

Impact of Agrochemicals on Climate Change : A Study

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Abstract

Agriculture is an area where activities directly or indirectly play a major role in climate change. Climate change and agricultural activities are interlinked processes that occur both globally. More than 10,000 insects, 600 weeds and 1,500 fungi are commonly seen, with some named insects adversely affecting human life. The quality of food produced, its quantity and stored yield affects the life of human beings by destroying it. At the same time, they make animals and crops the biggest cause of various diseases. Climate change can directly and indirectly affect the leaching of pesticides to ground and surface waters. The direct effect converts the natural reactions of the soil-ecosystem into climate variables (mainly temperature, precipitation, and potential evaporation). Indirect effects refer to any changes in pesticide use, fate, and transport that arise from human activities in response to climate change.

Agricultural pesticides adversely affect both the environment and human health. These effects are sensitive to climate change because insect pressures and optimal pesticide application rates vary with weather and climatic conditions. Agricultural activities account for about 30% of global emissions leading to climate change, including pesticide use. This amounts to 12% of all man-made greenhouse gas emissions. Synthetic nitrogen fertilizer is widely used extensively in agriculture because it emits N₂O (nitrous oxide) gas on a large scale, a powerful greenhouse gas that is one of the most important contributors to climate change. The manufacture and application of pesticides represent a smaller proportion of fossil fuel use and greenhouse gas emissions in farming than fertilizer use. Through this paper an attempt has been made to understand in detail how pesticides play a role in climate change.

Keywords: Climate Change, Agrochemicals, Environment, Soil fertility, Agricultural activities

1. Introduction

India is an agricultural country. The Indian economy is primarily based on agriculture. Agriculture is highly ambitious for India, as it provides food nutrition and livelihood protection. More than 60 percent people in India depend on agriculture for their livelihood [1]. Agriculture contributes about 17 percent of the total GDP. Different types of industries depend on agriculture to supply raw materials.

In the last few decades, Indian agriculture has earned excellent progress. The production of food grains in 1950-51 was 51 million tons [2], which has increased to 250 million tons in the year 2011-12 and similarly the production of oilseeds has also increased from 5 million tons to 28 million tons. As a result of this rapid growth, Indian agriculture has made its presence globally.

Nowadays the world is struggling with the problem of climate change, due to which India is also not left untouched. Due to climate change, many kinds of changes in the environment such as increase in temperature, more or less rainfall, changes in the direction of the wind, etc. are taking place, due to which agriculture is having a bad effect. The main cause of climate change is global warming and the main cause of global warming is the increase in the amount of greenhouse gases like carbon dioxide (CO₂), methane (CH₄), nitrous oxide (NO) in the environment [3].

In the last few decades, the demand for chemical fertilizers has increased so fast that today more than 1000 types of insecticides are available worldwide. As their use is increasing, their quantity is also increasing in the air, water and land, which are continuously polluting the environment and causing them to become deadly.

The increasing number of moths is the result of breaking the natural process. Scientists around the world have fought a one-sided battle against pests. Termites and green grasshoppers used to be named after insects during the years 1950-60, today there are hundreds. Pesticides and fertilizers have helped to increase their number by spoiling the cycle of nature. (Ishwar Singh Kundu, Farmer Scientist, Haryana)

The risk of drought on Indian agriculture is high because even today the irrigation system is monsoon based and two-thirds of the arable land is rainfed area. The risk of floods in northeast India, cyclones in the eastern coastal areas, frost in northwest India, hot waves in central and northern regions are increasing. These climatic disasters cause huge losses on agricultural production. Climate change affects agriculture by direct and indirect means such as impact on crops, soil, cattle, insect-mites etc. India's climate has changed to extreme extent in the last few years e.g. famine in the years 2002, 2004, 2006, 2009, 2010 and 2012, floods in 2005, 2006, 2008, 2010 and 2013, cold in 2002-03 and 2005-06 Lahar, 2004, 2005, 2010 [4], high temperatures in the month of January-March, effect of hot waves in Andhra Pradesh in May 2003 etc.

According to the United Nations Environment Program (UNEP) report published in 2009, the world temperature has increased by 0.74 degrees in the last 100 years [5]. The first decade of this century (2000-2009) has been the cheapest decade ever. Climate change will undoubtedly have serious consequences in a tropical country like India, which will pose these potential side effects on different regions of the country.

