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REVIEW PAPER

The Impact of Agricultural Chemicals on the Environment and Human Health in India: A Review

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Abstract

The use of modern chemicals, including herbicides, pesticides, and fertilizers, has certainly improved food production globally, in the form of herbicides, pesticides, and fertilizers. As a result of excessive chemical application, the health of people and the environment were permanently affected by the effects of chemical exposure. Depending on how the residual effects of agrochemicals are applied to the ecosystem, neither terrestrial nor marine life might be protected. Better food and the use of fewer hazardous chemicals are required to fulfill upcoming food demand. To lessen the amount of chemical use, alternative approaches such as the use of GMOs, precision farming, and IPM must be implemented. This review illustrates the health risks associated with improper and excessive use of agrochemicals. It discusses the underlying elements, the most critical of which is a deficient education and extension system.

Keywords: Chemical fertilizers; Pesticides; Environment; Human health.

1. Introduction

Agricultural production should satisfy the present needs of society for food and, at the same time, provide surplus amounts of food. Surplus quantities of food can be exported and used in the future [1]. As a result of the increased population and food demand, agricultural production and productivity also hiked, and a number of chemical inputs have been employed in this process, including pesticides. Pesticides are chemicals that, as their name implies, are used to kill pests directly. Biological agents and chemical agents can be used as pesticides to destroy pets. Viruses, bacteria anti microbes or disinfectants can act as these agents [2]. A wide range of pests that can harm crops and livestock as well as lower farm output have traditionally been controlled or eradicated using agricultural pesticides. Since the introduction of pesticides in early 1900s farmers and people everywhere in the world have attributed a great deal of improvement in agricultural yield due to pesticides. In order to overcome the food crisis [3], the Indian agriculture sector extensively promoted and used pesticides as well as fertilizer during the Green Revolution. Using pesticides provides advantages, but it also has long-term negative effects on ecosystems and human health. India, the largest producer of pesticides in Asia, is currently ranked 12th in the world for pesticide usage. Despite having a much lower average pesticide consumption than many other developed countries, India has a serious pesticide residue problem [4].

In and around their houses, many people spray their lawns and gardens with pesticides [5], yet agrochemicals have made it possible to reproduce food production during the past century. Pesticides are also utilized for public health purposes [6]. The worldwide utilization of agrochemicals crossed the acceptable level and make the environmental balance more vulnerable. This is a result of ignorance regarding the safe use of agrochemicals, their dangers, and environmental and public health concerns. Nitrogen (N), phosphorus as phosphate (P_2O_5), and potassium as potash (K_2O) are the three main fertilizer nutrients that are used globally and, the cumulative use of these chemicals is reached in 2016 to 186.67 million tonnes.

The expected increase in the worldwide annual demand for agrochemicals by the end of 2020 will be 2.4%. India also follows the same trend as the world's agrochemical demand. Even though the cropping intensity in India has increased from 118 tons per hector to 135 tons per hector over these years. At the same time, the gross irrigated crop area has been reducing in the same period. In the present situation, any kind of decline in agriculture production will lead to food scarcity. The population of India will reach 1400 million by 2025. The amount of food grain needed then will be 300 million tons, up from around 200 million tons now. So, food security has been a serious concern for India. In addition to this, climatic variations, environmental disasters, and low soil fertility will contribute to a much worse situation for the agriculture sector.

Hence more crop yield becomes the major objective of the Government of India and for this, the government promoted the excess production and use of fertilizers. But, in the long term, excessive use of agrochemicals will reduce soil fertility and disturb the soil texture. India is the fourth-largest producer of agrochemicals in the world, after China, the US, and Japan. But in agrochemicals utilization, India occupied the lowest position. India uses just 0.58 Kg per hectare compared to the US's 4.5 Kg and Japan's 11 Kg. The maximum usage of chemicals in India used for Paddy cultivation, (28%), which is followed by cotton (20%). The method of application, as well as the proper management of agrochemicals, is so important to get the expected result. Improper management and application will lead to serious environmental and social issues. In India, we can find such situations and we have to rectify it for and adopt sustainable methods for long-term living. According to FAO statistics (From 2002 to 2017), the world's fertilizer and pesticides use increase with each passing year, which indicates the intensity of the agrochemical utilization (Figure 1 and 2). On the other hand, India shows a different trend in fertilizer and pesticide usage. Fertilizer usage in India declines after 2010 and after that, maintained a steady state with minimum fluctuations. In pesticide usage in India, a drastic decline recorded in the year 2006. But in 2008, utilization again increased and crossed the previous hike in 2010 and continued with fluctuations [7].

