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Impacts of Industrial Soil Pollution on Agricultural Productivity in Savar Municipality: A Management Perspective

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Abstract

Industrialization promotes the development or economic growth of a country. Since the early 1990s, Savar Municipality has evolved as a vital suburb of Dhaka City, offering possibilities but also experiencing environmental pollution at the same time due to uncontrolled industrial growth. The purpose of this research is to determine the impact of industrial soil pollution on agriculture at Savar municipality, Dhaka, Bangladesh by measuring various soil quality parameters, conducting Key Informant Interview (KII) and Focused Group Discussion (FGD) with the farmers of the study area. Most observed heavy metal concentrations in the soil exceeded Soil Resource Development Institute (SRDI) specifications, with high levels of zinc, copper, iron, and nickel jeopardizing plant growth. Nutrient components in the soil varied, with some above and others below the acceptable amount. A very poor state of moisture content was also observed. discharging of untreated toxic effluents by industries into nearby water bodies allows the spreading of the effluents into the agricultural land, degrading soil fertility and reducing crop yield. A noticeable decrease in per hectare production of different crops was also found along with very sharp decrease in the amount of arable land over the last fifteen years. Legislative measures must enforce industries to treat industrial effluents before discharge.

Keywords: Soil, Agriculture, Nutrients, Heavy metals, Pollution

1. Introduction

In the past, as nations transitioned from low to middle income state, the industry sector has been the area that has propelled development. Economic expansion is accelerated by industrialization, but environmental pollution and deterioration are also accelerated (Hasan et. al, 2021). Since the formation of the Export Processing Zone in the early 1990s, the manufacturing sector has begun to play a greater role in Bangladesh's economic growth and the rate of GDP growth has amplified (EPZ) (Hossain et al., 2019). However, Bangladesh's expanding industrial base is not without its issues. Over time, Bangladesh's unplanned development has seriously degraded the environment.

To support the rapid industrialization, practically every industrial facility makes extensive use of natural resources. As a result, industrial development contributes to increased environmental degradation (Khanam and Shahnewaj, 2017). The total number of industries in Bangladesh are 46,291 and the wastewater discharge is expected to continue increasing if traditional dyeing techniques are used by the textile sectors (Ovi 2019, Hossain et. al., 2018). It is concerning when industrial effluents are released into

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agricultural fields and channels without appropriate treatment as they can eventually enter the river system and spread (Sultana et al., 2009, Eruola et al., 2011). Untreated wastewater effluent resulting from various human actions such as food production, textile, manufacturing, pharmaceutical and medical procedures, and the oil and gas sectors damages soil and surface water, which has a severe effect on agriculture, insect pests, animals, and human health (Hossain et. al., 2010, Izah et al., 2022).

Industrial wastewaters have a substantial effect on soil condition, causing it to lose its fertility and become nutrient-contaminated (Ladwani et al., 2012). Lengthy irrigation with industrial wastewater is well-known to significantly affect the amount of heavy and trace elements in surface soil, including Cu, Zn, Cr, Ni, Pb, and Mn. (Mapanda et al., 2005). Therefore, significant trace element deposition in agricultural soils caused by wastewater irrigation may compromise the quality and safety of food in addition to contaminating the soil (Muchaweti et al., 2006; Kumar Sharma et al., 2007).

Additionally, contamination can impair soil quality over time, making it more challenging to cultivate crops. 40% of the world's population, or at least 3.2 billion people, are currently impacted by the deterioration of land and soils (United Nations Environment Programme, 2020). Bangladesh's economy is largely focused on agriculture. Even though this percentage is declining, agriculture is still the main source of income for most people today. The most significant cereal crop in Bangladesh is rice, which is crucial to the country's economy and provides around 73% of the population's daily protein and calories (Alam et al., 2002). Rapid industrialization, however, has created a persistent barrier that is adverse for the development of agriculture due to its detrimental effects on the air, water, soil, and climate (Anik, 2019). Bangladesh loses 221 hectares of agricultural land per day and 82900 ha of crop land, or 1% of its total arable land, per year (Mahabub, 2003).

Industrial growth started in Savar Municipality in the early 1990s of the previous centuries (Sultana et al., 2012). Savar municipality has been subjected to unplanned industrialization over the decade. The toxic effluents released from these industries enter the soil when the toxic water is used for irrigation purposes or the water bodies get over flooded during monsoon. The significant industrial concentration and the coexistence of industrial and agricultural land in Savar Municipality influence the agricultural productivity of the area.

2. Material And Methods

The objectives of this study are to investigate the impacts of industrial soil pollution agricultural productivity and providing some recommendations based on the outcome. In this study mix methods approach has been used to conduct the research where both qualitative and quantitative methods have been used to carry out the study. Convenience sampling technique was used to collect soil and conduct Focus Group Discussions (FGD) for the purpose of the study. Four FGDs containing 10 farmers in each discussion and Key Informant Interview (KII) in the study area have been conducted to get an insight about how industrial soil pollution can affect agricultural productivity. 4 surface soil samples were conveniently collected starting with a point source covering 4 buffer zones with 250 m between them. All the soil samples were collected during August of 2024.

