmad and Chaurasia, 2019). Kanpur city is one of the important urban centers of the state of Uttar Pradesh where water supply is a common problem. It is situated on the bank of river Ganga and is one of the industrial clusters. The city is completely dependent on the river to meet its needs and acts as a sink for much of the sewage generated in the city

(Bassiet.al, 2019). The lifeline of the northern part of India is the Ganga river. Kanpur city is also an industrial center situated around the river Ganga, and is located on the bank of river Ganga affects the water quality, as the effluent from the industrial area affects the drinking water and agriculture area of the river Ganga and the surrounding areas (Ahmad and Chaurasia, 2019). Due to population growth, rapid industrialization and agricultural runoff, this river is very important for the communities living on the bank of river Ganga, but its quality is deteriorating day by day (Singh, 2010). Clean and fresh water is very essential for healthy life. According to the world Health Organization, 80% of human diseases are caused by drinking dirty water. 1300 million liters of sewage reaches the river indirectly or directly. Lakhs of people depend on these industries for

their daily needs and livelihood. Ganga is one of the 10 most endangered rivers of the world. The level of pollution has been increasing for many years because the cities and towns through which the river flows throw informal sewage, huge amounts of garbage and many other harmful substances into the river. In fact, the river is dead in many places where pollution has increased. The levels are so high that aquatic life cannot survive. There are more than 5000 industries in Kanpur which include leather, detergent, fertilizer and paint industries. These industrial units discharge toxic chemical waste into rivers and streams causing water pollution for example paper factories, refineries, sugar mills and textile and chemical factories. This industries release chemical pollution into the water (NCERT).



Source: Orissa POST- 91 Kanpur tanneries 'polluting' Ganga closed.

#### Effect of tannery effluent on flora and fauna

Pollution emanating from tannery industries has a very bad effect on the life and health of animal. The emissions of waste materials from the tannery industry contain complex organic and inorganic compounds that harm the flora and fauna living in the ecosystem as well as cause great harm to human health, even leading to death (Science space (2023).

#### (a) Human and animal

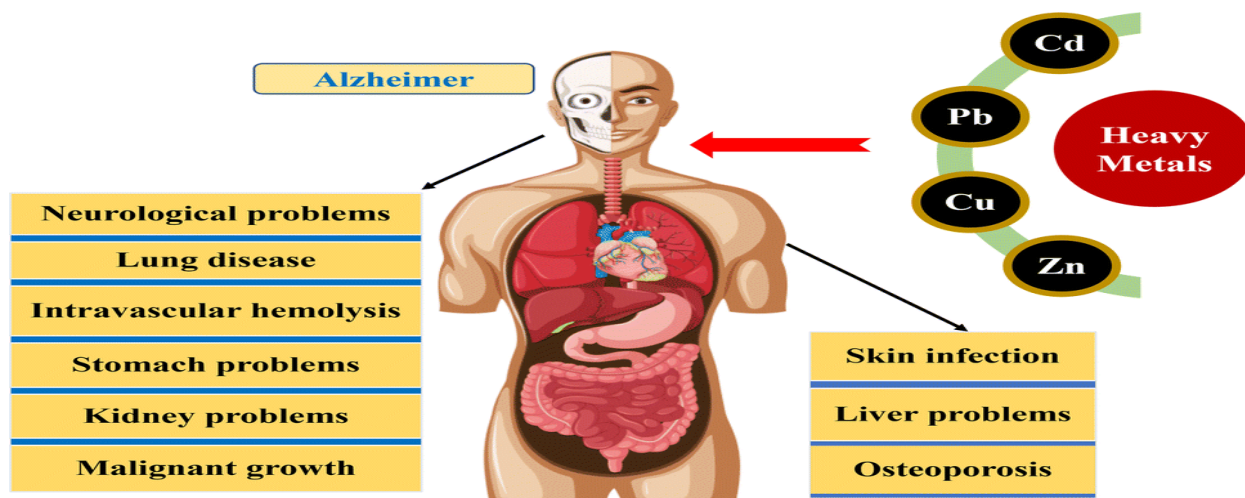
The tannery industry is a major environmental polluter due to the release of uneconomical wastes. Has high potential to contaminate land and water. It releases a complex mixture of toxic organic hexavalent chromium ( $\text{Cr}^{6+}$ ), chlorinated phenols and other toxic compounds including pesticides residues, mineral salts, dyes, formaldehyde resins, greases and solvents such as oils. It uses more than 250 chemicals in the production of leather.  $\text{Cr}^{6+}$  and chlorinated phenols are the two most common pollutants in tannery waste water which are harmful to human and animal. The presence of

chromium compounds and cancer-causing substances such as skin problems and polycyclic aromatic hydrocarbon (PAHs) in tannery effluent is linked to an increased risk of abnormalities are also found in people exposed to tannery waste.