According to a NASA report, the average temperature of the atmosphere is increasing by 0.8 degree Celsius. The area of farming is having the most impact on the area of farming. Food and Farming Organization (FAO) data shows [6, 7] that India is among the first 10 countries to be most affected by climate change. According to a study, by 2050, the temperature of winter can increase by about 3 to 4 degrees Celsius. Through the review article presented, their role in climate enforcement of chemicals used in agriculture has been demonstrated.

2. Classifications of Agrochemicals

Agrochemicals are mainly pesticides excluding fertilizers that may include nematocides, fungicides, molluscicides, rodents, herbicides, etc. The classification of agrochemicals is also shown by Fig.

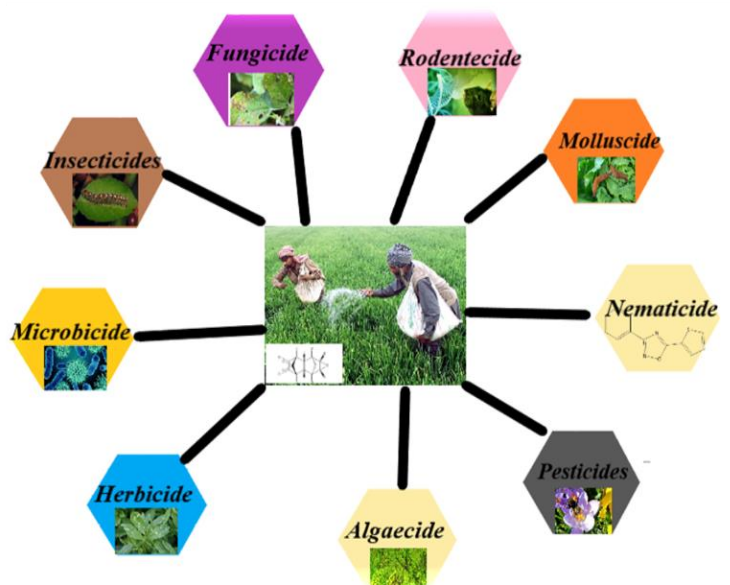


Figure 1. Classification of Agrochemicals has shown by the image. This image showing that the agrochemicals term is mostly used for pesticides.

2.1. Pesticides

A pesticide is a mixture of chemical or biological substances that is used to reduce, kill, or prevent side effects from insect pests. It is used extensively in agriculture to save tree plants. For examples- Phosphamidone, lindane, fluoropyriphos, heptachlor and malathion etc.

2.2. Pesticide Use in India

There are 234 pesticides registered in India. Out of these, 4 are WHO Class Ia pesticides, 15 are WHO Class Ib pesticides and 76 are WHO Class II pesticides, together constituting 40% of the registered pesticides in India [8]. In terms of consumption too, the greatest volumes consumed are of these poisons. The following is a broad picture of the top pesticide-consuming states in India as tabulated as table 1 and showing in figure 2. (total pesticides consumed, in metric tonnes of technical grade material, during 2005-06 to 2009-10, as per official data of the Directorate of Plant Protection, Quarantine and Storage, Govt of India).

Table 1: The table presented describes the consumption of pesticide chemicals in various states of India.

State	Total Consumed Pesticides
Uttar Pradesh	39948
Punjab	29235
Haryana	21908
Maharashtra	16480
Rajasthan	15239
Gujarat	13430
Tamil Nadu	12851
All India	210,600

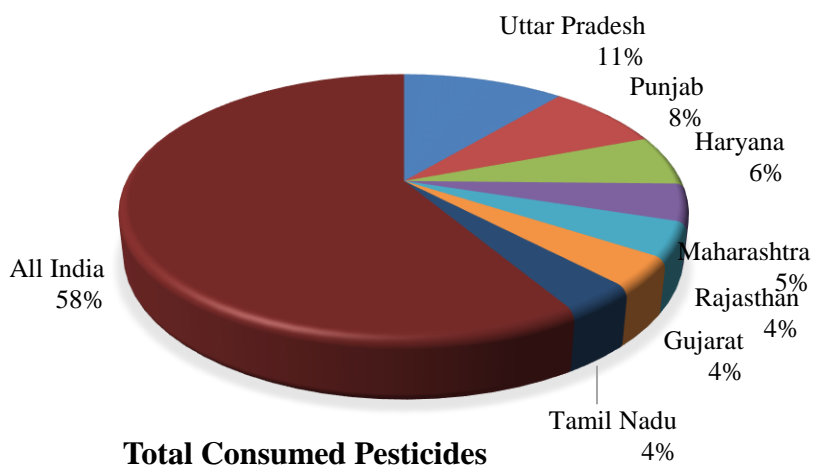


Figure 2: Most consumed pesticides in different percentage in the India (during 2005-06 to 2009-10)

2.3. Fertilizers: Fertilizers, these are chemicals that are very helpful in the growth of plants. Usually, fertilizers can be given to the plants in two ways- (1) by putting them in the ground, from which these elements are absorbed by the roots of the plants. (2) By spraying them on the leaves, they are absorbed by the leaves. Fertilizers supply essential elements for plants.