A significant amount of hazardous effluents has been released into the earth, air, and water due to unsustainable agricultural practices used in many developing nations [8]. The current situation of soil inputs and their deterioration has become much more problematic with the emergence of nanotechnology and nonmaterials [9]. Also, it is crucial to consider how different soil characteristics depend on geographical and meteorological factors [10], [11] Herbicides, fungicides, insecticides, nematicides, molluscicides, rodenticides, and chemical fertilizers are just a few of the agrochemicals that are now being misused [12].

India's economy is mostly dependent on agriculture, and the majority of the rural population works in related fields. India, a developing country, already struggles with a number of conventional problems including starvation, personal hygiene, poor sanitation, inadequate medical treatment, etc. The never-ending list of occupational health risks is a result of economic growth, industrial expansion, and globalization. Using chemicals (such as insecticides, fungicides, herbicides, or fertilisers) has become a crucial component of Indian agriculture application as it has been shown that farm productivity is significantly correlated with the chemical application [13]. For instance, 38% of the nation's pesticides are used in the states of Karnataka, Andhra Pradesh, Maharashtra, and Punjab, and agrochemical use is more common in regions with robust irrigation infrastructure [14, 15].

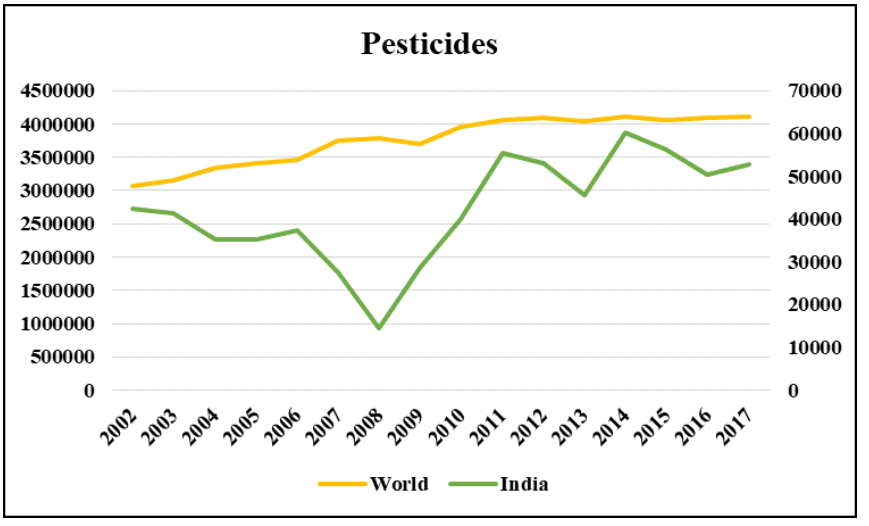

Figure 1: *Pesticides use of World and India in tones.*

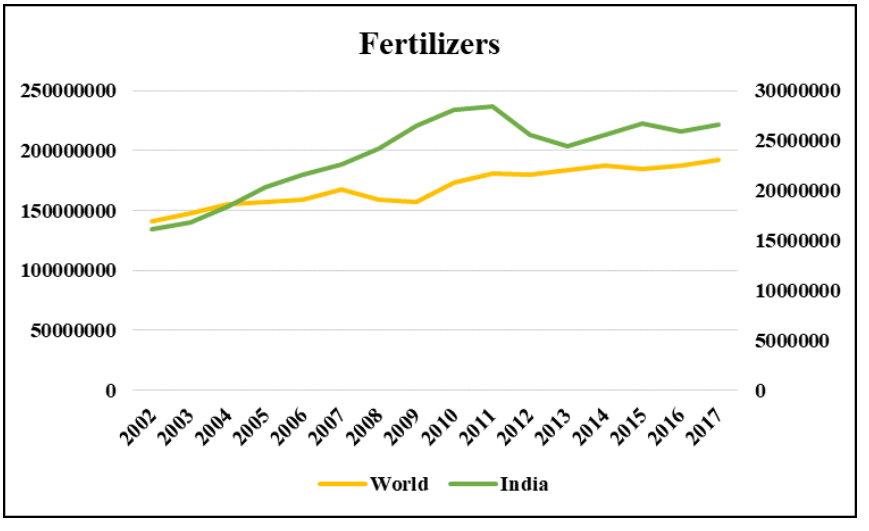

Figure 2: *Fertilizers use of World and India in tones.*

Arguments that claim improper and excessive use of agrochemicals in agriculture and related industries are to blame for global health issues and environmental degradation in addition to having an adverse effect on the health of the soil [16]. India alone accounts for one-third of all pesticide poisoning cases worldwide [15] . Agriculture workers, and women experience negative consequences from exposure to agrochemicals (mostly pesticides), which pass on their ill effects to future generations. Which pass on their ill effects to future generations, the same study carried out by Chitra [17] found that over 75% of farmers utilize very dangerous chemicals for farm use, and that pesticides directly expose 68% of farmers, when they are applied in South India. Furthermore, 88% of farmers that apply chemicals do so without taking any safety measures. Furthermore, by 2023, the global market for pesticides is projected to reach 90 billion doller, according to TechSci Research 2018. Class II pesticides were likewise discouraged by the FAO, who advised against the use of Class* Ia and Ib

pesticides in underdeveloped nations. Unfortunately, India continues to rely significantly on the usage of these "powerful" pesticides. Mega-companies promote the claim that "Potent Pesticides-Reduce Crop Loss" as a way to distinguish themselves, yet this just serves to intensify the downward spiral [17].