Animal in the vicinity of a tannery may consume or be exposed to contaminated soil or wastewater, resulting in reduced organ, lack of fitness and systemic toxicity (singhet.al, 2023). Tannery water contain hazardous pollutants with mainly dark brown color, foul smell and dangerous. Pollution with some residual material and persistent organic compound in varying amounts. Environmental pollutants can disrupt intercellular signaling pathways in humans and cause a wide range of developmental and reproductive problems (Lineyet.al, 2005). Workers working in tannery industries for a period of 6 months to 15 years are exposed to disease related to genetic damage over a very long period of time. Due to lack of knowledge about the toxic wastes of chromium, lead, zinc, cadmium and formaldehyde released from

tanneries, people are facing chronic diseases like headache, Dizziness, allergic reaction, collapse due to oxygen as well as long term illness like

occupational asthma. In human and animal health, they suffer from diseases like ulcer, genetic defects and dermatitis etc (Rajendran, 2010).



**Source:** RSC Publishing- Heavy metal pollution in the aquatic environment: efficient and low cost removal approaches to eliminate their toxicity: a review (Aziz *et.al*, 2023).



**Source:** Pulitzer center-India: the toxic price of leather, image by Sean Gallangher, 2014)

**(b) Plants and vegetables**

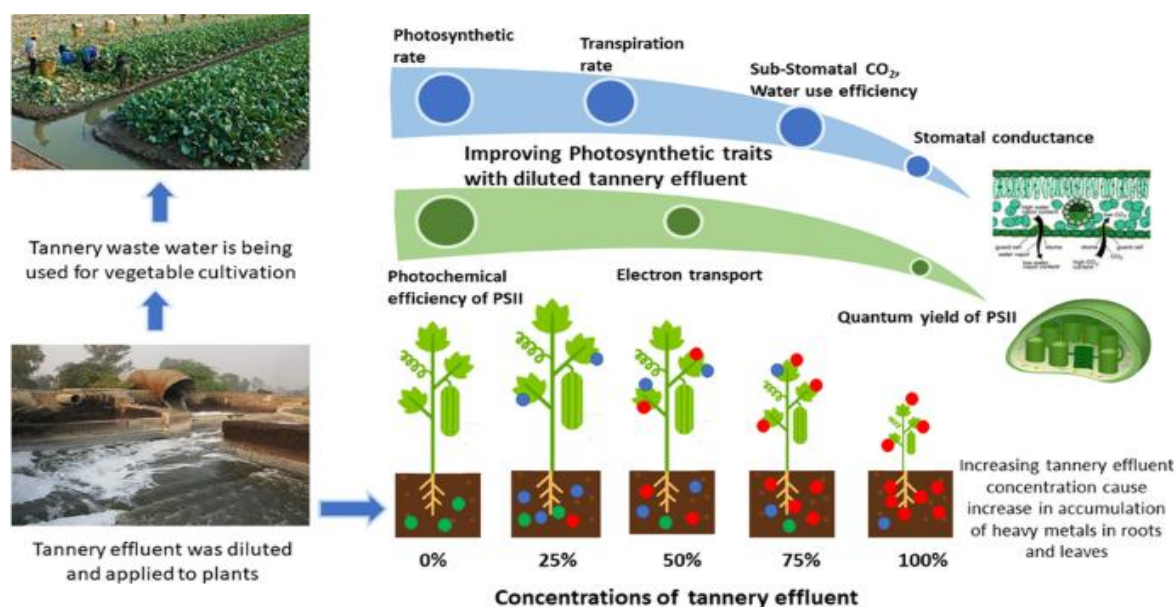
In developing country like Kanpur which is also called an agricultural country and facing the problems of water pollution. Leather industry present in Kanpur is a major economic sector. Due to tanneries, people are facing great difficulties. The poisonous waste material coming out of them is released into the surrounding drains and rivers, due to which the water there becomes contaminated. This water is used for agriculture, which harms the plants and effect on growing vegetables. Plants are unable to grow and their lifespan ends early (Shakir, 2012). Industrial wastecontaining heavy metals used for irrigation of

plants have adverse effects on the growth and development of crops (Muthuswany, 2023). Organic and inorganic elements are included in tannery effluent as pollutants which reduce plant growth. The effect of toxic substances released tannery effluents has reduced the nutrient in the leaves due to the presence of heavy metals Cr, Cd, Mn in the leaves and roots and has also reduced the functioning of photosynthetic pigments end the rate of photosynthesis. They effect the growth of plants and the flowers, fruit, vegetables that grow on them (Zaheer *et.al*, 2022).Heavy metals leach from wastewater into agricultural land as a result of irrigation (Mapanda, 2005). Water routes are the

main reason through which heavy metals move out of the soil and are taken up by vegetation. Toxic metal are redistributed when plants die and result in enrichment in agricultural soils.

