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**Dr. Surender Kumar**  
Associate Professor of  
Geography, Govt. P.G. College,  
Hisar, Haryana, India

**Manish Kumar**  
Assistant Professor of  
Geography, GDC Memorial  
College, Bahal, Bhiwani,  
Haryana, India

**Corresponding Author:**  
**Dr. Surender Kumar**  
Associate Professor of  
Geography, Govt. P.G. College,  
Hisar, Haryana, India

## Green revolution and its impacts on environment: A review

**Dr. Surender Kumar and Manish Kumar**

### Abstract

In the 1940s to 1960s a series of technical research started in the field of agriculture which increased the agricultural production worldwide that's refers the Green Revolution. Green revolution was highly successful as agricultural production and the verities of food. But there is not only positive impacts of Green revolution while some adverse impact on environment also Land degradation like loss of soil fertility, erosion of soil, soil toxicity; deforestation, diminishing water resources like pollution and salinity; loss of biodiversity, increase in greenhouse gas emissions and global warming, increased in sequence of human and livestock diseases are some of the negative impacts of over adoption of agricultural technologies by the farmers to make the Green Revolution successful. During the last 45 years various scientific studies and research are introduced the fertilizer and pesticide like nitrates, organochlorines, organophosphates, synthetic pyrethroids and carbamates at higher level. So we can say that while the Green Revolution has made a positive impact by increase the production food resources, on the other hand, it has also created a negative relationship between human beings and environment. The present study aimed to explore the adverse impacts of Green Revolution on the Environment.

**Keywords:** green revolution, environment, agriculture

### Introduction

#### Historical Background of Green Revolution:

William Gaud was used firstly the term green revolution. Mexico has been called the 'birthplace' and 'burial ground' of the Green Revolution. The introduction of High Yielding Varieties (HYV) of seeds and the increased use of chemical fertilizers and irrigation are known collectively as Green Revolution. High yielding wheat was first introduced to India in 1968 by American agronomist Norman Borlaug. Borlaug has been hailed as father of Green Revolution, but MS Swaminathan is known as 'Father of Green Revolution in India'. The Green Revolution refers to a series of research and development and technology transfer initiatives, occurring between the 1940s and the late 1960s that increased agricultural production worldwide, particularly in the developing world, beginning most markedly in the late 1960s.

In 1947, when India became independent in 1947, almost about 90% of its population lived in villages depending mainly on agriculture for their subsistence. As a comparison, Indian agriculture remained unchanged without any technological changes in agricultural practices from the last two centuries mainly. The technologies employed in agriculture were the seeds cultivated by the farmers having a genetic makeup that went back thousands of years and the involvement of wooden plows, waterwheels, and bullock carts, along with the agricultural practices driven by the energy provided by animals and humans. Therefore, failure of the agriculture sector to meet the demands of India after 1947 until 1965 reflected negatively in the growth of the industrial sector. The lack of proper technological change and land reforms combined with droughts brought India to the verge of massive famine in the mid-1960s. However, this situation was averted by massive shipments of subsidized food grains mainly wheat by the USA. This measure, in turn, depleted the reserves of the nation. So, in order to save the reserves and to increase the productivity of cereals, all the stakeholders and donor agencies decided to induce changes in agricultural technology and practices.

Food grains mainly rice and wheat are introduced by the Green Revolution. The HYVs of wheat and rice were tested by the Indian scientists in 1962 and 1964 respectively.

Later, these tested varieties were introduced throughout the nation during the crop year of 1965–1966. Thus, the Green Revolution involved the use of HYVs of wheat and rice and adoption of new agricultural practices involving the use of new machinery in agriculture like tractor, combines, mechanical threshers etc., chemical fertilizers and pesticides, technology for irrigation. As the response of these techniques the production of food grains was increased from 2.4% per annum before 1965 to 3.5% after 1965.