Classification according to FAO [18]: Class Ia pesticides are the most dangerous, Class Ib pesticides are the second most dangerous, and Class II pesticides are the moderately dangerous. Organochlorines, such as heptachlor and dichloro-diphenyl-trichloroethane (DDT), and endosulfan are, extremely effective pesticides that resemble steroid hormones in their structural makeup [19]. Similar to organophosphate and carbamates (such as, carbofuran and aldicarb) prevent synaptic impulse transmission by acting as AchE inhibitors. Similarly, nicotinic acetylcholine receptors (nAChRs) are antagonistic to neurotoxic pesticides like the insecticide imidacloprid [20]. The truth is that these poisonous chemicals' effects extend beyond the intended target pest and also have an impact on organisms that are not intended targets. The most notable and widely recorded effect is that of DDT, which is still found in small amounts throughout the food chain. There is evidence that herbicides have an impact on mammals' neurological and excretory systems [21],[22]. Hence, we should reflect on our past errors and spread awareness about the safe use of agrochemicals.

These pesticides are causing an increase in water contamination, and they are harmful to the ecosystem even in low quantities [23]. Several pesticides induce neurological disorders and degenerative diseases, others have an impact on prenatal growth and result in congenital malformations, and others are human carcinogenic, according to research collected over the past two decades about pesticide exposure and health [24]. For the past three decades, reckless use and management of pesticides in agriculture has caused significant problems with human health in many developing nations [25].

2. Chemical pesticides and fertilizers' effects on human health

One of the main issues is that the negative effects of pesticide use on human health have not yet reached alarming proportions. Kerala's endosulfan tragedy clearly showcases the severity of this issue. The UNO classifies endosulfan, organochlorine pesticide, as a highly toxic insecticide and it has been banned in 62 countries from 1976 to 2001, and Kasaragod district cashew plantations received three regular applications of endosulfan per year. According to reports, aerial spraying was done to eradicate the tea mosquito, but by the 1990s, a number of human health problems had emerged. Children were shown to be the most adversely impacted by congenital defects, mental retardation, physical deformities, cerebral palsy, epilepsy, etc. Genetic issues that babies inherit as well as the degradation of biodiversity have not yet been recovered.

As demonstrated by the blue-baby syndrome, where excessive water nitrate levels can cause met hemoglobinemia in babies, a potentially fatal illness, agriculture-related water pollution directly harms human health. Pesticide buildup in water showed negative impacts on people. As a result, several pesticides (including DDT and numerous organophosphates) were widely outlawed; however, some of these pesticides are still in use in developing nations. This use has negative short-term and long-term health impacts. Aquatic ecosystems are also impacted by agricultural pollution; for example, eutrophication caused by the accumulation of nutrients in lakes and coastal rivers damages biodiversity and fisheries [26, 27].

