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Effects of Chemical Fertilizers and Pesticides on Human Health and Environment: A Review

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ABSTRACT

In developing country like India, a marketable surplus of agriculture is the most important factor which influences the economic development of a country. To meet the demands of agriculture goods adequately and to feed the increasing population, the phenomenon of Green Revolution came into existence. Green Revolution, allowed developing countries like India to overcome continual food scarcity by producing more food and other agricultural products by using high-yielding varieties of seeds, modifying farm equipment, and substantially increasing use of chemical fertilizers. For an optimum production of agriculture produce and to feed the growing population, application of chemical fertilizers and pesticides has become necessary. Such type of agriculture practices allowed growth and sustainability of food grains but at the same time have the major impact on the environment and human health. This article provides a sketch of effects of chemical fertilizers and pesticides on human health and environment.

Highlights

- Application of chemical fertilizers, pesticides have boomed in the agricultural land after green revolution.
- Application of chemical fertilizers, pesticides have negative effect on human health and environment.

Keywords: Green revolution, chemical fertilizers, pesticides, environment, human health.

A goal of agriculture is to meet the present food need of the society with the surplus amount of availability for exporting and future purposes. For increasing agricultural production and productivity, use of chemical inputs such as pesticides has increased. Pesticides are chemical substances that are meant to kill pests. In general, a pesticide is a chemical or a biological agent such as a virus, bacterium, antimicrobial, or disinfectant that deters, incapacitates, kills, pests. It is commonly used to eliminate or control a variety of agricultural pests that can damage crops and livestock and reduce farm productivity. Pesticides have proved to be a boon for the farmers as well as people all around the world by increasing agricultural yield. Basically, the input of pesticides in Indian agriculture increases after the announcement of Green Revolution which in turn helps our country to fight the major problem of food crises. Although the application of pesticides serves as a boon but also had a long term negative effect of harming the environment and human health. Currently, India is the largest producer of pesticides in Asia and ranks twelfth in the world for the use of pesticides. Although Indian average consumption of pesticide is far lower than many other developed economies, the problem of pesticide residue is very high in India (Abhilash and Singh 2008).

The current issue of hazard posed by pesticides to human health and the environment has raised concerns. Production of better alternative to reduce pesticide formulations is an answer to this destruction condition. If the pesticides are used in appropriate quantities and used only when required

or necessary or opting for organic farming, then pesticide risks can be tackled to some extent.

Water pollution is on the rise due to these pesticides, even at low concentration, these pesticides have serious threat to the environment (Agrawal *et al.* 2010).

The data for the last two decades regarding pesticide exposure and human health revealed that several pesticides cause neuronal disorder and degenerative diseases, some effect fetal growth and cause congenital anomalies and other are carcinogenic for human (Asghar *et al*. 2016). Over the past three decades, the indiscriminate use and improper handling of pesticides in agriculture have caused serious human health problems in many developing countries (Dasgupta *et al*. 2007).

Effects of Chemical Fertilizers and Pesticides on Human Health

Bhandari (2014) studied an overview of agrochemicals and their effects on the environment in Nepal concluded that agrochemicals are considered as a powerful weapon or magic bullets in the developing countries in order to enhance the agriculture productivity. However, it has been observed that agrochemicals are causing serious hazards and certain pesticides may affect the human endocrine and immune systems and may promote the development of cancer.

It has been administered that farmers do not use the safety masks, gloves and other protective gears during the spraying of pesticides which results into the access of pesticides in the blood stream through inhalation and dermal exposure which can adversely affect their eyes, skin and the respiratory system. The study shows relationship between the extent of pesticide used and signs and symptoms of illnesses due to exposure among spray farmers of Bhopal, Madhya Pradesh India, who sprayed pesticides by themselves and therefore were directly exposed to pesticides were assessed. The 18 months exposed spray farmers reported maximum acute signs and symptoms like burning/stinging of eyes (18.42%), blurred vision (23.68%), skin redness/itching (50%), excessive sweating/shortness of breath (34.2%), dry sore throat (21.05%) and burning of nose (28.9%). The signs and symptoms were found to be duration dependent among the sprayers. It is concluded that there is need for creating more awareness among the farm sprayers and authorities in implementing and ensuring the use of protective gear while handling pesticides (Choudhary 2014).

When fertilizers and pesticides are used in farmlands, they are transmitted directly or indirectly into the corns and vegetable that affects the human health. Moreover, as pesticides are applied over the vegetable which are directly entered into human or livestock bodies. Excessive use of fertilizers may pollute the underground water with nitrate and it is so much hazardous to humans or livestock. Nitrate concentrated water can immobilize some of hemoglobin in blood. Organophosphate pesticides have increased in application, because they are both less persistent and harmful for environment than organochlorin pesticides. But, they are associated with acute health problems, such as abdominal pain, dizziness, headaches, nausea, vomiting, as well as skin and eye problems. There have been many studies intending to establish cancer – pesticides association. Organophosphate pesticides used in the vegetables gradually get deposit into human body and has a link with cancer (Miah *et al.* 2014).