Normalized Difference Vegetation Index (NDVI) Calculation: To determine the quantity of vegetation cover on Savar Municipality, satellite data was obtained from the United States Geological Survey (USGS) server. This study uses satellite pictures from Landsat 5 and Landsat 8 from 2010 to 2024 to ensure clear image resolution. ArcGIS software has been used for pre-processing, classification, and map creation.

NDVI measures the greenness of vegetation and is important for understanding vegetation density and assessing fluctuations in plant health. The NDVI values range from -1 to 1. Lower NDVI values (often 0 to 0.2) indicate light or dark soils, whereas higher NDVI values indicate dense vegetation (typically 3). NDVI is determined using the following equation:

$$NDVI = \frac{(\text{NIR} - \text{Red})}{(\text{NIR} + \text{Red})}$$

In Landsat 4-7,

$$NDVI = \frac{(\text{Band 4} - \text{Band 3})}{(\text{Band 4} + \text{Band 3})}$$

In Landsat 8-9,

$$NDVI = \frac{(\text{Band 5} - \text{Band 4})}{(\text{Band 5} + \text{Band 4})}$$

2.1 Study Area Profile

Savar municipality is a part of Savar Upazilla, which is also thought to be the closest municipality to the capital Dhaka, and is situated within Dhaka district. According to the district gazetteer, Savar was once the capital of the Sambhog principality, which was the realm of Raza Harish Chandra in the seventh century. The Savar municipality lies 26 kilometers from the northwestern edge of Dhaka, and it is bordered on the east by Turag, the west by Dhalashwari and Bangsi, and the south by Buriganga (Population & housing census, 2011). About 2, 50, 562 people make up the Savar municipality's whole population among them 86, 893 are male voters and 83, 361 are female voters. Savar Municipality's rate of population increase is roughly 8.83%. Savar Municipality has 29, 62, 9 households in total (Savar Municipality, 2022). The majority of the land in the municipality of Savar is utilized for housing. Additionally, thinly populated land is used for institutional, commercial, industrial, and infrastructure purposes. This locality also includes many open space, nuemerous road infrastructure and water bodies.

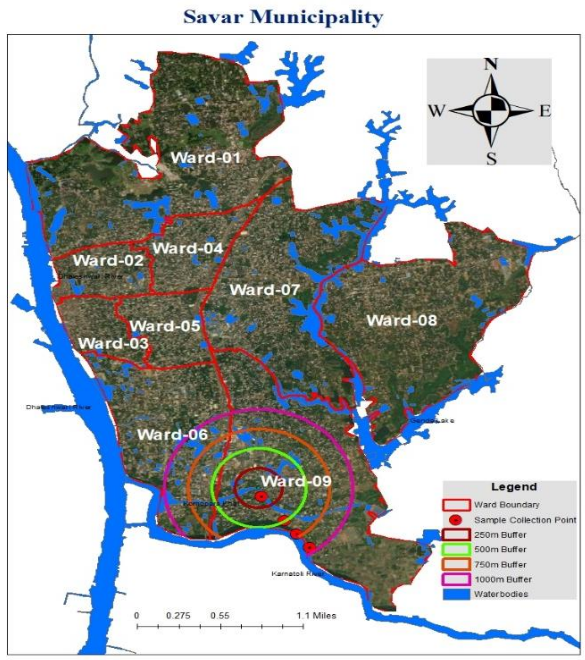


Figure 1: Sample Collection Point of Savar Municipality

Source: Developed by author, 2024

3. Results

Exploring existing soil quality helps to determine the soil fertility and detect nutrient level in the soil necessary for the plant development. It also helps to identify types of pollutants discharged at an alarming rate from the nearby industries enabling them to decide appropriate measures to prevent soil pollution. Moreover, analysis of existing quality of soil helps to track down the available quantities of plant nutrients in the soil.

Table 1: Comparison of soil sample parameters with the standard values

Physio-chemical parameters	Standards*	250 meters	500 meters	700 meters	1000 meters
pH	6.6-7.3	7.2	7.2	7	6.7
EC (ds/m)	0.50-1.25	0.85	0.72	0.18	0.33
Organic Carbon (%)	>2	3.627	3.393	1.209	1.248
Organic Matter (%)	1-10	6.2529	5.8495	2.0843	2.1515
Total Nitrogen (%)	0.271-0.36	0.3126	0.2924	0.1042	0.1075
Phosphorus (ppm)	22.51-30	18.53	14.06	10.20	26.75
Sulphur (ppm)	22.51-30	245.46	239.10	110.48	111.23
Boron (ppm)	0.451-0.6	0.06	1.04	0.23	0.39
Zinc (ppm)	0.226-0.30	20.41	19.96	4.16	5.29

Physio-chemical parameters	Standards*	250 meters	500 meters	700 meters	1000 meters
Copper (ppm)	0.451-0.6	16.89	13.36	8.69	8.47
Iron (ppm)	9.1-1.2	128.13	161.96	112.17	161.96
Manganese (ppm)	2.251-3	19.52	31.56	30.42	31.42
Chloride (cmol/kg)	0.4507	0.56	0.56	0.22	0.28
Chromium (ppm)	100	43.91	41.17	34.55	36.42
Nickel (ppm)	35	47.25	40.03	35.53	31.09

Source: Laboratory test from Soil Resource Development Institute (SRDI), 2024 (Standards*: SRDI, 2024)

From the analysis of the soil quality of the study area it is evident that the soil of the study area is in very poor state. Since long time, the effluents from various industries have been discharged into the nearby river and agricultural low land without any prior treatment. Thus, the soil quality of the study area is deteriorating day by day either due to lack of appropriate nutrients or presence of high level of heavy metals.