Although it is well established that agrochemicals pose serious risks, we are unable to completely exclude or prevent them from our lives since we must use available resources to meet our needs for food. Agrochemicals are viewed as a potent tool, particularly for developing nations, to boost agricultural productivity and significantly raise key public health indicators. But inappropriate agrochemical management accelerates the degradation rate of plant and animal species at an alarming rate. This will immediately affect the rural sector, as their day-to-day survival, is often depends on the natural resources around them. Apart from the agrochemical affects, the environment gets

weakened with thousands of man-made issues. In the past few decades, almost 1500 million km2 of forests have been converted into farmland or lost to other uses. Hence the threshold level of the mother earth may lower. Agrochemicals are thought of as a powerful instrument or "magic bullet" in poor countries to enhance agricultural productivity, according to Bhandari's [28, 29] research of agrochemicals and their environmental implications in Nepal. While various pesticides have been connected to cancer-causing effects on the human immune and endocrine systems, agrochemicals have been determined to represent significant dangers.

When spraying pesticides, farmers are urged to wear safety masks, gloves, and other protective gear. If they don't, pesticides can hurt their eyes, skin, and respiratory system by entering their circulation through inhalation and dermal exposure. The study shows a correlation between the amount of pesticide used and the signs and symptoms of illnesses brought on by exposure to pesticides among spray farmers in Bhopal and Madhya Pradesh, India, who independently applied pesticides and were thus directly exposed to pesticides. The majority of acute signs and symptoms were described by farmers who had been exposed for 18 months of chemical spraying, including burning/stinging eyes (18.42%), and blurred vision (23.68%), skin redness /itching (50%) and shortness of breath due to heavy sweating (34.2%). Among the sprayers, it was discovered that the signs and symptoms depended on the duration. The usage of protective equipment while handling pesticides and other chemicals must be implemented and ensured by authorities, who must raise awareness among field sprayers [30].

Human health is impacted when a pesticide or fertiliser used in agriculture finds its way, either directly or indirectly, into the grains and vegetables. In addition, pesticides are administered directly to plants, which cattle and humans consume. Nitrate contamination of subsurface water due to excessive fertiliser use is dangerous for the entire biota. Some haemoglobin in the blood can be immobilised by nitrate-concentrated water. Because organochlorin pesticides are less persistent and damaging to the environment than organophosphate pesticides, their use has increased. Nonetheless, they have the potential to result in serious health issues such abdominal pain, lightheadedness, and skin diseases. Organophosphate insecticides that are accumulated in vegetables over time cause cancer in people [31].

Wimalawansa [32] evaluated the effect of agricultural practices on human health in Sri Lanka and came to the conclusion that agrochemicals are used excessively and carelessly, which contributes to the ongoing contamination of the environment and the human food chain. Pesticides, herbicides, and phosphate fertilizers contaminated with heavy metals are among the toxic agrochemicals that pollute soil and water. Some pollutants are present in water, but they are so minuscule that it is impossible to smell or taste them. Because of this, the detrimental effects of them on humans take a long time to manifest, but over time, they have contributed to the spread of serious illnesses such chronic renal disease.

The Green Revolution allowed India to become food grain self-sufficient, but the unchecked use of synthetic fertilizers and pesticides damaged both our environment and our food. The grain bowl of India, Punjab, an agricultural province, is currently experiencing severe issues. Unbalanced soil nutrient levels, polluted surface waters, pesticide residues in food and milk from cows, and an increase in farmer cancer rates are some of the detrimental repercussions of the Green Revolution [33].

The study found that DDT was the most extensively used and effective insecticide for assisting people in warding off unwanted pests and greatly enhancing agriculture. However, use of DDT was outlawed globally after a few side effects of this insecticide were found. Notwithstanding the severe regulations, DDT is nevertheless unlawfully used in many places, notably in developing nations. DDT's detrimental effects on human health were well understood and widely publicized in order to inform the public and prevent unforeseen events. Despite not being used in recent years, DDT nevertheless has an impact on human health due to its long-lasting residual effectiveness and accumulation through the food chain. DDT is harmful to human health because it causes a variety

of malignancies, acute and long-term nervous system injuries, lung damage, reproductive system injuries, immune system and endocrine system problems, and birth defects and also act as a leading agent for difference types of cancer [22, 34].

