THE GREEN REVOLUTION TECHNOLOGY AND ITS IMPACT IN THE SOCIO ECONOMIC LIFE OF INDIA

Sutandra Singha
Ph.D. Research Scholar
Centre for Russian and Central Asian Studies, School of International Studies,
Jawaharlal Nehru University, New Delhi, India
E-mail: sutandra.singha@gmail.com

Abstract: *The Green Revolution technology was introduced to India in the 1960's to address the issue of food shortages. This technology involved bio-engineered High Yielding Varieties (HYV) seeds that worked in conjunction with chemical fertilizers and extensive irrigation to increase crop yields. Use of pesticides and insecticides, double cropping, land reforms, Command Area Development (CAD), consolidation of holdings, development of rural infrastructure, farm mechanization, supply of agricultural credit and setting up agricultural universities are additional characteristics of India's green revolution. Green Revolution has influenced the socio-economic life in India to a significant extent as is evident in terms of increase in agricultural production, prosperity among farmers, self-sufficiency in food grains, capitalistic farming, ploughing back of profits, agro-industrial growth and rural employment. However, poor farmers who could not participate in this capital intensive technology followed by widening income gaps between social classes. Heavy use of pesticides and chemical fertilizers caused some serious health problems. Recently, recurrent spells of shortages in some essential food items, increasing pressure of population on the available food stock, shrinking of agricultural land due to urban industrial development and erratic climatic behaviour are paving the way of food scarcity and inflation. Sadly, there has been no significant research in this regard. In this context, this paper discusses the past and present scenario regarding the impact of Green Revolution technology on India's economy and society. Concluding remarks suggest certain policies and practicable measures aimed to provide long-term food security to the nation.*

Keywords: *Capitalistic Farming, Chemical Fertilizers, High Yielding Varieties, Irrigation, Pesticides*

1. INTRODUCTION

Globalization has introduced new opportunities to developing countries. Major measures included in the globalization strategy were - heavy industrialization, urbanization and in the rural areas there was the mechanization and commercialization of agriculture i.e. the Green Revolution. The chief role of scientific knowledge in the field of agriculture has been to generate innovations that enable people to produce more with limited land and less effort and, the results have been marvelous. The credit for starting the Green Revolution of rice and wheat in Asia goes to a grouping of 16 international agricultural research institutes called as the Consultative Group on International Agricultural Research (Douthwaite et al. 2001). The improved crop varieties produced by the International Maize and Wheat Improvement Center and International Rice Research Institute from 1971 to 2000, have raised average wheat and rice yields by 1.65 and 2.3 times respectively, that feed the Asian population which grew by 70 per cent during that time

period (Douthwaite 2001). The crop varieties of Green Revolution attracted the farmers who later on spontaneously adopted that technology.

The implications of Green Revolution for a developing nation like India are many. It not only boosted and recovered India's agrarian economy but also increased food grain production manifold thereby making India a self-sufficient country. Along with these, Green Revolution promoted rural employment and made the farmers prosperous. However, there is the other side of coin also. Poor farmers could not participate in this capital intensive technology which leads to widening income gaps between social classes. Heavy use of pesticides and chemical fertilizers lead to air and water pollution followed by serious health problems. Recently, recurrent spells of shortages in some essential food items, increasing pressure of population on the available food stock, shrinking of agricultural land due to urban industrial development and erratic climatic behaviour are paving the way of food scarcity and inflation.

1.1 Objectives

The objectives behind this study can be listed as follows:

1. To analyse the background of India's Green Revolution.
2. To assess the characteristics of Green Revolution in India.
3. To describe the present and potential impact of Green Revolution on the socio-economic life of India.

2. METHODOLOGY

This study is quantitative, qualitative and analytical in nature and is based on primary and secondary data. The quantitative part contains line graphs. The analytical part represents the comprehensive analysis of Green Revolution vis-à-vis socio-economic life of India. This research depends on various primary and secondary sources. The primary sources include raw data obtained from Government sources and newspapers. Secondary sources include books, articles, web reports and newspaper reports.

2.1 Research Questions

The various aspects of Green Revolution and socio-economic life of India can be verified as follows:

1. What are the driving forces that initiated Green Revolution in India?
2. What are the characteristics of India's Green Revolution?
3. What are the socio-economic implications of Green Revolution in India?
4. What is India's approach in terms of major technical and policy initiatives to the socio-economic consequences of Green Revolution?