3.1 Impacts of Industrial Soil Pollution on Agricultural Productivity

In Bangladesh thousands of industries are built every year without any predefined plan. Some of the industries are built right beside agricultural land violating the environment conservation rule, 1997 of Bangladesh. These industries also dump their untreated industrial effluents carelessly causing severe damage to the nearby agricultural land and thus also affect the quality and quantity of crop production. These heavy metals can end up entering the human body causing various diseases like cancer, neurotoxicity, kidney damage, gastrointestinal effects etc.

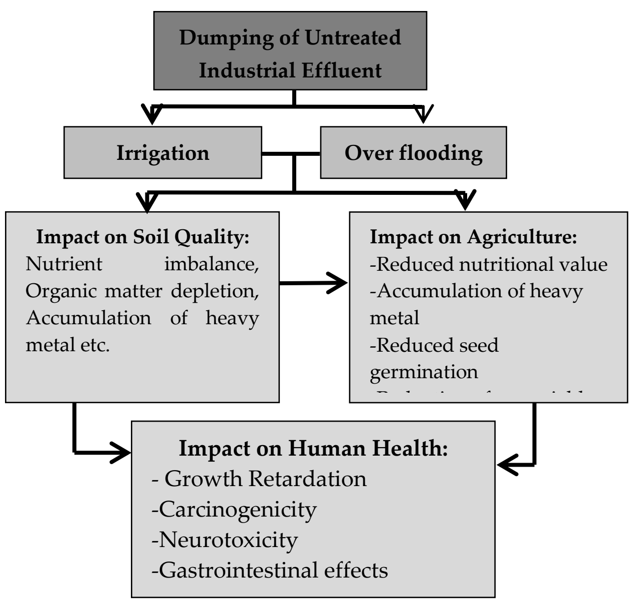


Figure 2. Impact of Industrial effluent on agricultural productivity
Source: Developed by authors 2024 with help of Khalid et al., 2018

Table 2 shows the impact of different heavy metals in soil on plant development or agricultural productivity

Table 2**:** Impacts of various heavy metals on plants

Parameters	Harms Caused by Deficiency	Harms Caused by Excessiveness	State in the Study Area
Zinc	Midrib of the leaf specially the root of becomes white. Older leafs get effected by rust like stain. Leafs become smaller in size and edge of some leafs become curly.	Relatively small leaves, chlorosis of the younger leaves, necrotic leaf tips, slowed overall crop growth, slower root development.	All the samples have higher amount of zinc.
Manganese	Crops that have been affected turn pale green and develop slowly.	Manganese overdose causes necrotic patches and chlorosis on elder vine leaves.	All the samples have excessively high amount of manganese.
Copper	Yellow-white stains appear on young leaves, along with creases or folding.	High copper levels can burn root tips, leading to reduced root development, stunted plant growth, and impaired seed germination.	All the samples have higher amount of copper than the standard limit.
Iron	The leaf gradually turns yellow-white, with symptoms first appearing in young leaves.	High soil iron levels affect proteins and lipids in crops like rice, reducing root development.	All the samples have excessively high amount of iron.
Nickel		Nickel toxicity causes reduced metabolic rates, stunted growth, and decreased resistance in affected plants.	All samples have higher amount of nickel
Chromium		Cr toxicity inhibits metabolism, damages root tissues, and slows plant development	Lesser than maximum permissible limit.

Source: SRDI, 2024

3.2 Changes in the Agricultural Land and Crop Production

According to Savar upazilla agriculture office, 2024; the total arable land of Savar municipality in the year 2023-24 is 35 hectares and 165 hectares of agricultural land loss can be observed over the past 15 years. The amount of total arable land in 2010 was 200 hectares which indicates how drastically the agricultural land is decreasing in the study area. Even after considering the very sharp decrease in the amount of agricultural land a

0.9 metric ton decrease can be observed in the per hectare production. The amount of paddy production of the area in the year 2023-24 was 49 metric ton which was 458 metric ton in the year 2009-10.

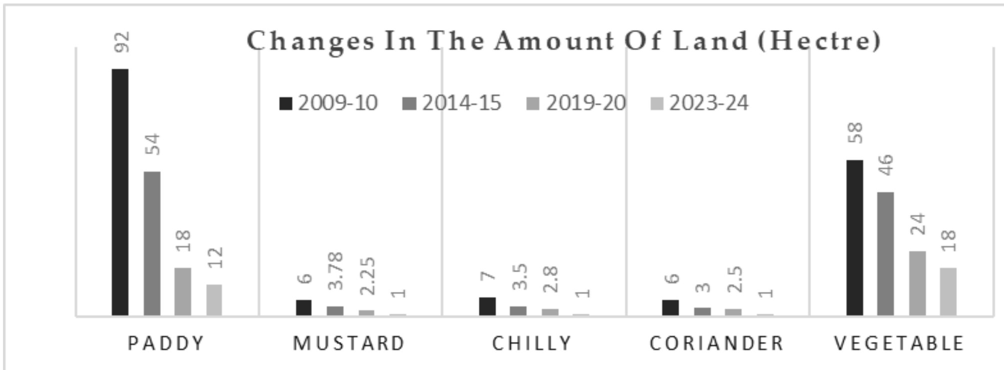


Figure 3. Changes in the amount of land from 2010-2024

Source: Savar Upazilla Agriculture Office, 2024

A very noticeable increase both in the amount of land and per hectare production of flower can be observed over the last 15 years. Farmers of the area got more interested in the floriculture with the passing years making Savar one of the Bangladesh's largest flower producers.