### **Adverse Impacts of Green Revolution on Environment**

Environment is a holistic system of biosphere consisting of both biotic and abiotic components interacting with each other and involving a series of cyclic balances. In this system, land, water, plant, animals, birds, insects, worms and humans are linked by complicated network of inter-connections and inter-dependence. The Green Revolution caused major changes in traditional eco-systems and agrarian structures. It resulted in major damages to environment. As per information from different sources, major consequences of green revolution on environment can be summarized as follows:

- Loss of Biodiversity.
- Land degradation.
- Soils diseased with salinity, soil toxicity, micro nutrient deficiency.
- Decrease in water table.
- Water-logging.
- DDT, Uranium in water and food resources has been found to the extent that mother feed is also not free from DDT.
- Greenhouse gas emissions.
- Dependence on non-renewable resources.
- Impact on Health.
- Degeneration of health.
- Economic inequality between big and small farmers increased.
- Increase in inter-class disparity as well as regional disparity.

### **Loss of Biodiversity**

The spread of Green Revolution agriculture affected both agricultural biodiversity and wild biodiversity. There is little disagreement that the Green Revolution acted to reduce agricultural biodiversity, as it relied on just a few high-yield varieties of each crop. For example, before the revolution, it is speculated that there were over 3000 variants of rice. Now it is estimated that only ten modified variety of rice is used. This has led to concerns about the susceptibility of a food supply to pathogens that cannot be controlled by agrochemicals, as well as the permanent loss of many valuable genetic traits bred into traditional varieties over thousands of years. To address these concerns, massive seed banks such as Consultative Group on International Agricultural Research's (CGIAR) and International Plant Genetic Resources Institute have been established.

There are varying opinions about the effect of the Green Revolution on wild biodiversity. One hypothesis speculates that by increasing production per unit of land area, agriculture will not need to expand into new, uncultivated areas to feed a growing human population. However, land degradation and soil nutrients depletion have forced farmers to clear up formerly forested areas in order to keep up with production. A counter-hypothesis speculates that

biodiversity was sacrificed because traditional systems of agriculture that were displaced sometimes incorporated practices to preserve wild biodiversity, and because the Green Revolution expanded agricultural development into new areas where it was once unprofitable or too arid. For example, the development of wheat varieties tolerant to acid soil conditions with high aluminium content permitted the introduction of agriculture in sensitive Brazilian ecosystems as Cerrado semi-humid tropical savanna and Amazon rainforest in the geo-economics macro regions of Centro-sul and Amazonia.

### **Intensive Irrigation and Land Degradation**

As new seeds have enormous thrust for irrigation water, the new agricultural strategy is based on expansion and intensification of irrigation form surface as well as from ground water. Need for irrigation was raised by Green revolution at two levels:

1. Shift from water prudent crops like millets and oilseeds to monoculture of wheat and rice which increased the demand of water throughout the year.
2. The replacement of old varieties of wheat and rice with new varieties also increased the intensity of irrigation. HYV seeds need about three times as much as irrigation as traditional varieties.

Thus, with respect to water use, the shift to HYV wheat varieties and the replacement of millets and maize by rice has led to decrease in productivity and other environmental problems such as:

**Problem of water logging, desertification and salinity:** The enormous increase in water use in green revolution has led to the total destabilization of water balance in the region. Water cycle can be destabilized by adding more water to an eco-system than natural drainage potential of that system. It leads to desertification through water logging and Stalinization of the land. Problem of salinity is very closely related to the problem of water logging. In arid areas-regions containing scarce rainfalls, the earth contains a large amount of unbleached salts. Pouring irrigation water to such soils brings those salts to the surface and leaves behind the residue when water evaporates. It causes to reduce the fertility of the soil and in extreme cases; the productivity of soil may be ruined/spoiled forever.

**Depletion of underground water table and water pollution:** Irrigation with underground water is being taken up extensively as electricity for driving pump sets is made available to farmers at subsidized rates. As a result, underground water reserve which required thousands of years to form is being quickly depleted.

