Second Green Revolution: A Key to Sustainability in India

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Abstract

Green revolution has made a significant rise in supply of food grains, but several negative impacts like gradual loss of soil fertility, increasing alkalinity and salinity, water logging and depletion of ground water resources decreasing biodiversity, chemical poisoning of soils, surface water and food have come to the forefront. Agriculture sector in India faces a serious challenge in terms of sustainability. Green revolution has given rise to new set of problems, overuse of water and fertilizers. The present paper examines the consequences of first green revolution which make need for broad based, inclusive and sustainable second green revolution. For this it is required to produce more without depleting natural resources any further. The paper focuses on the requirement for second green revolution for bringing food and nutritional security for its billion plus population. Right strategies, policies and interventions in agriculture sector are necessary conditions for inclusive growth. There is urgent need to focus on efficient use of resources and conservation of soil, water and ecology on a sustainable basis.

Keywords: *First green revolution, Second green revolution, Sustainable agriculture.*

Introduction

Agriculture sector in India is the backbone of country's development and lifeline of 65 percent of the population based in rural areas. More than approximately 58 percent of the population is still dependent on agriculture for their livelihood. As per World Bank Report (India: Issues and Priorities for Agriculture, 2012), India is a global agricultural powerhouse.

Despite the fact that agriculture in India accounts for 7.68 percent of total global agricultural output but the fact cannot be ignored that in India approximately 194.6 million people are undernourished.

Table 1: Food grains: All India Area, Production, Yield along with coverage under Irrigation Area (Million Hectares, Production- Million Tonnes, Yield- Kg/hectare)

Year	Area	GR	Production	GR	Yield	GR	Area Under Irrigation (%)	GR
2005-06	121.60	-	208.60	-	1715	-	45.5	-
2006-07	123.71	0.017	217.28	0.042	1756	0.024	46.3	0.018
2007-08	124.07	0.003	230.78	0.062	1860	0.059	46.8	0.011
2008-09	122.83	-0.009	234.47	0.016	1909	0.026	48.3	0.032
2009-10	121.33	-0.012	218.11	-0.069	1798	-0.058	47.8	-0.010
2010-11	126.67	0.044	244.49	0.121	1930	0.073	47.8	0
2011-12	124.27	-0.015	259.29	0.061	2078	0.074	49.8	0.042
2012-13	120.78	-0.032	257.13	-0.008	2129	0.025	51.2	0.028
Average	122.44		237.67		1936.50		47.38	
S.D.	1.57		19.70		146.99		1.79	
C.V.	0.013		0.083		0.076		0.038	
CAGR	0.04		1.94		1.90		1.49	

Source: Directorate of Economics & Statistics, Ministry of Agriculture& Farmer's Welfare, India, 2015

Note: Average, S.D. (Standard Deviation), C.V. (Coefficient of Variation), CAGR (Compound Annual Growth Rate), GR (Simple Growth Rate) is calculated

As shown in Table 1, low value of standard deviation and coefficient of variation in case of area indicates less variability and more consistency over a period of years. On the other hand, high value of coefficient of variation in case of production indicates less consistency and very high value of standard deviation in case of yield indicates large variability.

First Green Revolution in India-An Overview

Green revolution was initially applied to the period from 1967-1978 basically in parts of Punjab, Haryana and Western Uttar Pradesh and its main concern was only with wheat and rice. Dr. M. S. Swaminathan from India led the Green revolution as a project. Generally green revolution is the phrase used to describe the spectacular increase that took place during 1967-68 in continuing in the production of food grains in India. The introduction of high-yielding varieties of seeds after mid 1960s and the increased use of fertilizers and irrigation provided the increase in production which improved agriculture in India. Initially three basic elements in the method of Green Revolution were adopted:

- Continued expansion of farming areas.
- Double-cropping on existing farmland.
- Using seeds with imposed genetics.

Negative Impacts of Green Revolution

Some of the ecological impacts of green revolution are:

- Excessive use of pesticides and fertilizers creating hazardous (health of human beings and other life), resulting in extinction of certain species of birds and animals.
- Neglect of low input agricultural practices.
- Use of harmful toxins making the land barren.
- The continuous application of chemical fertilizers has contaminated water bodies. The Malwa belt of Punjab is the worst affected with 60 percent of contaminated water resources.
- Dominant monoculture of paddy-wheat rotation has resulted in deceleration of agricultural growth.
- The mono-cropping encompasses intensive cultivation, high use of agro-chemicals, greater requirement of water and usage of heavy machinery which have adversely affected environment and ecological balances.
- Rapidly depleting levels of groundwater is one of the biggest threats to food security and livelihood in the country. According to news report, excessive exploitation of limited groundwater resources for irrigation of cash crops such as sugarcane has caused a 6 percentage point decline in the availability of water within 10 meters ground level.
- The north western and southern western parts of the country are worst hit. These are also the regions responsible for most of the country's agricultural production and food crisis is a natural corollary.
    - Excessive tillage coupled with use of heavy machinery for harvesting and lack of adequate soil conservation causes a multitude of soil and environmental problems.
    - Decline in soil organic matter leads to limited soil life and the poor soil structure.