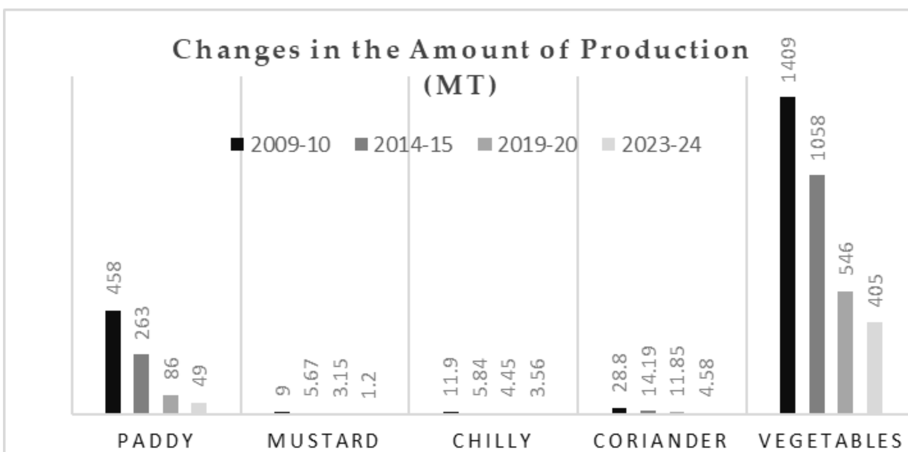
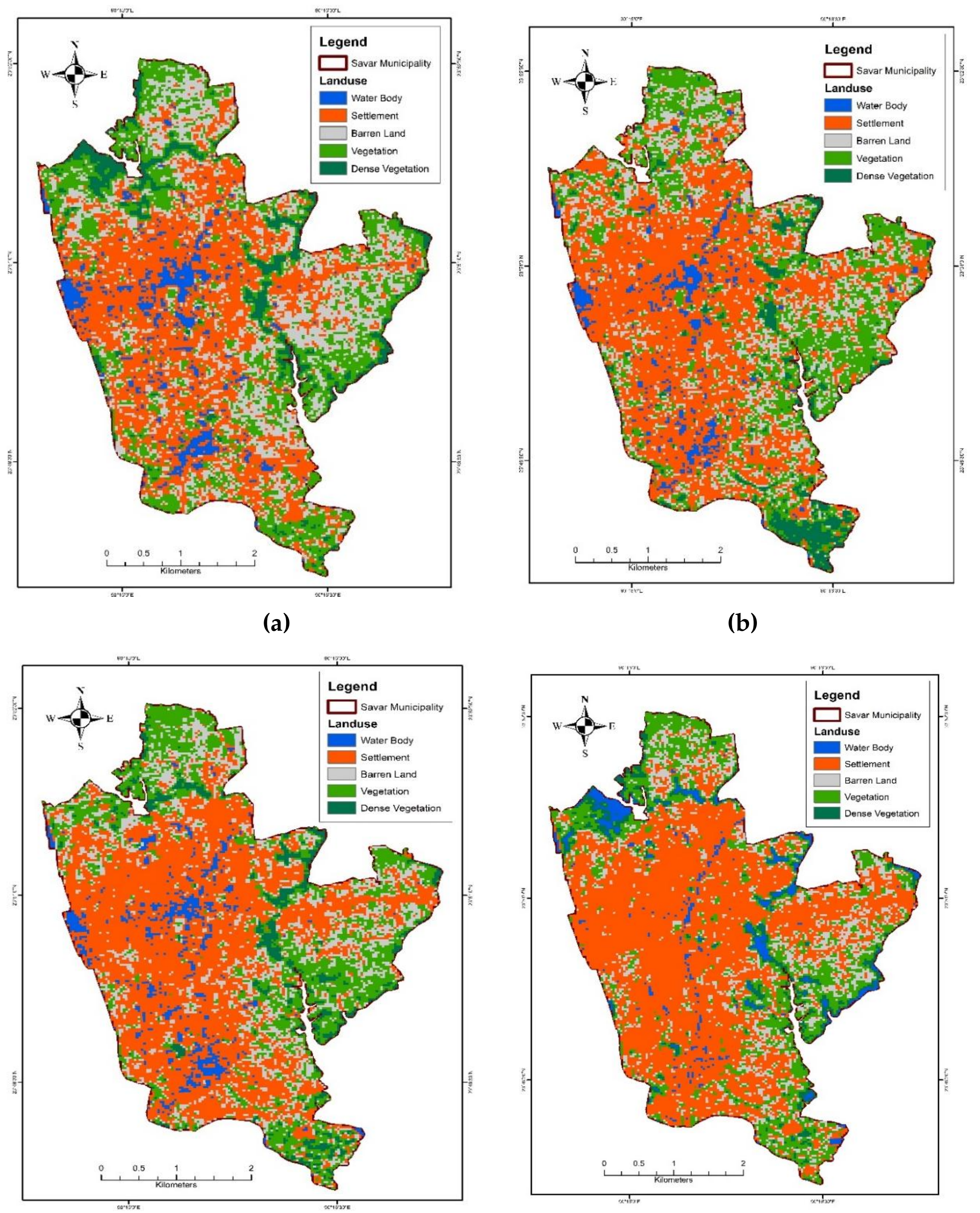


