



Green Revolution and its Impact on Environment

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Abstract:

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. Green revolution was highly successful as agricultural production of most of countries increased. But Green revolution has some adverse impact on environment in forms of deforestation, land degradation, loss of biodiversity, increase in greenhouse gas emissions etc. 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. 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. Nevertheless, the world community has clearly acknowledged the negative aspects of agricultural expansion as the 1992 Rio Treaty, signed by 189 nations, has generated numerous national Biodiversity Action Plans which assign significant biodiversity loss to agriculture's expansion into new domains. Most high intensity agricultural production is highly reliant on non-renewable resources. Agricultural machinery and transport, as well as the production of pesticides and nitrates all depend on fossil fuels. Moreover, the essential mineral nutrient phosphorus is often a limiting factor in crop cultivation, while phosphorus mines are rapidly being depleted worldwide. The consumption of the pesticides used to kill pests by humans in some cases may be increasing the likelihood of cancer in some of the rural villages using them.

Keywords: *Green revolution, Environment*

1. Introduction

The Green Revolution refers to a series of research and development and technology transfer initiatives, occurring between the 1940s and the late 1960s (with prequels in the work of the agrarian genetist Nazareno Strampelli in the 1920s and 1930s), that increased agricultural production worldwide, particularly in the developing world, beginning most markedly in the late 1960s. The initiatives, led by Norman Borlaug, the "Father of the Green Revolution," who won the Nobel Prize in 1970, credited with saving over a billion people from starvation, involved the development of high-yielding varieties of cereal grains, expansion of irrigation infrastructure, modernization of management techniques, distribution of hybridized seeds, synthetic fertilizers, and pesticides to farmers. The term "Green Revolution" was first used in 1968 by former United States Agency for International Development (USAID) director William Gaud, who noted the spread of the new technologies:

In 1961, India was on the brink of mass famine. Norman Borlaug was invited to India by the adviser to the Indian minister of agriculture C. Subramaniam. Despite bureaucratic hurdles imposed by India's grain monopolies, the Ford Foundation and Indian government collaborated to import wheat seed from the International Maize and Wheat Improvement Center (CIMMYT). Punjab was selected by the Indian government to be the first site to try the new crops because of its reliable water supply and a

history of agricultural success. India began its own Green Revolution program of plant breeding, irrigation development, and financing of agrochemicals.

2. Impacts of Green Revolution

Green revolution was highly successful as agricultural production of most of countries increased. India which was once dependant on import of food grains for satisfying need of its population gradually become exporter of food grains. Green revolution has both its positive and negative effects.

India adopted IR8 –a semi-dwarf rice variety developed by the International Rice Research Institute (IRRI) that could produce more grains of rice per plant when grown with certain fertilizers and irrigation. In 1968, Indian agronomist S.K. De Datta published his findings that IR8 rice yielded about 5 tons per hectare with no fertilizer, and almost 10 tons per hectare under optimal conditions. This was 10 times the yield of traditional rice. IR8 was a success throughout Asia, and dubbed the "Miracle Rice". IR8 was also developed into Semi-dwarf IR36.

In the 1960s, rice yields in India were about two tons per hectare; by the mid-1990s, they had risen to six tons per hectare. In the 1970s, rice cost about \$550 a ton; in 2001, it cost under \$200 a ton. India became one of the world's most successful rice producers, and is now a major rice exporter, shipping nearly 4.5 million tons in 2006.

3. Impact of Green Revolution on Environment

The green revolution has some negative impacts on environments which can be discussed under following headings

4. 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) International Plant Genetic Resources Institute (now Bioversity International) 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 geoeconomic macroregions of Centro-Sul and Amazônia. Before the Green Revolution, other Brazilian ecosystems were also significantly damaged by human activity, such as the once 1st or 2nd main contributor to Brazilian megadiversity Atlantic Rainforest (above 85% of deforestation in the 1980s, about 95% after the 2010s) and the important xeric shrublands called Caatinga mainly in

the Northeastern Brazil (about 40% in the 1980s, about 50% after the 2010s-deforestation of the Caatinga biome is generally associated with greater risks of desertification). Nevertheless, the world community has clearly acknowledged the negative aspects of agricultural expansion as the 1992 Rio Treaty, signed by 189 nations, has generated numerous national Biodiversity Action Plans which assign significant biodiversity loss to agriculture's expansion into new domains.