2.4. Types of fertilizers: In agriculture, nitrogen, phosphorus, potassium, calcium etc. are required for higher production of crops and growth of plants. Plants take these elements from the ground. But gradually there is a shortage of these elements in the land. Compounds of artificially made elements are added to the soil to fill this deficiency. These compounds made artificially are called fertilizers. If these compounds of the elements are not mixed in the land, the productivity of the land will be reduced.

3. Pesticide intensities and climate change

Earth's climate is changing due to increase in greenhouse gases produced by agro activities. Atmospheric CO₂ increased [9,12] from 280 to 400 ppm over the last century and may reach 550 ppm

by 2050. Pesticide use itself is a major contributor to climate change. A report by the Intergovernmental panel on climate change found that agricultural activities accounted for about 30% of global emissions leading to climate change, including pesticides as table 2 shows that these are used in a very big quantity in our country, fertilizers and chemicals used in agriculture [13, 15-18].

Table 2: Showing the consumed different quantity of pesticides in India.

Pesticide	Consumed Quantity (metric tonnes)
Sulphur (fungicide)	16424
Endosulfan (insecticide)	15537
Mancozeb (fungicide)	11067
Phorate (insecticide)	10763
Methyl Parathion (insecticide)	08408
Monocrotophos (insecticide)	08209
Cypermethrin (insecticide)	07309
Isoproturon (herbicide)	07163
Chlorpyrifos (insecticide)	07163
Malathion (insecticide)	07103
Carbendazim (fungicide)	06767
Butachlor (herbicide)	06750
Quinalphos (insecticide)	06329
Copper oxychloride	06055
Dichlorvos (insecticide)	05833

Climate change has the potential to affect agriculture. Changes in temperature have an effect on agriculture and changes in moisture fields. Agriculture can also reduce global warming and can make this situation worse. Some of the increase in CO₂ in the atmosphere is also due to the decomposition of organic materials in the soil [14]. And most of the methane released into the atmosphere comes from decomposition of organic matter in wet soil, such as paddy fields. In addition, wet and anaerobic soils also release nitrogen through denitrification, releasing the greenhouse gas nitric oxide, and the soil can be used to separate some of the CO₂ in the atmosphere.

Pesticides are responsible for continuously increasing the temperature on the earth, increasing the quantity of CO₂ gas, phobia of drought and storms and interactive climatic effects.

A research has shown that more than 200 million pounds of agricultural pesticides such as ingredients are being used in California fields every year [19]. These chemicals contain more than 40 million pounds of fumigants, one of the most dangerous and greenhouse gas-producing pesticides. Fumigant is used to contribute to nitrous oxide, which emits 300 times more greenhouse gases than carbon dioxide. In spite of this, they are being used continuously and are caused major issues as shown as figure 3.