Figure 4. Changes in the amount of production from 2010-2024

Source: Savar Upazilla Agriculture Office, 2024

For each type of agricultural product, a reduction in both the amount of agricultural land and production can be observed except for flower cultivation. Though amount of agricultural land decrease is very high, it is not the only reason for the reduced crop yield. A very significant decrease in the amount of per hectare crop production is evident for each type of crops except flowers. Over the years a reduction in per hectare crop production for paddy, mustard, chilly, coriander and vegetables in the area amounting

0.9 metric ton, 0.3 metric ton, 0.14 metric ton, 0.22 metric ton and 1.8 metric ton respectively can be observed. The slow deterioration of the land in the study area is the main cause of this drop in agricultural output.



(a) (b)

(c) (d)

Figure 5: NDVI of Savar municipality of 2010 (a), 2015 (b), 2020 (c) and 2024 (d)
Source: Developed by author, 2024

Settlement increased significantly between 2010 and 2024 (17.74%), while all other types exhibited reductions, particularly Barren Land (10%) and Vegetation (4.88%). Additionally, there were decreases of 1.47% and 1.39% in waterbodies and dense vegetation, respectively. These results support the findings that industrial expansion and the increasing industrial pollution, such as heavy metal contamination in the soil, decreased soil nutrients, etc., are to blame for the struggles of the local farmer and a notable decline in arable land.

Table 3**:** Change Pattern of Savar Municipality

Types	**Area (Km²)**				**Percentage (%)**			
	2010	**2015**	**2020**	**2024**	**2010**	**2015**	**2020**	**2024**
Waterbody	0.97	0.75	0.82	0.71	5.52	4.26	4.67	4.05
Settlement	6.69	8.05	8.60	9.81	38.05	45.76	48.91	55.79
Barren land	4.60	3.74	3.54	2.84	26.16	21.27	20.11	16.16
Vegetation	4.26	4.11	3.74	3.40	24.24	23.38	21.26	19.36
Dense Vegetation	1.06	0.94	0.89	0.82	6.03	5.32	5.06	4.64

3.3 Farmer's Perception

Majority of the farmers in the study area are mostly engaged in cultivation of 'Boro' rice while many of them are also engaged in growing other crops like mustard, chilly, coriander etc. Additionally, most of the farmers are also engaged in homestead vegetation.

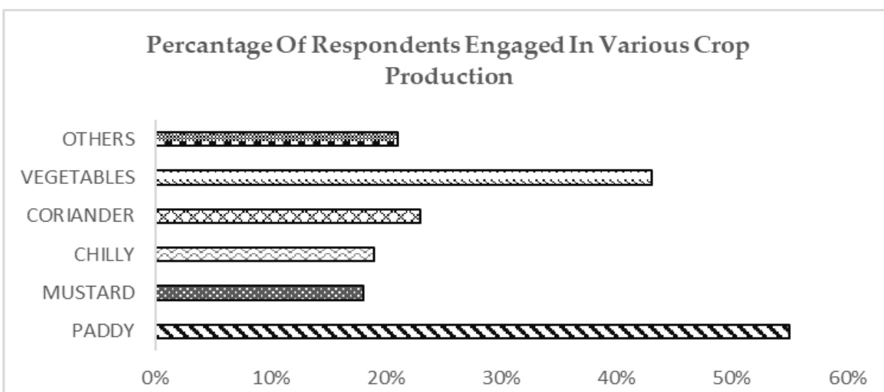


Figure 6. Percentage of the respondents engaged in various crop productions

Source: Field Survey, 2024

Most farmers view the increasing number of industries as a danger to their farming operations. Many of the farmers mentioned the possibility that the water they used for irrigation might be contaminated by industrial effluents as they observe surrounding industries disposing waste into the nearby river. Additionally, they believe that this may be a major cause of the decline in the fertility of their agricultural land.

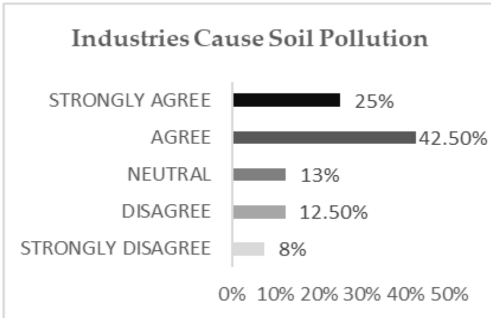


Figure 7. Opinion of the respondents on soil pollution

Source: Field Survey, 2024

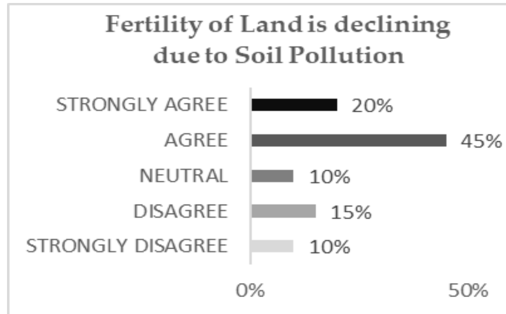


Figure 8: Respondents' opinions on declining land fertility

Source: Field Survey, 2024

Many respondents have also indicated that the reduction of agricultural land is partly due to the selling of agricultural land as the fertility of land and crop yield is decreasing gradually.