Wimalawansa and Wimalawansa (2014) assessed the impact of changing agricultural practices on human health in Srilanka and concluded that detrimental agricultural habits, including the excessive and indiscriminate use of toxic agrochemicals, allowing continued environmental contamination and contamination of the human food chain. Contamination of soil and water with toxic agrochemicals (*e.g*., phosphate fertilizer contaminated with heavy metals, pesticides and herbicides *etc*.) are a particular concern. These pollutants in water generally are in small quantities, and thus, cannot be seen or tasted. Therefore, their harmful effects do not manifest in humans for several years but led to the escalation of deadly disease like chronic kidney disease.

Green Revolution makes India self-dependent in term of food grains but indiscriminate use of synthetic fertilizers and pesticides contaminated our food and environment. Punjab, an agricultural state of the Indian Republic known as the grain bowl of the country is facing serious problems. Nutrient imbalance in the soil and surface water contamination, pesticide residues in food and bovine milk and increasing cancer rate in farmers

are some of the example of Green Revolution (Rahman and Debnath 2015).

The study shows that DDT was the most popular and effective pesticide to help people combat unwanted organisms and gain dramatically improvement in agriculture. However, since a number of adverse effects of this insecticide were reported, usage of DDT was banned international wide. Despite the severe restriction, DDT is still illegally used in many areas, especially in developing nations. Negative impacts of DDT on the human health were acknowledged and disseminated widely to warn population and prevent unexpected situations occur. Nevertheless, although DDT was not used in recent time, it still impacts on human health due to long residual efficacy and accumulation through food chain. In term of human health, DDT is the cause of many kinds of cancer, acute and persistent injury to the nervous system, lung damage, injury to the reproductive organs, dysfunction of the immune and endocrine systems, birth defects (Thuy, 2015).

The use of pesticides was introduced in India during the mid-sixties as a part of green revolution and malaria prevention programs. While pesticides turned useful for pest control they were at the same time responsible for human health injuries. Today these chemicals in particular those which accumulate in food chain, impose several human health hazards. Intake of food containing pesticide residues is documented to result in highest exposure, about 10^3 –10^5 times higher than that arising from contaminated drinking water or air. Pesticides have been reported to cause several adverse health effects which depend on the extent and duration of exposure. Health effects of pesticides range from mild allergies, rashes, breathing difficulties, neurotoxicity and reproductive abnormalities to deadly chronic diseases like cancer. This challenge to food safety may be addressed by preventive strategies which include the use of alternative sustainable agricultural practices or mitigating strategies which are based on reducing pesticide exposure from food and water by different processing techniques (Tomer *et al*. 2015).

Effects of chemical fertilizers and pesticides on environment

Soil, the basic need of farming may happen to pollute by the accumulation of various heavy metals, through emissions by industries, mining process, disposal of high metal wastes, gasoline, application of fertilizers, sewage sludge, pesticides, wastewater irrigation, coal combustion residues, etc. Historically, a large amount of chemicals is annually applied at the agricultural soils as fertilizers and pesticides. Such applications may result in the increase level of heavy metals, particularly Cd, Pb, and As in the soil (Atafar *et al*. 2010). Usage of pesticides, insecticides and other various chemicals in agriculture is very easy, quick and inexpensive solution for controlling weeds and insect pests. However, use of chemicals comes with a significant cost. They have contaminated almost every part of our environment and their residues are found in soil, water, land and air.

Kumar *et al.* (2013) concluded that pesticides are often considered a quick, easy and inexpensive solution for controlling weeds and insect pests in urban landscapes. Pesticides have contaminated almost every component of our environment. Pesticide residues are found in soil and air, and in surface and ground water across the nation, and urban pesticide uses contribute to the problem. Pesticide contamination poses significant risks to the environment and non-target organisms ranging from beneficial soil microorganisms, to insects, plants, fish, and birds. Contrary to common misconceptions, even herbicides can cause harm to the environment.