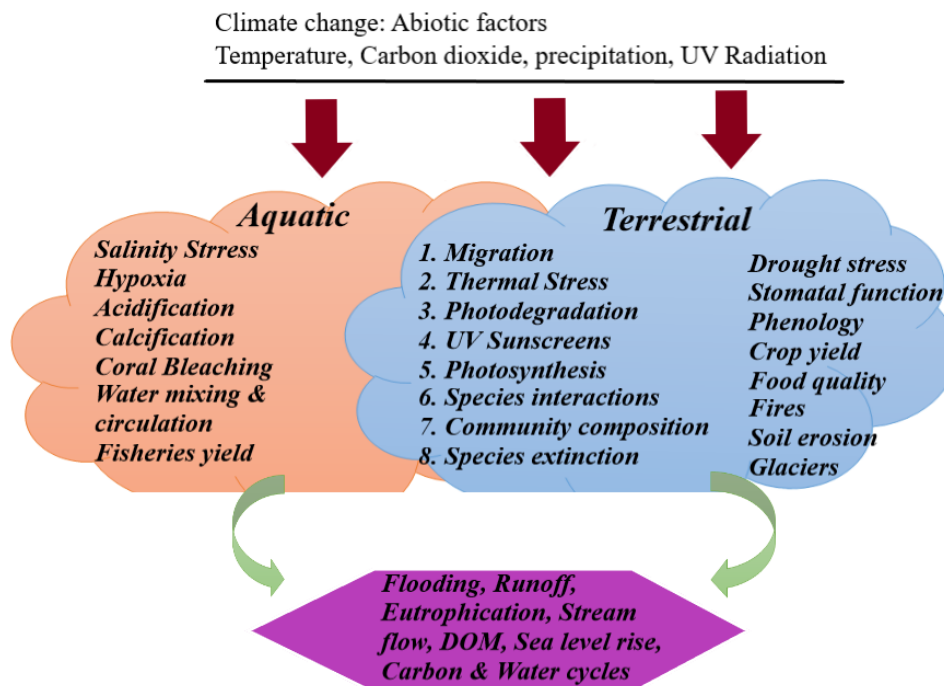


Figure 3: As shown in the picture, agrochemicals play an important role in climate change by affecting abiotic factors to a great extent.

Bringing Solid and Realistic Plans on Climate Change United Nations chief Antonio Gutarais has asked world leaders to come forward with concrete and realistic plans to take strong steps on climate change [20]. He said that global temperatures from greenhouse gas emissions are rising to dangerous levels, affecting millions of people. The State of the Global Climate Report released by the World Meteorological Organization (WMO) provides a serious picture of the socio-economic effects of climate change and growing physical signals worldwide.

4. Areas of impact

Pesticides have a special contribution in solving the food problem due to agricultural development, but certain fertilizers and chemicals are also having harmful effects on the environment and humans and other organisms, which needs to be aware. Chemicals, fertilizers and pesticides, weed and diseases are directly or indirectly harming organisms and flora, i.e. they are causing environmental pollution as shown in the picture 4. It has now become clear that the environment is being polluted by biochemistry (insect destroying, disease destroying).

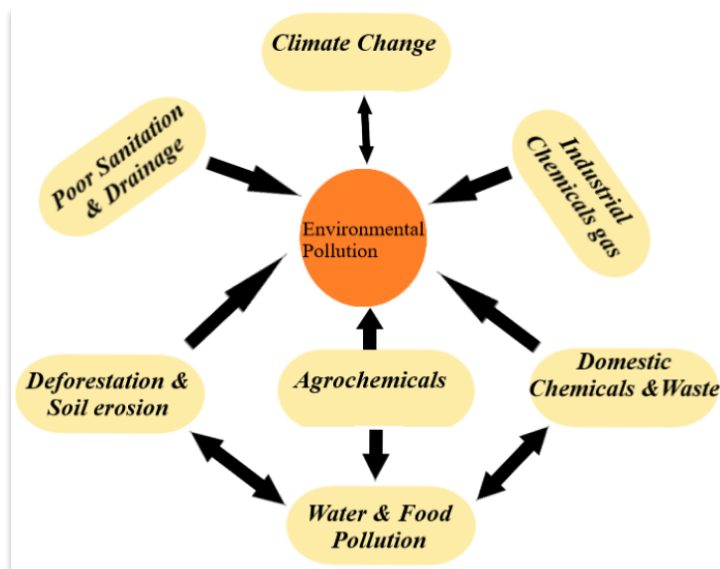


Figure 4: Environment of agrochemicals and Climate change is explained through diagram. These agrochemicals affect the environment, climate change as well as the biota of there.

In countries with borders along the coast, such as Bangladesh, Indonesia, Pakistan, Thailand, Zambia, Maldives, Monjambique, Egypt, Suriname, Senegal, India, etc., migration and climate change in agricultural areas along the coastal parts Agriculture in the regions will definitely affect crop production and productivity. The population inhabiting these areas will be particularly affected.

5. Areas of impact

Climate change is affecting agriculture the most [21]. Agriculture is the backbone of India's economy. In such a situation, climate change is also posing a threat to our economy. The productivity of agriculture is completely dependent on the availability of weather, climate and water, agricultural production is affected by the change or change of any of these factors. On one hand, the direct impact of climate change is on agricultural production, the indirect effect is reflected in the loss of income and rising prices of grains.