Bioaccumulation of these heavy metals into ecosystems can lead to soil accumulation and bioaccumulation thus, long-term irrigation of waste water leads to the build-up of heavy metals in soil and food crops (Khan *et.al*, 2008). As a result of rapid industrialization and urbanization, sewage effluents and industrial effluents are often discharged into lakes and rivers with inadequate environmental monitoring planning, leading to

gradual pollution of our water resources. Waste water is often discharged into agriculture land where this polluted water is used to irrigate crops and vegetables. The fertility of agricultural land gets destroyed, which affects the crops and vegetables growing in it (Asfaw *et.al*, 2013). Kanpur city in Uttar Pradesh, India is aptly called heavy metals. "Leather city" as some of the largest tanneries in India are situated here. Over the years, soil and water pollution in Kanpur region has drastically reduced the crop yields by 25-40%. The totally cropping area also decreased due to the pollution (Sahu *et.al*, 2007).



**Source:** Springer link- Mining tannery effluent and fertilizing effect on growth, nutrient accumulation and photosynthetic capacity of some cucurbitaceans vegetables: A little help from foe (Zaheer *et.al*, 2023).

### Treatment of tannery effluent

The leather industry is one of the most polluting sectors in terms of volume and difficulty of waste disposal. Over the years there has been a special focus on the use of advanced treatment technologies in the treatment of industrial waste water. Electrochemical technology is one of the most promising methods for the treatment of waste water containing organic pollutants. Energy efficiency, automation and environmental friendliness are among the benefits of electrochemical technology (Suman *et.al*, 2021). Application of physico-chemical methods for various treatment tannery wastewater (Song *et.al*, 2000), electro-floatation (Muruganathan *et.al*, 2004), membrane filtration (Justina *et.al*, 2009) and biological methods (Martinez *et.al*, 2003; Murat *et.al*, 2006; Munz *et.al*, 2008; Zupancic and Jemec, 2010). Wastewater contains many organic compounds that are resistant to conventional chemical and biological treatment (Schrank *et.al*, 2004).

The following are the main aspects of treatment –

#### (a) Preliminary treatment

In the case of general effluent treatment plants (CETPs) often found in developing countries serving ternary agglomerations it is necessary to install complete treatment units in individual tanneries. This rule requires large deposits of sludge and grease to be removed but the sulphide and chrome content must be reduced before releasing the waste into the collection network.

#### (b) Primary treatment (physical-chemical treatment)

Removal of organic and inorganic solid capable of settling by sedimentation and removal of floating materials by skimming. During primary treatment approximately 25-50% of the bio-chemical oxygen demand (BODs), 50-70% of the suspended solids and 65% of the grease and oil are removed. The sludge and flux resulting from primary sedimentation are called primary sludge and flux.

#### (c) Secondary treatment (biological treatment)

Primary treatment is followed by secondary treatment, which aims to remove biodegradable dissolved and colloidal organic matter using aerobic biological treatment. Aerobic biological

treatment is carried out by aerobic micro-organisms (mainly bacteria) in the presence of oxygen that metabolize organic matter in the waste water, producing more micro-organisms and inorganic end products (mainly  $\text{CO}_2$ ,  $\text{NH}_2$  and  $\text{H}_2\text{O}$ ). Several aerobic biological processes are used for secondary treatment. The main differences between them related to the rate at which the organism metabolizes organic matter and the way oxygen is supplied to the micro-organisms.

**(d) Tertiary treatment (advanced treatment)**

The use of tertiary and advanced waste water treatment is employed to reduce COD load throughout.

**(e) Sludge handling and disposal**

Wastewater treatment plants produce treated effluent and sludge because naturally the primary purpose of wastewater treatment is to remove certain potentially hazardous substances and solids from the waste water. Apart from this, the degraded organic matter gets converted biologically into bacterial cells and the removed from the wastewater.



**Source:** KNN India- 20 MLD CETP approved for Jajmau, Kanpur, at estimated cost Rs 554 Cr for treatment of effluent from tanneries.

**CONCLUSION**

The waste material coming out of Jajmau tannery industry located in Kanpur contains excess of heavy metals, which affects the organisms present in the soil and environment. There is excess of chromium in the arable soil, rivers and drains in the area around tannery industry in Jajmau and it affects the plant growing in the soil, humans, animals and the environment such as stopping the growth of plants, various diseases in humans etc. Hazardous waste effluents from the tannery industry can be treated using a variety of treatment such as CETPs and aerobic biological treatment processes. This treatment is quite effective.

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