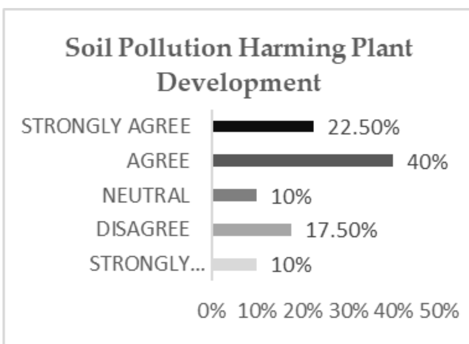


Figure 9. Respondents' opinions on soil pollution's impact on plant development

Source: Field Survey, 2024

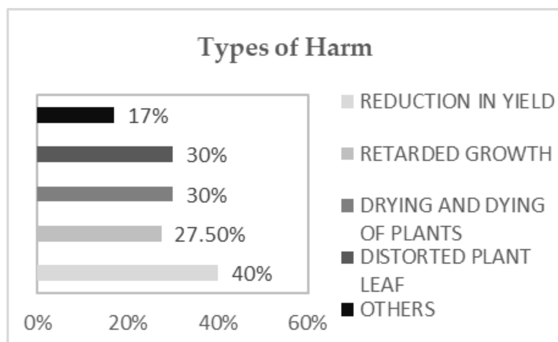


Figure 10. Respondents' opinions on major types of harms on plants

Source: Field Survey, 2024

So many farmers are losing their interest in farming due lack of manpower, improper market value of agricultural output, lack of proper incentives, lack of improved mechanized agricultural technology as well as decreasing fertility of land.

4. Discussions

Despite government mandates requiring installation of ETP (Effluent Treatment Plant) for industries discharging toxic effluents, majority of the industries of the study area have none or non-functioning ETP. This has led to the contamination soil and water of the area, mainly surrounding agricultural land resulting in reduced crop yield, retarded growth etc.

4.1 Recommendations

For all the current industrial clusters located in the research region, pollution from industry must be reduced. Some major measures that can be taken are briefly given below:

Use of Functional Finishes to Protect Environment: Beeswax, aloe vera, and vitamin A finish is a wonderful substitute for dangerous chemicals used to finish the fabric. A fire-retardant finish that uses chemicals devoid of dangerous components is currently being sought after (Rahman et al., 2001).

Organic Cotton Production to Save the Environment: Utilizing organic cotton (OC) from farms with enough natural precipitation to irrigate crops should be considered a priority. Environmental pollution might be decreased if organic cotton could be cultivated without the use of pesticides and chemicals (Parvin et. al., 2020).

Uses of Different Technologies: "Air Dyeing Technology," can be used in dying textiles as it is a method that employs wind as opposed to water, allowing businesses to produce clothes without jeopardizing the environment or the supply of water. It uses 87 percent less energy and emits 84 percent fewer greenhouse gases (Parvin et. al., 2020). It is important in existing buildings to replace energy-intensive equipment with energy-efficient equipment. ***Modification of the Faulty Machineries:*** Poor air quality and water usage can both be reduced through the alteration of current equipment. Additionally, the adoption of modern technology can hasten result in the removal of subpar machinery (Müezzinoğlu, 1998).

Lean Manufacturing Model to Reduce Waste Disposal: To help businesses cut waste, lean Production provides an array of tools (Chiarini, 2014) where waste reduction is concerned with cutting down on excessive production, faulty products, trash, work-in-process inventories, waiting periods, and unnecessary movements (Bellido, 2018).

Focus on Green Building when Developing New Facilities: The notion of "green building" refers to environmentally friendly structures that conserve energy, water, and other natural resources while preserving the building's functionality and can reduce wastewater as water conservation is a part of it (Ayuningtyas et al., 2022).

***Cleaner Production Process for Industries*:** Cleaner production (CP) refers to the continuous execution of an integrated preventative environmental approach to processes, goods, and services to mitigate risk, enhance environmental conditions, boost economic benefits, boost productivity, and more (Cheremisinoff, 2006; Drexhage and Murphy, 2010).