The usage of pesticides in India started in the middle of the 1960s as a result of anti-malaria and green revolution activities. While pesticides worked well to manage pests, they also had a negative impact on people's health. As a result of their accumulation in the food chain, these substances now provide a multitude of dangers to human health. Studies show that the risk of exposure from ingesting pesticide-affected food is between 103 and 105 times greater than the risk from breathing in or drinking polluted water. Pesticides have been connected to a multitude of detrimental health effects, depending on the amount and duration of exposure. From minor allergies, rashes, breathing problems, neurotoxicity, and reproductive anomalies to severe chronic diseases like cancer, pesticides can cause anything. To address this hazard to food safety, preventive steps, like the use of alternative sustainable agricultural practices, or mitigation measures, like changing processing techniques to decrease pesticide exposure to food and water, may be utilized [35].

3. Environmental effects of chemical pesticides and fertilizers

The buildup of various heavy metals due to industrial emissions, mining, high-metal waste disposal, gasoline, fertilizer use, sewage sludge, pesticides, wastewater irrigation, coal combustion residues, etc. can all lead to soil pollution, which is a fundamental requirement for agriculture. In the past, a lot of chemicals were sprayed annually as fertilizers and insecticides to the soils used for farming. The soil's concentration of heavy metals, especially Cd, Pb, and As, may rise as a result of such treatments [36]. To control weeds and insect pests, agriculture uses a variety of herbicides, insecticides, and other chemicals. This approach is easy, efficient, and affordable. However, using chemicals has a big price tag. They have polluted practically every aspect of our environment, and soil, water, land, and air all contain their leftovers (Figure 3).

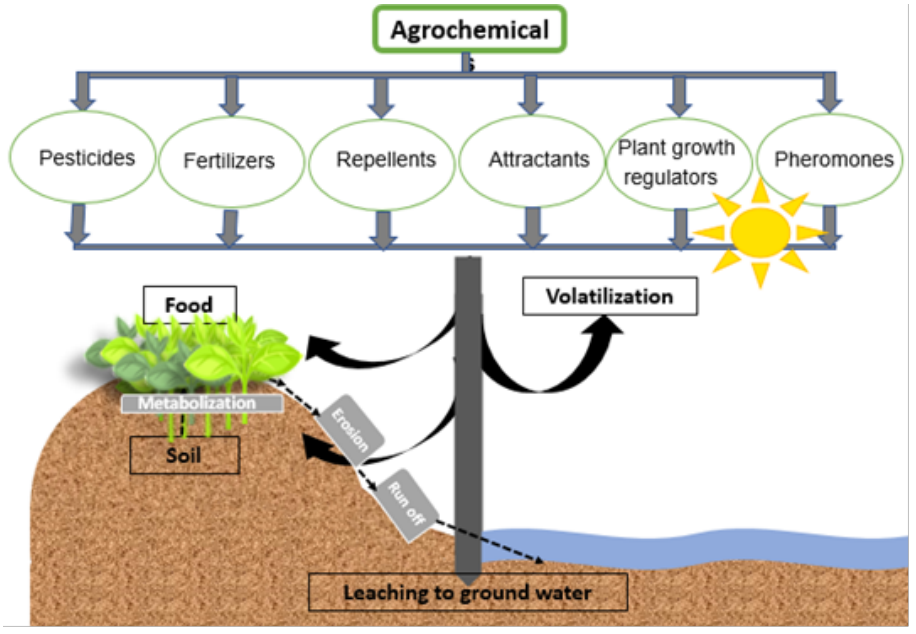

Figure 3: *Agrochemical pesticides and fertilizers environment.*

According to Kumar [37] pesticides are frequently considered a quick, easy, and cost-effective

way to control weeds and insect pests in urban settings. Pesticides have poisoned the bulk of the components in our environment. The issue of pesticide residues in soil, air, surface, and ground water across the nation is exacerbated by urban pesticide use. Pesticide contamination poses a serious threat to the environment and non-target animals, including beneficial soil bacteria, insects, plants, fish, and birds. Despite what many people think, even herbicides can harm the ecosystem.