- Poor physical condition of soil leads to poor crop establishment and water logging after irrigation. The National Bureau of Soil Survey and Land Use Planning (NBSS & LUP) data show that nearly 3.7 Mha suffer from nutrient loss and/or depletion of Soil organic matter (SOM).

Burning of crop residues for cooking, heating or simply disposal is a pervasive problem in India and contributes to SOM loss. Crop residue generation is greatest in Uttar Pradesh (60 Mt) followed by Punjab (51 Mt) and Maharashtra (46 Mt).

Need For Sustainable Agricultural Practices

Sustainable agriculture in terms of food security, rural employment and environmentally sustainable technologies such as soil conservation, sustainable natural resource management and biodiversity protection are essential for holistic rural development. Sustainable agriculture may be defined as any set of agronomic practices that are economically viable, environmentally safe and socially acceptable.

Advocates of sustainable agriculture agree with biological focus and hope to reduce, but not necessarily eliminate, chemical use. Sustainable agriculture has many advantages:

- It improves soil structure and prevents erosion.
- It helps in increasing the diversity of crops produce and raising the diversity of insects and other animals and plants in and around field.
- It increases the organic content of top soil, raising its ability to retain and store water that fall as rain.
- It reduces the use of hazardous chemicals.
- It improves productivity and conserves soil.

Sustainable agriculture system can be economically, environmentally and socially viable and at the same time contribute to local livelihoods. The resource conservation practices conceived for this include minimum or zero tillage, letting crop residues get back into the soil instead of burning them, immaculate land levelling to ensure even spread of water and applying only need-based fertilizers and water to crops. An improved emphasis on conservation of soil, water, energy and biological resources is required. One measure for sustainable agriculture lies in organic farming.

Table 2 indicates state-wise share of agriculture and allied sector in gross domestic product at current prices (2004-05 series). Year-wise as well as state-wise average, standard deviation, coefficient of variation is calculated. Moreover Compound annual growth rate is also calculated. Year-wise figures of standard deviation and coefficient of variation shows the stability over a period of two years that is from 2012-13 to 2013-14 at all India level. Standard deviation and coefficient of variation is zero in case of Andhra Pradesh, Chattisgarh, Himachal Pradesh, Jharkhand, Sikkim, Tamil Nadu, Tripura, West Bengal which indicates stability in share of agriculture and allied sector in gross domestic product at current prices.

Table 2: State-wise Share of Agriculture & Allied Sector in Gross State Domestic Product at Current Prices (2004-05) series

State	2012-13	2013-14	Average	S.D.	C.V.	CAGR
Andhra Pradesh	27.80	27.84	27.00	0.00	0.00	-0.25
Arunchal Pradesh	47.25	45.39	45.66	0.94	0.02	-1.29
Assam	23.15	23.33	22.67	0.47	0.02	-0.71
Bihar	27.01	23.83	24.00	2.16	0.09	-5.31
Chattisgarh	21.61	21.33	21.00	0.00	0.00	-0.14
Goa	6.02	8.01	7.00	1.00	0.14	15.35
Gujarat	17.30	20.41	18.50	1.50	0.08	8.62
Haryana	20.22	20.21	19.33	0.94	0.05	-2.43
Himachal Pradesh	19.44	19.50	19.00	0.00	0.00	0.15
Jammu & Kashmir	22.35	24.17	22.33	1.25	0.06	-0.59
Jharkhand	18.35	18.59	18.00	0.00	0.00	0.79
Karnataka	16.41	17.08	16.61	0.47	0.03	2.23
Kerala	14.29	13.67	13.50	0.50	0.04	1.47
Madhya Pradesh	28.76	33.22	32.33	3.30	0.10	8.50
Maharashtra	10.77	11.27	10.00	0.82	0.08	-2.87
Manipur	22.07	21.36	21.50	0.50	0.02	-1.08
Meghalaya	16.34	15.87	15.33	0.47	0.03	-2.66
Mizoram	18.17	16.26	17.00	1.00	0.06	-5.40
Nagaland	26.04	26.28	26.00	0.00	0.00	0.62
Odisha	20.47	18.91	18.67	0.94	0.05	-2.78
Punjab	28.72	28.13	27.33	0.94	0.03	-2.43
Rajasthan	28.10	28.17	27.67	0.47	0.02	-0.69
Sikkim	10.53	10.08	10.00	0.00	0.00	-1.45
Tamil Nadu	11.63	11.71	11.00	0.00	0.00	0.06
Telangana	20.02	20.56	19.00	1.41	0.07	-3.66
Tripura	23.96	23.40	23.00	0.00	0.00	-1.18
Uttar Pradesh	29.40	28.12	28.33	0.47	0.02	-0.54
Uttrakhand	15.40	14.13	14.33	0.47	0.03	-2.34
West Bengal	22.75	23.57	9.00	0.00	0.00	-2.32
Average	20.35	20.31				
S.D.	8.03	7.84				
C.V.	0.39	0.39				

Source: Directorate of Economics & Statistics, Ministry of Agriculture& Farmer's Welfare, India, 2015.