The study performed in the surface water of Sharda river region in Lakhimpurkheeri, Uttar Pradesh-India reports the concentration levels and distribution patterns of the 21 organochlorine pesticide residues in Solid Phase Extraction (SPE) is used for the extraction of organochlorine pesticide residues in water sample. The most commonly encountered Organochlorine pesticides in surface water were dieldrin, heptachlor epoxide, isomers of hexachlorocyclohexane and DDT. In some cases the concentrations detected were higher than the quanlitative target levels set by the European Union, especially for γ-hexachlorocyclohexane&pp'- DDT. The concentration levels found are lower than the EU maximum acceptable concentration of 0.10 μg l^{-1} for all compounds examined, except for δ-HCH in seven samples (0.2772, 0.1950, 0.2210, 0.2045, 0.1994, 0.1523, 0.1390 μg l^{-1}) and four samples (0.1877, 0.2365, 0.1478, 0.1269 μg l^{-1}) of pp'-DDT during 2008-2010.

The occurrence of these compounds in Sharda river region surface waters can be attributed to intense agricultural activity as well as to transboundary pollution (Maurya and Kumar 2013).

Pesticides have contaminated almost every part of our environment and pesticide residues are found in soil, air and in surface and groundwater. Pesticide contamination poses significant risks to the environment and non-target organisms ranging from beneficial soil microorganisms to insects, plants, fish, and birds. Recent studies have indicated that our environment is chronically polluted by pesticides and levels of biocidal contamination have increased tremendously. The environmental deterioration due to pesticides is endangering the situation of future (Sitaramaraju *et al*. 2014).

Soil analysis is carried out in the villages of Loni, Adgaon, Chinchpur, Sadatpur, Gogalgaon, falling in Taluka of Rahata & Sangamneer. Chemical fertilizers and pesticides are continuously being applied to agricultural fields for past many years boosting the agricultural yield and increasing chemical fertilizer consumption. The requirement of agricultural product (sugarcane, bajra, vegetables, food & fodder for animals) to cater to the domestic and industrial needs have made farmers to use fertilizer and pesticide beyond the prescribed dosage. The soil pH varied between from 7.46 to 8.9 and soil was found to be moderate alkaline. The soil is found to be free from salt accumulation. Organic carbon in soil was found to vary from moderate to very low indicating the need for improving the soil fertility. Available Nitrogen was found to be low in about 80% of soil sample, indicating lack of nitrogen status and the need for adequate application of nitrogenous fertilizer.50% of the sample tested revealed very low Available Phosphorous content, remaining with moderate to low content. More than 80% of soil sample showed high value of Available Potassium as high as 963.2kg/ha, remaining have moderate to low values. Micronutrients, Zn, Cu, had moderate to low value and Fe showed very low value, but about 48% of sample had Mn higher value. This nature of micronutrients may probably due to the moderate alkali value in the soil Groundwater studies in the region have shown growing alkalinity, Nitrates and other fertilizer and pesticide residue in the water. The growing soil contamination can lead to further deterioration of ground water quality, which needs to be controlled through controlled application of water and application biofertilizer, organic manure (Natraj and Katyal 2014).

A research has been done in (Ardabil- Iran) Moghan's irrigation and drainage network in order to evaluate long term effects of pesticides and chemical fertilizers usage on soil properties and heavy metals accumulation. The results showed that soil physical characteristics such as bulk density were changed in long-term and it was increased compared to control soil. The heavy metals accumulations in soil were highly affected and the concentration of some metals such as cadmium has reached a limit beyond the standard for agricultural purposes. The results also showed that fortunately the concentration of other metals is not beyond the standard. In this context, given the state of the soil and gained results, considering pesticides and fertilizers management is essential and it requires planning to reduce or replace pesticides and fertilizers usage in this region (Yargholi and Azarneshan 2014).

CONCLUDING REMARKS

By reviewing the literature, it can be concluded that the farmers do not follow appropriate safety precautions with regard to pesticide application, large amounts of pesticides are inappropriately used by these farmers, leading to several human health disease, polluting our air, land, water. Since about major proportion of the population relies on agriculture for subsistence, the pesticides are used very widely in agricultural field to increase the production by protecting the yields from potential threat. To safeguard human life and environment from the toxic effects of pesticides, adequate steps need to be taken. Now it is a well established fact that there is the foremost need to step forward towards our mother earth by nurturing it by going for the organic farming system. An answer to this havoc is the organic farming, an environmentally friendly agricultural approach which ultimately leads to proper human health. Moving back to our ancestor's course by performing organic agriculture is a step towards sustainability. Organic agriculture is a holistic production and management system which is supportive of the environment, health and sustainability (Dubey, 2013). Though the Government of India has been making concerted

efforts to encourage farmers and people regarding organic produce and product, but it has not resulted in bridging the gap between the demand and supply of organic product in the market. A proper training should be given to the farmers regarding organic farming, its scope, potential, profit and environment sustainability. It has been administered that organic food consumption is increasing in India and this is evident from the fact that many organic food stores are prompt up in India. So, working upon niche area of organic farming is yet to be explored and flourish.

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