The investigation was carried out in the surface water of the Sharda River region in Lakhimpurkheeri, Uttar Pradesh, India. Solid Phase Extraction (SPE), which is used to remove organochlorine pesticide residues from water samples. The report describes the 21 organochlorine pesticide residues' concentration levels and distribution trends. The four isomers of hexachlorocyclohexane, dieldrin, heptachlor epoxide, and DDT were the most often found organochlorine insecticides in surface water. Particularly for "hexachlorocyclohexane and pp'- DDT," the amounts observed in certain cases exceeded the quantitative target values established by the European Union (EU). The concentration levels found are lower than the EU maximum acceptable concentration of 0.10 g l1 for all compounds examined, with the exception of -HCH in seven samples (0.2772, 0.1950, 0.2210, 0.2045, 0.1994, 0.1523, and 0.1390 g l-1) and four samples (0.1877, 0.2365, 0.1478, and 0.1269 g l-1) of pp'-DDT from 2008 to 2010. These compounds have been found in the surface waters of the Sharda River basin, and their presence is attributed to both intense agricultural activity and transboundary contamination [37] .

Pesticide residues can be found in soil, air, surface and groundwater, and have contaminated practically every aspect of our ecosystem. The ecosystem and non-target creatures are significantly in danger from pesticide pollution. Recent investigations have shown that levels of biocidal contamination have greatly increased, and that pesticide pollution of our environment is a persistent issue. The future is at risk due to the environmental damage caused by pesticides [38].

In order to manage, eliminate, combat, or repel pests, illnesses, and parasites, agriculture uses various chemically produced compounds known as pesticides. Based on their chemical makeup, pesticides are divided into many classes, such as Corganotins, carbamates, formamidines, organochlorines, antibiotics, etc. [28] .In general, the classification and naming of pesticides are according to the nature of the pest that they manage (Table 1). Fertilizers are the large group of chemicals used to increase the nutrient status of the soil (Table 2). There are so many other chemicals which use to alter the crop growth and control the pest, but they do not belong to fertilizers or pesticides. Some of them are;

• Plant growth regulators, such as Abscisic Acid (ABA), 2,4-Dichlorophenoxyacetic Acid (2,4-D), Gibberellic Acid (GA), and Ethylene, are used to alter the projected growth, blooming, or reproduction rate of plants.

• Attractants: attract pests to a trap or bait. Food is considered as an attractant even it contains pesticides.

• Pheromones: interfere with insect mating behavior.

• Repellents: deter pests like birds and insect (such as mosquitoes).

The agrochemicals are incorporated into the soil followed by its application, and they may diffuse and transport in the field. This transport process in the soil is controlled by collective effects of different factors like the characteristics of agrochemical and soil, mode of application, site conditions etc.

Soil samples have been examined in the communities of Loni, Adgaon, Chinchpur, Sadatpur, and Gogalgaon, which are all part of the Taluka of Rahata and Sangamneer. Many years ago, agricultural fields were regularly treated with chemical herbicides and fertilizers for improving agricultural productivity. The necessity for agricultural products (sugarcane, bajra, vegetables, food, and animal feed) to meet its demand, has forced farmers to use fertilizer and insecticide in excess of the recommended dosage. The pH of the soil was found to be fairly alkaline, ranging from 7.46 to 8.9. It is determined that there is no salt buildup in the soil. The range of the soil's organic carbon

Table 1: *Insecticides are categorized according to their uses (Source: www.quizlet.com, 2020).*

Algicides	In the water bodies, get rid of the algae. Examples include hydrogen dioxide, peroxyacetic acid, chelated copper, and copper sulphate.
Antifoulants	Organisms that adhere to submerged surfaces should be eliminated or repelled. Eg: Chlorothalonil, Dichlofluanid, DCOIT, Diuron, Irgarol„ TCMS-pyridine, Zinc pyrithione and Zineb
Antimicrobials	Destroy bacteria and viruses among other microbes. Eg: Avoparcin, Vancomycin
Biopesticides	Kill pest and insect. Eg: Trichoderma, Phytopthora and Bacillus thuringiensis
Biocides	Eliminate microorganisms.
Defoliants	Cause leaves to fall off from a plant, usually to make harvesting easier. Eg: 2,4-D and 2,4,5-T
Desiccants	Encourage the drying of live parts, like undesirable plant tips. Eg: Calcium chloride, and Benzophenone
Disinfectants	Eliminate or inactivate pathogenic microorganisms. Eg: Chlorine, Quats, and Iodine
Fungicides	Remove fungi (including blights, mildews, molds, and rusts). Eg: Mancozeb, Ferbam and Folpet
Fumigants	Create gas or vapor that is designed to kill pests, for instance in soil or structures. Eg: Methyl bromide, Dichloropropane, and Chloropicrin.
Herbicides	Eliminate weeds and other unwanted plants that are growing. Eg: Diquat and Paraquat
Insecticides	Eliminate insects and other arthropods. Eg: DDT, BHC, lindane and Chlorobenzilate,
Miticides/ Acaricides	Kill animals and plant-eating mites. Eg: Azobenzene, Dicofol, Ovex, and Tetradifon
Molluscicides	Eliminate snails and slugs. Eg: Aluminium sulfate, and Ferric sodium EDTA
Nematicides	Destroy microscopic, worm-like organisms that feed on plant roots- nematods. Eg: Aldicarb
Rodenticides	Control mice and other rodents Eg: Sulfur dioxide, Carbon monoxide and Hydrogen cyanide