Note: Average, S.D.(Standard Deviation), C.V. (Coefficient of Variation), CAGR (Compound Annual Growth rate) are calculated.

Standard deviation and coefficient of variation is zero in case of Andhra Pradesh, Chattisgarh, Himachal Pradesh, Jharkhand, Sikkim, Tamil Nadu, Tripura, West Bengal which indicates stability in share of agriculture and allied sector in gross domestic product at current prices. The standard

deviation is highest in case of Madhya Pradesh indicating more variability and less consistency. Compound annual growth rate is negative in large number of states except states of Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Madhya Pradesh, Nagaland, Tamilnadu and is highest in case of Goa. On an average states of Arunachal Pradesh (45.66) and Madhya Pradesh (32.33) have maximum share in gross domestic product at current prices.

Organic Agriculture

Organic Agriculture is a form of agriculture that relies on ecosystem management and attempts to reduce and eliminate external agricultural inputs, especially synthetic ones. It promotes agro-system health, including bio-diversity, biological cycles and soil biological activity. If a field is compared where chemical fertilizers have been used to grow the crops and field where organic inputs such as farmyard manure have been used, one can clearly see that the presence of earthworms, millipedes and ants is more in an organic field.

National Project on Organic Farming was launched during the 10th Plan with the view to promote organic farming practices and reduce the burden on chemical fertilizers. It further provides for insuring effective utilization of farm resources and to cater to growing domestic and international organic food market. This scheme was continued in the 11th Plan also.

In India, organic agriculture has huge potential. Government should further help farmers to go organic. Many subsistence farms are present in remote and marginal areas. They could be covered by a specific programme concentrating on organic agriculture to help farmers make themselves self-sufficient on a sustainable basis.

Need For Second Green Revolution for Achieving Sustainability

India needs second green revolution to bring food and nutritional security for its billion plus population. As per study conducted by Swaminathan & Bhavani (2013) given that India's population is likely to reach 1.5 billion by 2030, the challenge facing the country is to produce more and more from diminishing per capita arable land and irrigation water resources and expanding abiotic and biotic stresses. Second round of green revolution with new focus should be introduced. It should aim at promoting sustainable livelihood, enabling the poor to come out of poverty by generating gainful self-employment.

While the first Green Revolution aimed at undertaking mass agricultural production, the second green revolution should be to promote agricultural production by the masses. There is need for second green revolution to be more broad based, more inclusive and more sustainable. India currently produces about 230 million tonnes of cereals to meet the needs of a population of 1.15 billion. The current situation in India is that cereal production has to be doubled by 2050 in order to meet the needs of the expected population of 1.7 billion in addition to meeting the needs of livestock and poultry (Swaninathan & Bhavani, 2013).For Second Green Revolution genetic engineering of new crops and foods will take the lead in providing food security in India. Second round of green revolution with newer farm technologies and innovations in farming system is the need of the hour. Right strategies, policies and interventions in agriculture sector are necessary conditions for inclusive growth. Second green revolution is much desired evergreen revolution in India. In order to overcome all the negative impacts of first green revolution, it becomes essential to work upon Second Green Revolution which must ensure food security, promote sustainable livelihood, enables poor to overcome poverty by gaining self-employment.

Even Bill Gates has been among the proponents of a second green revolution, saying, "Three quarters of the world's poorest people get their food and income by farming small plots of land….if we can make small holder farming more productive and more profitable, we can have a massive impact on hunger and nutrition and poverty….the change is clear we have to develop crops that can grow in a drought; that can survive in a flood; that can resist pests and diseases, we need higher yields on the same land in harsher weather.

Conclusion

From the above discussion, it can be concluded that since independence agricultural sector has experienced a phenomenal growth rate but at the same time, the first green revolution has adversely affected agriculture and the health of both, farmers and general public. Now agriculture sector faces a serious challenge in terms of sustainability. The food safety net for each and every of the over a billion citizens requires enhanced agricultural production. Further, special attention needs to be provided to fruits and vegetables production, which had remained untouched in the first green revolution but are essential for nutritional security. The choice before the nation is clear- to invest more in agriculture and allied sector with right strategies, policies and interventions.

Recommendations for Achieving Sustainability in Agriculture

- There is an urgent need to evolve more remunerative alternatives to existing paddy-wheat rotation with emphasis on bio-technology research for improved varieties of alternative crops and development of high-value products etc.
- Special programmes for dry land farming in the arid and semi-arid regions of the country are essential. Crop cultivation should be planned according to water needs.
- Farmers should employ modern practices of agriculture keeping in view sustainable agriculture. Eco-friendly techniques must be adopted.
- To raise agricultural production without further environment degradation, the farmers should practice organic farming.
- Collaboration with the domestic and international research institutes and private research centres will help in reducing knowledge and yield gaps.

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