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## Classification of Agrochemical and Its effect at a glance

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**ABSTRACT:** Agrochemicals have been used for many years to manage agricultural pests and diseases. However, their prolonged use has led to harmful effects on human health and environmental organisms. This review highlights the impact of agrochemicals, particularly pesticides and fertilizers, and their potential risks to both human well-being and ecological balance. It is very difficult to educate and train farmers on the proper use of agrochemicals in high-population, developing countries. Agrochemicals are classified into inorganic pesticides and fertilizers, which are used to increase crop yield and control diseases, pests, and weeds. Pesticides include insecticides, fungicides, and herbicides, while fertilizers consist of macronutrients (such as NPK) and micronutrients (such as Zinc and Iron). The main focus of this review is to classify agrochemicals and examine their effects on human health (such as chronic and acute illnesses, cancer, neurological disorders, reproductive harm, anemia, and birth defects) as well as their environmental impact on non-targeted plants, animals, soil fertility, and water contamination. Studies related to the prevalence of agrochemicals are also discussed. This review is based on secondary data, descriptive analysis, and previously available relevant literature, including journals, magazines, and e-resources. The findings suggest that the government should regulate the use of agrochemicals, imposing limitations, and focus more on biological methods for agriculture rather than chemical alternatives, due to the harmful effects of agrochemicals.

**Keywords:** Agrochemical classification, human health, environmental impact, organisms, pesticides, fertilizers.

**INTRODUCTION:** Agrochemicals are chemicals used in agriculture to increase crop yield and to control weeds and insect pests. They are easy to use, inexpensive, and inorganic, but they are also toxic substances used to improve the growth and development of crops. Agrochemicals refer to pesticides and fertilizers, which are inorganic. There are two types of farming methods: organic, which uses natural and traditional techniques, and inorganic, which employs chemical methods to enhance crop growth and development. Agrochemical terms include various chemical products such as fertilizers (NPK, nitrogen, phosphorus, potassium, calcium, urea, DAP, etc.) and pesticides like insecticides, fungicides, and herbicides, as well as soil treatment methods for soil improvement. It has been found that pesticide use in Bangladesh is lower than in other countries, at 0.03 kg/ha compared to 0.3 kg/ha in India and 0.4 kg/ha in Sri Lanka (Sultana and Nobutazu, 2001). This review is conducted to classify agrochemicals and examine their advanced effects on human health and the environment. The impacts of agrochemicals are particularly assessed through the use of pesticides and fertilizers. Additionally, this review evaluates the knowledge of farmers and the general public regarding the advanced impacts of pesticides and fertilizers on human health and the environment.

### OBJECTIVES:

- To classify agrochemicals at a glance.
- To examine the effect of agrochemicals on the environment.
- To explain the impact of agrochemicals on human health.
- To explore the effect of agrochemicals on biodiversity and water contamination.

### METHODOLOGY:

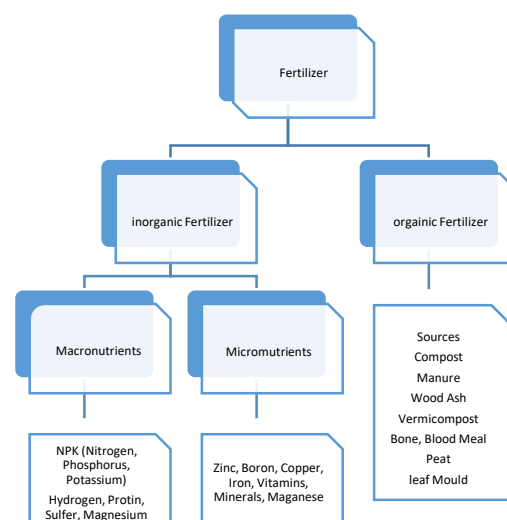
This review is entirely based on literature analysis. Secondary data and information relevant to this research have been collected from various sources, including journals, newspapers, magazines, previous research papers, government publications, and other useful internal materials. The aim of this study is to reach a critical conclusion based on the gathered information. The nature of this study is both descriptive and conceptual.