content, from moderate to very low, was found to highlight the need to improve soil fertility. A lack of nitrogen status and the need for a suitable application of nitrogenous fertilizers were indicated by the low amounts of accessible nitrogen found in almost 80% of the soil samples. While the remaining 50% of the sample had a moderate to low content, the test results for 50% of the sample showed very low Accessible Phosphorous concentration. Up to 963.2 kg/ha of potassium was readily available in more than 80% of soil samples, whereas the other samples had moderate to low levels. Micronutrient values for Zn, Cu, and Fe were moderate to low, but values for Mn were greater in 48% of the samples. This characteristic of micronutrients may be caused by the soil's moderate alkali content. Investigations on the area's groundwater have shown that nitrate, alkalinity, and other fertiliser and pesticide residues are all increasing. The ground water needs water and the application of biofertilizer and organic manure, and the expanding soil contamination could cause the quality of the water to further deteriorate [39].

Table 2: *Commonly used Fertilizers (Source: MoAD, 2013).*

Ammonium Molybdate [(NH4)6Mo7O24H2O]	Ammonium Sulfate Phosphate (20-20-0)
Ammonium Phosphate Sulphate Nitrate (20-20-0)	Sulfate of Ammonium (21-0-0)
Borax (Na2B4O7.10H2O for soil application)	Decahydrate Borax (Na2B4O7.10H2O)
Calcium Ammonium Nitrate (25-0-0)	Calcium Ammonium Nitrate (26-0-0)
Fe as Chelated Iron	Sulfate of copper (CuSO4.5H2O)
Diammonium Phosphate (18-46-0)	EDTA Chelated Zinc as Zn-EDTA
Ferrous Sulphate (FeSO4.7H2O)	Granulated NPK (20-20-10)
Granular Single Super Phosphate	Granular Urea (46%N)
Manganese Sulphate	Muriate of Potash (MOP) (0-0-60)
NPK (10-26-26)	NPK (12-32-16)
Potassium Sulphate (0-0-50)	Powdered Single Super Phosphate
SOLUBOR (Na2B4O7.5H2O+Na2B10O16.10H2O)	Triple Super Phosphate T.S.P
Urea (46-0-0)	Urea Ammonium Phosphate (28-28-0)
Zinc Hepta-Hydrate (ZnSO4.7H2O)	Zinc Sulphate Monohydrate (ZnSO4.H2O)

In order to ascertain the long-term effects of utilizing pesticides and chemical fertilizers on the properties of the soil and the accumulation of heavy metals, research has been done on the irrigation and drainage system in Moghan (Ardabil, Iran). The bulk density of the soil, which was similarly larger than in the control soil, showed long-term alterations in the data. Heavy metal deposition in soil was adversely impacted, and some metal concentrations, including cadmium, are now too high for agricultural usage. The findings, fortunately, indicated that the concentration of other metals is within permissible bounds. It is vital in this situation to consider pesticides and fertiliser management and to develop strategies to replace or limit their use in this area given the state of the soil and the results gained [40].

4. Agrochemicals' effects on soil, water, and air

Agrochemicals are the major potential pollutants in agricultural lands. The intensification of agrochemical-based agriculture production may lead the environment towards pollution. The reason for this boostis mainly to increase the food and biofuel production. Due to the excessive use of agrochemicals, the environment's three primary constituents-soil, water, and air-are being contaminated.

Soil health is one of the principal factors which will promote the growth of flora and fauna. A healthy soil has a high population of beneficial organisms, adequate nutrients, good drainage,

minimal weed pressure, good tilth, and resistance to degrading [41]. Excess agrochemical application in soil damages its quality hence, soil health gets reduced. It may alter the acidity and negatively affect the beneficial soil organisms like an earthworm. So, the application of chemical fertilizers alone is not advisable for soil health and sustainable development.