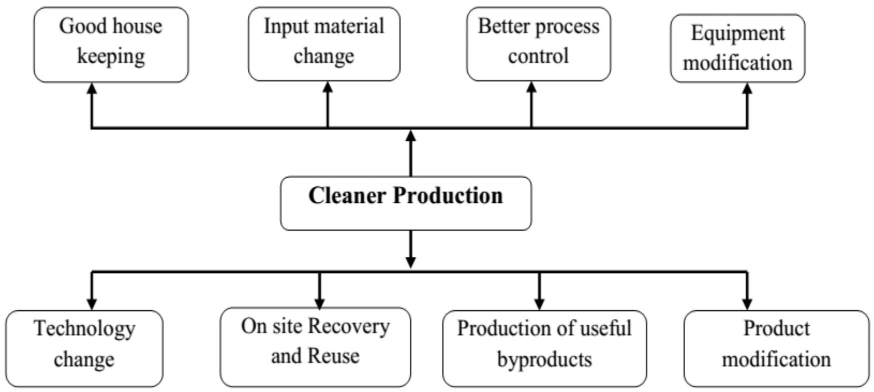


Figure 11. Elements of cleaner production system

Source: UNIDO-UNEP, 2010

Industrial Effluent Treatment: ETPs are designed to treat contaminated water in accordance with national standards, buyer requirements, and public concerns, therefore regular monitoring is required for effective operation (Sultana et al., 2013).

Policy and Management Interventions: It's essential to give priority to the several actions for effective pollution prevention and environmental management such as developing laws specially designed for soil pollution prevention, upholding standards for soil quality, and imposing obligations on businesses to make up for the harm caused by soil pollution etc. (Ramón & Lull, 2019; Xia and Luo 2006; Sousa, 2001).

5. Conclusion

The composition of irrigation water drained from canals has significantly changed because of effluent discharge, and as a result, several chemical components have also increased in the soil of the irrigated farmland. Additionally, the presence of untreated harmful industrial effluent has a negative impact on the nearby farmed land's ability to produce crops. Consumption of these metal-contaminated veggies over an extended period can result in cancer, dermatitis, brain and kidney damage, thalassemia, and other illnesses. To prevent an excessive buildup of hazardous substances in the food chain, regular monitoring industries is crucial.

References

Alam, M. G. M., Allinson, G., Stagnitti, F., Tanaka, A., & Westbrooke, M. (2002). Arsenic contamination in Bangladesh groundwater: A major environmental and social disaster. International Journal of Environmental Health Research, 12(3), 235–253. https://doi.org/10.1080/0960312021000000998

Anik (2019). Industrialisation in Bangladesh: Prospects and Challenges. *Daily Sun*. https://www.daily-sun.com/post/368122/Industrialisation-in-Bangladesh:-Prospects-and-Challenges

Ayuningtyas, U., Susanto, D. A., Buwana, E., & Emelia, T. (2022). The compliance of water conservation aspects of clean water, wastewater, and rainwater management for residential buildings to support the green building concept. *IOP Conference Series: Earth and Environmental Science*, *1108*(1), 012015. https://doi.org/10.1088/1755-1315/1108/1/012015

Bellido, Y., La Rosa, A., Torres, C., Quispe, G., & Raymundo, C. (2018). Waste optimization model based on Lean Manufacturing to increase productivity in micro-and small-medium enterprises of the textile sector. *CICIC 2018 - Octava Conferencia Iberoamericana de Complejidad, Informatica y Cibernetica, Memorias, 1*, 148-153.

Cheremisinoff, N. P. (2006). Getting an EMS Started. In Environmental Managament Systems Handbook for Refinieries (pp. 55–110). Elsevier. https://doi.org/10.1016/B978-0-9765113-8-0.50006-1

Chiarini, A. (2014). Sustainable manufacturing-greening processes using specific Lean Production tools: an empirical observation from European motorcycle component manufacturers. *Journal of Cleaner Production*, *85*, 226-233. https://doi.org/10.1016/j.jclepro.2014.07.080

Drexhage, J. & Murphy, D. A. (2010). Sustainable development: from Brundtland to Rio 2012. *New York, NY: United Nations*, *26*.

Eruola, A. O., Ufoegbune, G. C., Eruola, A. O., Awomeso, J. A., Adeofun, C. O., Idowu, O. A., & Abhulimen, S. I. (2011). An assessment of the effect of industrial pollution on Ibese River, Lagos, Nigeria. *African Journal of Environmental Science and Technology*, *5*(8), 608-615.

Hasan, M. M., Basak, R., Sujan, M. H., Kabir, M. N., Das, D., Aritro, S. S., & Howladar, M. F. (2021). An Assessment of the Impact of Industrialization on Physical Environment and Socio-economic Conditions around the Alipur Industrial Area, Bangladesh. *American Journal of Agricultural Science, Engineering, and Technology*, *5*(2), 309-325. https://doi.org/10.54536/ajaset.v5i2.102

Hossain, M. A., Zahid, A. M., Arifunnahar, M., & Siddique, M. N. A. (2019). Effect of brick kiln on arable land degradation, environmental pollution and consequences on livelihood of Bangladesh. *Journal of Science, Technology and Environment Informatics*, *6*(02), 474-488. https://doi.org/10.18801/jstei.060219.50

Hossain, L., Sarker, S. K., & Khan, M. S. (2018). Evaluation of present and future wastewater impacts of textile dyeing industries in Bangladesh. *Environmental Development, 26,* 23–33. https://doi.org/10.1016/j.envdev.2018.03.005

Hossain, M. A., Uddin, M. K., Molla, A., Afrad, M., Rahman, M., & Rahman, G. (2010). Impact of Industrial Effluents Discharges on Degradation of Natural Resources and Threat to Food Security. *The Agriculturists, 8*(2), 80–87. https://doi.org/10.3329/agric.v8i2.7581