### CLASSIFICATION OF AGROCHEMICAL

For a long time, agrochemicals have been used in India to increase crop production and yield. The use of agrochemicals contributes to economic benefits for the country. Agrochemicals include both chemical fertilizers and pesticides, which are studied in detail. Sunkara. (2023)

### FERTILIZER:

For the growth and development of crops, fertilizers are applied to the fields. Fertilizers are of two types: organic and inorganic. **Organic fertilizers** come from living beings, such as plants and animals. They provide nutrients to crops. This includes animal husbandry byproducts, plant dry leaves, and peat, blood meal, and compost manures.



**Inorganic fertilizers** are man-made synthetic compounds, such as urea, nitrogen, DAP, SS, phosphate, and potassium. These are rich in nutrients and provide quick results. (Baum hart et. al. - 2014)

Fertilizers are substances used to promote crop growth. While they are not highly harmful to crops, they still have some adverse effects on the environment, human health, soil, and biodiversity. Fertilizers are divided into two categories: micronutrients and macronutrients. **Macronutrients** are essential nutrients added to crops to ensure proper nutrition and are used on a primary scale, such as NPK, urea, nitrogen, phosphorus, potassium, calcium, and DAP. These are applied to fulfill the necessary nutrient requirements of crops.

**Micronutrients** are added to crops to enhance their growth, but they are applied on a secondary scale. While crops do require these nutrients, they are needed in smaller quantities compared to macronutrients. Micronutrients can be mixed with macronutrients and applied to crops. Therefore, they can also be referred to as nutrients that support the action of macronutrients. These are used in smaller quantities. Examples of micronutrients include zinc, iron, copper, manganese, boron, proton, vitamins, minerals, etc.

## **PESTICIDE**

Pesticide are chemical substances applied to crops when they are affected by diseases. Crops are susceptible to various diseases, and each year, farmers face numerous challenges with their crops, such as pest infestations and weed growth, which hinder the complete development of the crops. The presence of fungi, molds, and the sudden wilting or rotting of crops also negatively impact the health of plants, preventing their complete development. The diseases that affect crops can generally be categorized into three types: first, pest infestations or yellowing of the plants; second, the growth of weeds; and third, fungal infections in the roots of the crops.

Considering the above factors, the pesticides used to combat diseases in crops are mainly divided into three categories:

- 1) Insecticides
- 2) Herbicides
- 3) Fungicides.

**Insecticides** are used to eliminate harmful diseases in crops, such as pest infestations, locust attacks, and aphids. When crops are not growing properly and exhibit yellowing, insecticide pesticide products are applied. There are various brands of insecticides pesticides available in the market across different sectors, and these are used according to the instructions and recommendations of shopkeepers, dealers, or manufacturing companies. Brands:- KEM Immunity Builder, Soloman etc.

**Herbicide** pesticides are used when weeds start growing among crops. Although the growth of weeds is common, it reduces the crops' growth and yield, causing significant damage. Therefore, herbicides are applied to control this issue. Herbicides are also available in various brands across different regions. Brands: Roundup Herbicide, Touchdown Herbicide, Ferio Herbicide etc

**Fungicides** are used when crops develop diseases affecting the roots. If there are signs of fungal infections, such as rotting, decay, or the appearance of spots on the crops, it indicates that the crops are suffering from a severe fungal disease. Fungicides are applied to control and prevent these issues, and they are also available in various brands across different regions. Brands: Anvil Fungicide, Tricolor Fungicide, Score Fungicide etc

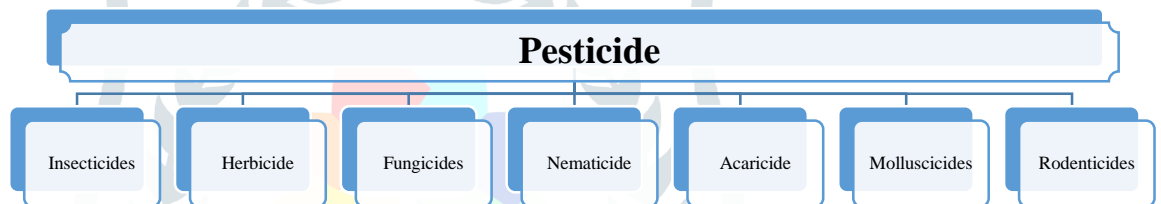
Apart from these, there are other pesticides that are used from time to time when crop diseases are detected. These include Rodenticides, Nematicides, Acaricides, and Molluscicides.