Like soil, water and air are also get affected by agrochemical utilization. The fate of agrochemicals that are applied at a higher concentration may be fixed by soil particles, or it could percolate, penetrate, or leak through the soil, or it could even be transported away by soil erosion. More nitrogen and phosphates may seep into the groundwater or reach streams through surface runoff. In comparison to nitrate and ammonia, phosphorus is less soluble in water. As a result, they may have a tendency to stick to soil particles or may get into water sources through soil erosion. The runoff of agrochemicals into the water bodies can increase the rate of eutrophication, biomagnification, and pollution which will make water unfit for drinking. Many nations utilize insecticides, pesticides, herbicides, and fungicides. The wrong utilization of them can contaminate water resources. All life forms may be badly impacted by them because they include carcinogens and other hazardous substances. The use of pesticides can increase air pollution and wind will carry airborne particles to different locations. Pesticides in the air can spread more quickly depending on the weather at the time of application. Low relative humidity and high temperature cause more chemical sprays to evaporate, and when people breathe this polluted air it leads to a variety of ailments.

Ingestion of contaminated air and water through the food chain can have both direct and indirect effects on human health. Through inhalation, Pesticides can enter in our body as dust and vapor. Direct contact through skin exposure is also possible. According on the chemical's toxicity and the level of exposure, pesticides can have negative effects on human health. Hence, its greatest exposure is experienced by farm workers and their families this exposure may cause health issues that range from simple irritation in the skin to problems with the nervous system. Reproductive issues and cancer growth also may cause.

5. How to tackle the situation?

We need to approach this problem with a suitable solution to ensure environmental sustainability. So, wise-full usage of natural resources is required for protecting ecosystems. As a result, strategies like integrated pest management (IPM), organic farming, and the promotion of alternative pest control methods including the use of biopesticides are necessary. Some effective alternatives to the usage of pesticides include the growth of transgenic crops, the use of biopesticides, bio-remediation techniques, and plant-associated microorganisms. The uses of ideal pest-killing chemicals are safe and recommended for our environment. They specifically destroy the selected pests and do not influence the target organism's genetic resistance, after that, ideal pest-killing chemicals break down into harmless components. The fertility of the soil, agricultural productivity, and financial success depends on bio-fertilizers, which are chemicals containing living cells of various beneficial microbes (bacteria, fungi, protozoa, algae, and viruses). Some of the more frequently used beneficial bacterial species in agriculture are Rhizobia, Mycorrhizae, Azospirillum, Bacillus, Pseudomonas, Trichoderma, and Streptomyces. to make more essential micronutrients (boron, copper, chlorine, iron, manganese, molybdenum, and zinc) and macronutrients (nitrogen, phosphorus, potassium, sulphur, calcium, and magnesium) available to crop plants. It is imperative that beneficial microbes break down organic matter in the soil. Additionally, the management of sewage and solid waste is significantly influenced by beneficial bacteria. Plants are more resilient to environmental conditions including drought, heat, cold, and salinity due to beneficial bacteria. It also helps to increase plant resistance against pests and diseases. They are also capable of improving crop quality with high crop growth and productivity. Additionally, enhance crop quality by eradicating various plant diseases and insects. Beneficial bacteria decrease the demand for chemical fertilizers, which reduces environmental pollution brought on by those chemicals [42] .

6. Concluding remarks

This analysis of the research demonstrates that farmers overuse a large amount of pesticides, which causes pollution of our air, land, and water and a number of diseases that harm human health. Moreover, farmers do not follow the basic safety precautions when using pesticides. Pesticides are widely used in agricultural fields to increase output by protecting the harvests from potential harm because a major portion of the population depends on agriculture for survival. To safeguard both the environment and human life from the harmful effects of pesticides, adequate precautions must be taken. It is now commonly acknowledged that selecting organic farming practices and a sustainable way of life is the most important thing we can do for the world. The answer to this confusion is organic farming, an environmentally friendly agricultural technique that ultimately supports good human health. Organic farming, which is a return to our ancestors' way of life, is a step towards sustainability. The supply and demand gaps in the market have not been filled despite the Indian government's best efforts to boost the availability of organic fruit and commodities. A sufficient amount of training should be provided to farmers about organic farming, including its breadth, potential, financial viability, and environmental sustainability.

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