5.1. Weed problem

The increase in carbon dioxide content and concentration may have an impact on the weed growth found especially in C_3 group crops [22]. Their age is much older than that of crops, which can adversely affect the crops of this group. Also, the growth of weeds of C_3 group can increase the competition of nutrients of weeds with crops of C_4 group. Experiments have proved that weeds called Belvet leaf have been shown to increase relatively more due to increased carbon dioxide in maize.

It has also been proved that weeds have less sensitivity to climate, and adaptability more than crops. Thus, varieties of weeds and their invasive potential may be further increased due to atmospheric warming. In temperate climates due to low temperature, there is less possibility of isothermal weeds to grow. If the temperature continues to increase, the probability of growth of these weeds in the particular area can increase even more.

5.2. Climate change impacts soil

Soil like other components of agriculture is also affected by climate. The soil was already becoming organic carbon free due to the use of chemical fertilizers; now increasing the temperature is affecting the moisture and work capacity of the soil, increasing the salinity in the soil. Declining groundwater level is affecting soil fertility.

5.3. Effect on soil fertility and productivity

Soil itself is a natural ecosystem where the components of the food chain, i.e. producer, consumer and dissection, all three processes continue. If the current rate of temperature rise continues, obviously soil temperature will also increase in the future. Plants obtain their food by mineralization of organic matter and micro-biological processes [23].

Due to the increase in biological activity of micro-organisms by increasing the soil temperature, the maximum dissolution of organic matter, organic carbon and nitrogen will emit more amounts of nitrogen oxides and carbon dioxide gases. On the other hand, for the supply of micro-organism organic energy, there will be a decline in the amount of maximum organic and nitrogen organic matter, which can have far-reaching consequences in terms of soil fertility and productivity. Due to which the use capacity of organic materials in crops is decreased and the entire soil is reduced in bio-carbon and nitrogen source, i.e., the plants will be unable to use them. Apart from this, their contribution can be in the form of increase in the effect of plant gases and increase in global temperature.

5.4. Physical effects on plants

The process of making food in plants has a critical limit of photosynthesis. Based on some research results, scientists believe that after increasing the temperature, carbon dioxide concentration and concentration to a certain extent, the extent of gain can also be reduced. Particularly in equatorial climatic regions, climate change can also increase the overall bio-weight of crops and decrease the weight of the grain and the seed i.e. increased in the production of fodder crops.

5.5. Effect on genetics

If the annual average growth of the current temperature is 0.3 to 0.6 percent of the current temperature due to plant effects generated by the increasing amount and concentration of plant house gases in the atmosphere [24], then in future it may lead to deterioration of biodiversity and genetic degradation as the main centres of biodiversity are plant- Species will not be able to organize themselves in temperature rise. Biodiversity is the genetic basis of crop improvement. The development and improvement of new species of disease and pest resistant crops is done keeping in mind the diversity in desirable properties present in wild plant species. The decline in biodiversity and genetics-erosion can have a direct impact on crop improvement programs.

5.6. Crop order change

Due to the transfer of climatic zones through climate change, the order of crops can change naturally. In those parts of the world where crops of temperate climate such as wheat, barley, peas, chickpea, potato, etc. are grown in shade, their location due to temperature rise, crops grown in isothermal climate, paddy, maize, and sorghum can take millet, soybean and peanuts. That is, keeping in mind the benefits, the crop cycle of taking crops may also have to be changed. Apart from this, in the case of floods or water logging in the coastal areas, there may be a change in the methods and the sequence of crops. The possibility of such changes in the consumption of food and food items and products among the people of the area cannot be denied.

Conclusions

In most developing countries, especially African and Asian, there are urgent needs to understand the dynamics of local climate and make predictions to respond to climate variability and change. The economies of most developing countries depend heavily on climate-sensitive sectors such as water, agriculture, fisheries, energy and tourism, climate change, therefore, poses a serious challenge to social and economic development in developing countries

Now we should discuss the effects of chemical pesticides on the basis of experiences, not arguments. In the hilly areas of Himalayas and Uttar Pradesh, where these chemicals are not used till now, there may be an increase in the benefits of farming but it is polluting every land, water and air, so they have to be stopped.

Naturally, in the context of pesticides in agriculture, there can be no better alternative than traditional measures.

Increased use of chemical fertilizers and pesticides is not only affecting the health of humans and animals, but is also decreasing the fertility of the land. Now the time has come for the government to review its agricultural policies. Take an accurate review of the advantages and disadvantages of the modern agricultural system. There should be an initiative by the government to control the use of pesticides and to promote farming practices that are both health and environment friendly, only then will the farm and farmers are safe.

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