Izah, S. C., Aigberua, A. O., & Srivastav, A. L. (2022). Factors influencing the alteration of microbial and heavy metal characteristics of river systems in the Niger Delta region of Nigeria. *In Ecological Significance of River Ecosystems* (pp. 51–78). Elsevier. https://doi.org/10.1016/B978-0-323-85045-2.00005-4

Khalid, S., Shahid, M., Natasha, Bibi, I., Sarwar, T., Shah, A. H., & Niazi, N. K. (2018). A review of environmental contamination and health risk assessment of wastewater use for crop irrigation with a focus on low and high-income countries. *International journal of environmental research and public health*, *15*(5), 895. https://doi.org/10.3390/ijerph15050895

Khanam, M., & Shahnewaj (2017). Environment and industrialization. *Daily Star.* https://www.thedailystar.net/law-our-rights/environment-and-industrialisation-1507165

Kumar Sharma, R., Agrawal, M., & Marshall, F. (2007). Heavy metal contamination of soil and vegetables in suburban areas of Varanasi, India. *Ecotoxicology and Environmental Safety*, *66*(2), 258–266. https://doi.org/10.1016/j.ecoenv.2005.11.007

Ladwani, K. D., Ladwani, K. D., Manik, V. S.,&Ramteke, D. S. (2012). Impact of industrial effluent discharge on Physico-chemical characteristics of agricultural soil. *International Research Journal of Environment Sciences*, *1*(3), 32-36.

Mahbub A. (2003). Agricultural land loss and food security: An assessment. *IRRI, Manila, The Philippines.*

Mapanda, F., Mangwayana, E. N., Nyamangara, J., & Giller, K. E. (2005). The effects of long-term irrigation using water on heavy metal contents of soils under vegetables. *Agriculture Ecosystem and Environment, 107*(2–3), 151–165.

Muchuweti, M., Birkett, J. W., Chinyanga, E., Zvauya, R., Scrimshaw, M. D., & Lester, J. (2006). Heavy metal content of vegetables irrigated with mixture of wastewater and sewage sludge in Zimbabwe: Implications for human health. *Agriculture Ecosystem and Environment*, *112*(1), 41–48.

Müezzinoğlu A (1998). Air pollutant emission potentials of cotton textile manufacturing industry. *Journal of Cleaner Production 6*(3-4), 339-347

Ovi, I. (2019). BBS Survey 2019: Number of small industries up, large and medium one down. *Dhaka Tribune.* https://www.dhakatribune.com/business/2019/05/30/bbs-survey-2019-number-of-small-industries-up-and-medium-ones-down

Parvin, F., Islam, S., Urmy, Z., Ahmed, S., & Islam, A. (2020). *A Study on the Solutions of Environment Pollutions and Worker's Health Problems Caused by Textile Manufacturing Operations.* https://doi.org/10.13140/RG.2.2.13842.79048

Population & Housing Census (2011). Bangladesh Bureau of Statistics

Rahman, F., Langford, K. H., Scrimshaw, M. D., & Lester, J. N. (2001). Polybrominated diphenyl ether (PBDE) flame retardants. *Science of The Total Environment*, *275*(1–3), 1–17. https://doi.org/10.1016/S0048-9697(01)00852-X

Ramón, F., & Lull, C. (2019). Legal measures to prevent and manage soil contamination and to increase food safety for consumer health: The case of Spain. *Environmental Pollution*, *250*, 883–891. https://doi.org/10.1016/j.envpol.2019.04.074

Savar Municipality. (2022). Savar Municipality. http://savar.dhaka.gov.bd/

Savar Upazila Agriculture Office. (2022). *Unpublished report.* Savar Upazila Agriculture Office.

Sousa, C. D. (2001). Contaminated sites: The Canadian situation in an international context. *Journal of Environmental Management*, *62*(2), 131–154. https://doi.org/10.1006/jema.2001.0431

Sultana, Z., Ali, Md. E., Uddin, Md. S., & Haque, Md. M. (2013). Implementation of Effluent Treatment Plants for Waste Water Treatment. *Journal of Environmental Protection*, *04*(03), 301–308. https://doi.org/10.4236/jep.2013.43035

Sultana, S., Rahman, U. & Saika, U. (2012). Industrialization and Urban development: A future land use plan at Kalma Mouza on Savar in Bangladesh. Bangladesh: LAP LAMBERT Academic Publishing.

Sultana, M. S., Islam, M. S., Saha, R., & Al-Mansur, M. A. (2009). Impact of the effluents of textile dyeing industries on the surface water quality inside DND embankment, Narayanganj. *Bangladesh Journal of Scientific and Industrial Research*, *44*(1), 65-80.

United Nations Environment Programme. (2020). *Soil pollution: A risk to our health and food security.* UNEP. https://www.unep.org/news-and-stories/story/soil-pollution-risk-our-health-and-food-security

UNIDO-UNEP. (2010). *Taking stock and moving forward: Sustainable production in practice in developing and transition countries* (16 pp.). The UNIDO-UNEP National Cleaner Production Centers.

Xia, J.-Q., & Luo, Y.-M. (2006). *Definition and three evaluation guidelines of soil contamination*. *22*, 87–90.