5. Greenhouse gas emissions

According to a study published in 2013 in PNAS, in the absence of the crop germplasm improvement associated with the Green revolution, greenhouse gas emissions would have been 5.2-7.4 Gt higher than observed in 1965–2004.

6. Dependence on non-renewable resources

Most high intensity agricultural production is highly reliant on non-renewable resources. Agricultural machinery and transport, as well as the production of pesticides and nitrates all depend on fossil fuels. Moreover, the essential mineral nutrient phosphorus is often a limiting factor in crop cultivation, while phosphorus mines are rapidly being depleted worldwide. The failure to depart from these non-sustainable agricultural production methods could potentially lead to a large scale collapse of the current system of intensive food production within this century.

7. Land degradation

Land degradation is also one of the major negative impacts of green revolution. The Global Land Assessment of Degradation (GLASOD) mapping exercise of Oldeman et al. (1991) found that 43% of South Asia's agricultural land was degraded to some degree. Young (1993) subsequently revisited these estimates using additional national data, claiming the problem was actually more severe and that nearly three-quarters of the agricultural land area was degraded to some extent, and that 40% was moderately or severely degraded. Degradation associated with irrigation accounts for 23% of the total degraded area and for 25% of the moderately or severely degraded area. For India, Sehgal and Abrol (1994) estimated that 64% of the land area is degraded to some extent, with 54% moderately to severely degraded.

8. Impact on Health

The consumption of the pesticides used to kill pests by humans in some cases may be increasing the likelihood of cancer in some of the rural villages using them. Poor farming practices including non-compliance to usage of masks and over-usage of the chemicals compound this situation. In 1989, WHO and UNEP estimated that there were around 1 million human pesticide poisonings annually. Some 20,000 (mostly in developing countries) ended in death, as a result of poor labeling, loose safety standards etc.

9. Pesticides and cancer

Long term exposure to pesticides such as organochlorines, creosote, and sulfate has been correlated with higher cancer rates and organochlorines DDT, chlordane, and lindane as tumor promoters in animals. Contradictory epidemiologic studies in humans have linked phenoxy acid herbicides or contaminants in them with soft tissue sarcoma (STS) and malignant lymphoma, organochlorine insecticides with STS, non-Hodgkin's lymphoma (NHL), leukemia, and, less consistently, with cancers of the lung and breast, organophosphorous compounds with NHL and leukemia, and triazine herbicides with ovarian cancer.

10. Punjab case

Punjab pioneered green revolution among the other states transforming India into a food-surplus country. The state is witnessing serious consequences of intensive farming using chemicals and pesticide. A comprehensive study conducted by Post Graduate Institute of Medical Education and Research (PGIMER) has underlined the direct relationship between indiscriminate use of these

chemicals and increased incidence of cancer in this region. An increase in the number of cancer cases has been reported in several villages including Jhariwala, Koharwala, Puckka, Bhimawali, and Khara. Environmental activist Vandana Shiva has written extensively about the social, political and economic impacts of the Green Revolution in Punjab. She claims that the Green Revolution's reliance on heavy use of chemical inputs and monocultures has resulted in water scarcity, vulnerability to pests, and incidents of violent conflict and social marginalization.

In 2009, under a Greenpeace Research Laboratories investigation, Dr Reyes Tirado, from the University of Exeter, UK conducted the study in 50 villages in Muktsar, Bathinda and Ludhiana districts revealed chemical, radiation and biological toxicity rampant in Punjab. Twenty percent of the sampled wells showed nitrate levels above the safety limit of 50 mg/l, established by WHO, the study connected it with high use of synthetic nitrogen fertilizers.

11. Conclusion

Green revolution has done a lot of positive things, saving the life of millions of people and exponentially increasing the yield of food crops. But Critics are concerned that farmers will become dependent on large bio-tech firms and doubt the claims of increased productivity promised by the industry. Farmers have definitely shown Interest In modified crops however, rapidly expanding their planting of genetically modified Bollgard cotton seeds since Monsanto was first allowed to sell them In India in 2002. 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, shortterm solution to problems of food security. So, there is need of a second green revolution which should be more sustainable as well as inclusive.

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