**Nematicide** pesticides are used in agriculture to control and suppress microscopic roundworms known as nematodes, which cause harm to plants. These chemicals work by killing or inhibiting nematodes, thereby protecting crops from damage. Some common brands include Nemate-10G and Saferoot Nematicide.

**Acaricide** pesticides are used to eliminate ticks and mites, which belong to the arachnid subclass Acari. These chemicals effectively target and kill these pests, protecting plants and animals from damage. Examples of acaricides include Bifocal, Acaricide etc.

**Molluscicides** are chemical substances used to kill mollusks, such as snails and slugs, which can be harmful to crops and vegetation. These substances help protect plants from damage caused by these pests. Some popular brands of Molluscicide pesticides include Lumachicida and Anti Snail, which are specifically formulated to control and eliminate snails and slugs effectively.

**Rodenticides** are chemical substances or mixtures that kill, repel, or control rodentse.g. rats and mice. Widely employed in agricultural, residential and commercial settings, they help prevent the damage to crops, property and public health caused by rodents. Rodenticides act in a number of different ways, including anticoagulation, acute toxicity, or interfering with the function of the rodent's nervous system. These products can be effective, but must be used with caution as they have risks to non-target animals, humans and the wider environment.

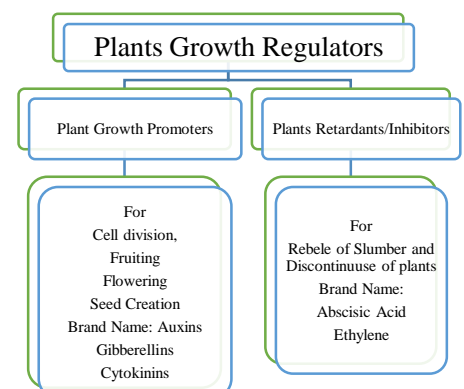


## **PLANTS GROWTH REGULATORS**

Plant Growth Regulators (PGRs) include compounds such as growth promoters and growth retardants. These are small, simple plant hormones that are relatively low in toxicity. PGRs are used to regulate and manage the growth and development of plants effectively.

There are two types of Plant Growth Regulators:

1. **Plant Growth Promoters:** These compounds promote cell division, cell enlargement, and the formation of fruits, flowers, and seeds. Some common growth promoters include Auxins, Gibberellins, and Cytokinins.
2. **Plant Growth Retardants/Inhibitors:** These substances induce dormancy, slow down growth, and cause the detachment of plant parts. They are used to regulate and suppress plant growth, known as growth retardants. Some examples of growth inhibitors are Abscisic Acid and Ethylene.



## SOIL BOOSTER, STRENGTHENER AND CHEMICAL SUBSTANCE USED IN ANIMAL HUSBANDRY

To enhance soil conditioning and boost its restorative capacity, synthetic substances are often integrated into animal husbandry byproducts, such as cow dung. This practice aims to increase soil fertility and elevate crop productivity to the next level. Mixing chemical substances with animal husbandry byproducts and applying them to crops significantly enhances soil quality and productivity. These substances work in two ways: first, by increasing antibiotics, and second, by compensating for hormonal deficiencies. Soil strengthener products are those that control water erosion or enhance water retention capacity, improving soil properties by preventing deficiencies in its structure and nutrients. (Baumhart et al., 2014)

Here are some chemicals used in animal husbandry:

- **Antibiotics:** Used for growth promotion and to prevent diseases.
- **Enzymes:** Added to animal feed to improve animal and poultry products.
- **Glyphosate:** Used to improve hay for animal feeding.
- **Mineral oil:** Helps reduce constipation in pets.

Soil boosters, strengtheners, and synthetic substances (such as antibiotics, hormones, enzymes, glyphosate, and mineral oil) are present in animal dung.

## EFFECT OF AGROCHEMICALS ON VARIOUS REGIONS

Agrochemicals can provide significant benefits in terms of crop production and economic growth, but their overuse or misuse can lead to negative environmental and health consequences across different regions. Agrochemicals, including pesticides, herbicides, fungicides, and fertilizers, can have varying effects on different regions depending on the local environment, soil types, water systems, and agricultural practices.