### **Effects of Inorganic Fertilizers**

The earth is endowed with natural biological process to recover soil fertility. In this process, earthworms and other useful bacteria eat up decomposed organic material on the earth and convert them to natural nitrogenous and phosphatic manures. On the other hand, chemical fertilizers, being toxic in nature, prevent the earth from regaining soil fertility in the natural way, because, fertilizers kill these earthworms, insects. Once the chemical fertilizers are applied to raise agricultural production, the soil loses its natural fertility. Moreover, nitrogenous fertilizers leach through porous soil contaminating underground water rendering it unsuitable for drinking. Fertilizers, which are

not absorbed by plants, are washed away by rain into ponds, rivers and streams and ultimately make the surface water unsafe. Phosphatic fertilizers like the superphosphate are manufactured from crude phosphate rock mineral which contains traces of arsenic, lead and mercury, all of which are detrimental to biological organisms and may be deposited into human body through food-grains and vegetables, causing cancer of liver, kidney, or bone and also diseases related with the nervous system.

### Effects of Pesticides

Different types of pesticides like parathion, malathion, BHC†, and DDT‡ which have been long used for controlling pests in agricultural crops have been found to have hazardous effects on environment. In fact, pests develop immunity from pesticides very quickly. These pesticides not only kill harmful pests, but also have proved deadly to bio-friendly creatures like earthworms, crab, rat, field snake, bird, fish, butterfly, honeybee etc. pesticides can spread through water and wind and enter into biological system of animals, birds and human beings. In this way, such cyclic process adversely effects to all living beings on the earth. Despite their harmful impacts on human beings and environment, pesticides are being increasingly used to protect plants and food grains from pests. Unfortunately, a majority of pesticides now in use in India are unsafe.

### Deforestation and Soil Erosion

The ecological deterioration can be attributed mainly to extension of cultivation to marginal and sub-marginal dry-land and to deforestation. Apart from rapid population growth and acute poverty, the pressure of demand for fuel wood, timber, meat, wool from high income groups has been major cause of denudation of the environment. Moreover, development projects, construction of big dams, heavy industrialization, urbanization and growing population involve deforestation. Deforestation is a serious problem because it leads to erosion of land. Soil erosion accompanying water logging and salinity of soil reduce crop yield in agriculture and cause deterioration of eco-system.

### Some Other Impacts of Green Revolution

There were many other areas too, where green revolution impacted to the great extent. Views of the respondents have been summarized as follows:

- Wherever technological advances occurred in agriculture, concomitant changes have taken place in the socio-economic life of the people: production gain, income increase, reduction in farm employment, changes in agrarian relations, alterations in spending patterns, changes in occupational pattern, improvement in education, health, life style and the like. It has contributed to migration of good human resources to the other developed countries.
- Intensive farming with the new technology has generated demand for more farm labor. As a result, an acute labor shortage has arisen. Another contributory cause is that landless laborers, after receiving education, are going into professions and skilled jobs and are no longer interested in working on farms as unskilled laborers.
- Agricultural diversification is traditionally associated with subsistence farming and is an extremely important aspect of food security at the household level. It is

generally agreed that agricultural diversification helps humans obtain food security and improved, healthy foods. What is needed most at this stage to bring about crop diversification is for the central Government to assure the marketing of crops other than rice and wheat so that farmers can get out of the vicious cycle of rice-wheat monoculture. By promoting other crops, water can be saved because many of the pulses, bajra, jowar, etc. being adapted to arid environments, demand much less water than the rice-wheat combination.

### Conclusion

An attempt has been made to find out the impact of green revolution on environment. The Green Revolution Changed the pattern and meaning of agriculture, as it has provided an unprecedented level of food security. It has pulled a large number of poor people out of poverty and helped many non-poor people avoid the poverty and hunger they would have experienced had it not taken place. This revolution has saved over a billion people all over the world from famine. But the Green Revolution has posed innumerable challenges to the environment and ecosystem. Because it was the technical change in the agriculture methods and in the other ways we can say that traditional agriculture was changed in the modern agriculture. Apart from use of genetically modified seeds use of pesticide and fertilizers have also increased. The use of chemical fertilizers depletes the soils natural fertility and pesticides generates resistant pests farmers need more fertilizers and pesticides to achieve the same results environmental degradation makes green revolution overall inefficient, short term solution to problems of food security. Ultimately, it can be concluded that the model of development, which was adopted at global level in 1960s was essentially non-sustainable and this is ultimately impacting all aspects of Environment and Ecology at the global level.

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