Below is a classification based on their effects

- Effect on Water
- Effect on Soil Fertility
- Effect on Environment
- Effect on Human Health
- Effect on Biodiversity

### **Effect on Water**

Water pollution occurs due to the excessive use of agrochemicals. The overuse of phosphate fertilizers is a major contributor to water pollution. This is possible because large subsidies are directly provided to farmers, which encourages the irrational use of phosphate fertilizers. The government offers subsidies to farmers to promote economic growth.

Due to ignorance and lack of awareness, farmers often use fertilizers in excessive amounts, beyond the recommended limits set by the government. They believe that a over application of fertilizer will yield greater results, not realizing the long-term damage it causes. This leads to environmental degradation, a decrease in human health potential, and an increase in animal diseases.-(Shehani A. et al. 2014)

The excessive discharge of plant nutrients, particularly nitrate and phosphate fertilizers, into water bodies is significant. These nutrients are washed from farm soil into reservoirs and rivers, polluting the water sources. A survey conducted on the Mahaweli River in Sri Lanka revealed that toxic chemical substances in the water have led to kidney disease (KDS) among the local population. As a result, water from this area has been diverted, highlighting the severe impact on human health and the resulting environmental damage. – (Winalawansa Shehani A. et al. 2014)

Agrochemical residues can primarily pollute the soil, but they can also be found in surface water systems due to irrigation runoff, which indirectly affects water reservoirs, ponds, lakes, rivers, and can harm the aquatic environment, including algal growth (Pereira et al., 2009).

A study on pesticide residues was conducted on some ponds and rivers in Bangladesh in 2013. It was found that the pesticide carbofuran was detected in samples at concentrations ranging from 0.0143 to 0.0387 ppm, while the detection limit (LOD) was 0.01 ppm in pond water (Amin Uddin et al., 2013).

### **Effect on Soil Fertility**

The use of agrochemicals has a long-term negative impact on soil fertility. For instance, the application of nitrogenous fertilizers has been found to reduce soil pH levels, as observed in a study by Subehia et al. (2005), where the pH level dropped from 5.8 to 4.7. Excessive use of these chemicals on soil and water has been identified as a significant cause of pollution. Additionally, this overuse leads to reduced efficiency of pesticides and fertilizers. A study conducted in China highlights a significant increase in soil pollution within the country due to agrochemical usage between 2000 and 2008. The overuse of agrochemicals has resulted in a noticeable decline in soil fertility in China (Sun et al.).

Huan et al. predict that "The decline in the use of organochlorine varieties of pesticides should lead to a decrease (or at least a slowing) in the levels of some of the worst types of pesticide residues in China's rural soil and water."

The use of glyphosate negatively impacts soil quality, as well as the growth and activity of nitrogen-fixing bacteria in the soil, as reported by Santos and Flores (1995).

### **Effect on Human Health**

The continuous use of agrochemicals can have serious negative effects on human health and other living beings. Some chemicals are carcinogenic (likely to cause cancer) and impact the new generation in multiple ways (Geissbuhler, 1981).

The presence of agrochemical residues in food, the absorption of agrochemicals by water, acid rain, and direct exposure to airborne toxins are all significant contributors to human health issues (Lewandrowski Et Al, 1997).

In developing countries, children often suffer from anemia, while adults are increasingly affected by cancer (Jorgensen and Kuyendall, 2008). In China, the overuse of agrochemicals has led to serious health issues among farmers and local populations. A survey indicates that between 1987 and 1996, approximately 4,500 people suffered from health problems annually, and around 500 deaths per year were attributed to the unregulated use of agrochemicals (Huang et al.).

The report indicates that 80% of farmers were unaware of the consequences of agrochemical use and had limited experience regarding direct exposure to agrochemicals (Jorgensen and Kuyendall).

In addition, the application of agrochemicals may result in crops with lower nutritional value. As a consequence, issues such as iron deficiency, cancer, weakened immune system, and damage to the liver, intestines, stomach, lungs, and uterus have been observed due to agrochemical exposure (Arbona).

To address this issue, steps should be taken to adjust the prices of agrochemicals so that all farmers can afford the associated health costs. Furthermore, the application of agrochemicals must be regulated with a focus on safeguarding human health.

A study revealed a correlation between pesticide use and various types of cancer, including sarcomas (a type of cancer found in bones and tissues), as well as cancers of the pancreas, lungs, ovaries, breasts, liver, kidneys, intestines, and brain tumors (Dodeker and Dummmler, 1993). Other health issues, such as asthma, allergies, and hypersensitivity, are also associated with agrochemical exposure. This exposure is linked to cancer, reproductive problems, fetal development issues, and hormonal imbalances (Gilbert, 2012). A study found that out of 13 total tests conducted for hormonal effects, 37 pesticides were examined. Among these, 23 pesticides were categorized as anti-androgenic, while 7 were classified as androgenic (Orton et al., 2011). This indicates that these substances may lead to developmental disorders and sexual organ dysfunction.

#### **Effect on Biodiversity**

The diversification of plants and animals is affected by the use of fertilizers and pesticides. The use of pesticides has a harmful impact on animals. Pesticide exposure causes physical changes in insects, such as breeding failure, eggshell thinning, embryonic mortality, reduced fertility, wasting syndrome, and impaired incubation and chick-rearing behavior. Additionally, when agrochemical equipment is washed openly, toxic water from rain and irrigation systems enters lakes, rivers, and water bodies (reservoirs), leading to reduced nutrient content, eutrophication, and an overgrowth of plants on the surface of these water bodies. This results in algal blooms and toxic water, which can lead to the death of many species (Shororetta - 2012).

#### **Unfavorable effect on non-target Animals**

The excessive use of agrochemicals has had unfavorable effects on animals, plants, and the environment, leading to a continuous decline in biodiversity. The traditional flushing system has been disrupted, and small birds and wild animals are at risk due to the overuse of pesticides and fertilizers in crops such as rice, vegetables, grains, and sugarcane. A study in the Comilla district of Bangladesh found that 96% of rice farmers use insecticides to control pests. Older farmers reported that pest control through traditional methods has become more difficult for younger generations due to the increased use of insecticides (Barzman and Das, 2000).

A report from 1999 revealed that due to air spraying, cows, calves, goats, fish, honeybees, dragonflies, lady beetles, birds, and many other beneficial insects and animals are at risk and are in a very serious situation (Sultana and Nobukaru, 2001).

Khan and Law (2005) conducted a survey and intensive review on the unfavorable effects of agrochemicals, including pesticides, fertilizers, and other chemicals, on the enzyme and hormone systems of fish, amphibians, and reptiles. These species are in a very sensitive situation due to such exposure.

#### **Unfavorable effect on non-target Plants**

Herbicides are designed to kill undesirable plants, but it is not surprising that they can also harm desirable plants. When phenoxy herbicides are applied directly to leaves, they can damage trees and shrubs (Dreistadt et al., 1994).

Herbicide-contaminated water can also damage aquatic plants. In a study, oxadiazole herbicide (used to prevent grasses, vines, trees, etc.) was found to inhibit algal growth, which are simple plants that primarily grow in water (U.S. EPA, 1996).

#### **CONCLUSION**

Agrochemicals are chemical products that are easy to purchase, simple to apply on farms, and provide quick results, although they are generally expensive. These chemicals are used to control pests and enhance crop yield in agricultural fields. Pesticides significantly impact various aspects of society and the environment. Their residues are commonly found in areas such as soil, surface water, groundwater, biodiversity, human health, animals, and plants. They also affect non-target organisms, including plants, fish, and birds.

Farmers often lack the ability to make informed decisions regarding pest management and pesticide application. They are unaware of the correct methods and timing for pesticide use and often apply incorrect chemical doses. This leads to the destruction of beneficial organisms, crop damage, and financial losses.

Pesticides should be purchased and applied following government regulations and recommended limits. Proper guidance is essential to help farmers mitigate the harmful effects of agrochemicals. To reduce the adverse effects of pesticides on human health and the environment, farmers must be educated on safe application methods. This includes using high-quality sprayers, avoiding smoking during application, wearing protective gear, and changing clothes immediately after use.

Biological solutions are more effective and environmentally friendly alternatives to chemical fertilizers. Bio-pesticides also offer a sustainable option for pest control. Integrated Pest Management (IPM), the use of natural products, and biological agents provide hope for reducing both the non-target and target negative effects of agrochemicals.

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