2.2 Hypotheses

For the purpose of study, following hypotheses have been formulated:

1 There was an urgency of introducing of Green Revolution in India.

1 Green Revolution has both positive and negative sides in terms of socio-economic consequences in India.

3. GREEN REVOLUTION IN INDIA

Green Revolution can be considered as a product of complex phenomenon encompassing technological, economic, social, cultural institutional and environmental factors. Following the Green Revolution technology, commercialization of India's agriculture led to the far reaching and irreversible effects. This new technology replaced traditional agriculture with modern and technology intensive agriculture through the use of bio-engineered High Yielding Varieties (HYV) seeds that worked in conjunction with chemical fertilizers and extensive irrigation to increase crop yields (Nangju 2001). Green Revolution has influenced India's socio-economic life to a great extent in terms of increase in agricultural production, prosperity among farmers, self-sufficiency in food grains, capitalistic farming, ploughing back of profits, agro-industrial growth and rural employment. India has become self-sufficient in producing wheat and rice. Irrigation facilities and high-yielding seeds have made the farmers enthusiastic and mobilized the idea of revolution in agriculture (World Public Library 2016). However, poor farmers who could not participate in this capital intensive technology followed by widening income gaps between social classes. Heavy use of pesticides and chemical fertilizers caused some serious health problems as well as environmental degradation.

The early-maturing varieties and miracle seeds have brought about a sudden positive change in Indian agriculture (Singhal 2013). Extensive adoption of multiple cropping patterns brought about a vital revolutionary change. Machines like tractors, pumping sets, harvesters, croppers, etc. have become as implements for daily use in agricultural fields. Fertilizers and manures have also been extensively used. Farmers are easily receiving credit through institutional finance for agricultural development. Increase in the yield capacity of newly introduced varieties has been two to three times higher than the erstwhile varieties. The effects of Green Revolution in India can be discussed from two perspectives: social impact of green revolution and economic impact of green revolution.

4. IMPACT OF GREEN REVOLUTION ON THE SOCIAL LIFE OF INDIA

The green revolution has its impact on the Indian society. Agricultural revolution in the rural areas has increased the production which has pushed up the level of income but has widened inter personal and inter regional disparities.

4.1 Change in attitudes

Green revolution has changed the attitudes of farmers in areas where new agricultural techniques have been implemented and being practiced. Increased productivity has raised the status of agriculture from a low-level indigenous subsistence activity to a profitable activity. The Indian farmers have welcomed technical change for the purpose of profit thereby belaying the criticism against them that they are indigenous, conservative, backward and unresponsive to credit and productivity incentives (Singhal 2013).

4.2 Inter-personal inequalities

The green revolution has intensified inequalities and has widened the already existing gulf between the well off and the poor in the rural areas (Mondal 2015). Privileged and rich farmers are in a position to afford the new cost intensive technology and thereby a large part of the benefits of the green revolution has gone to them. Green Revolution pushed up the income of rich farmers considerably, whereas the poor farmers couldn't afford the costly strategy and

therefore failed to reap any benefit. This situation in turn widened the income gap. For example, In Punjab, Green Revolution resulted in concentration of wealth, assets and income in the hand of the rich farmers and gradual economic degradation of the rural poor followed by conflicts between the rich and the poor farmers.

4.3 Regional inequalities

The wheat-producing belt of the country received proper implementation of the new technology whereas the rice producing zones remained almost untouched (Dutta 2014). The new agricultural strategy remained restricted to only a few states - Punjab, Haryana, Maharashtra and Tamil Nadu. Whereas in eastern Uttar Pradesh, Madhya Pradesh and Orissa, the Green Revolution failed to make much agricultural production. Two-thirds of the total cultivable land areas remained devoid of the influence of the revolution. Therefore, regional disparity increased considerably. Only irrigated areas successfully witnessed the Green Revolution whereas the rainfed areas were almost deprived of it (Faridi 2010).

4.4 Farmer's Suicide

It is the category of marginal and small farmers which reported the maximum number of suicides (Kaur 2015).The farmers have killed themselves over the increasing burdens and stresses placed on them due to the Green Revolution (Kaur 2010:47). The indebtedness comes from their need to take out loans, which comes from their lack of income, which stems from the new technological advancements put into place and the stifling of their class by the government and large-scale farmers (Rodriguez 2014). They are being pushed by these agencies and the government to want more, to be better, to produce more, to succeed that once failure occurs, the failure of as the head of the house not providing for the family, that the only perceived way out is through death. Small-scale farmers, typically amongst the poorest in rural areas, are more likely to commit suicide. India recorded 12,360 farm suicides in 2014, slightly more than the statistics of 2013. However, officially recorded farm suicides shows gradual decline in the number of (Figure:1).

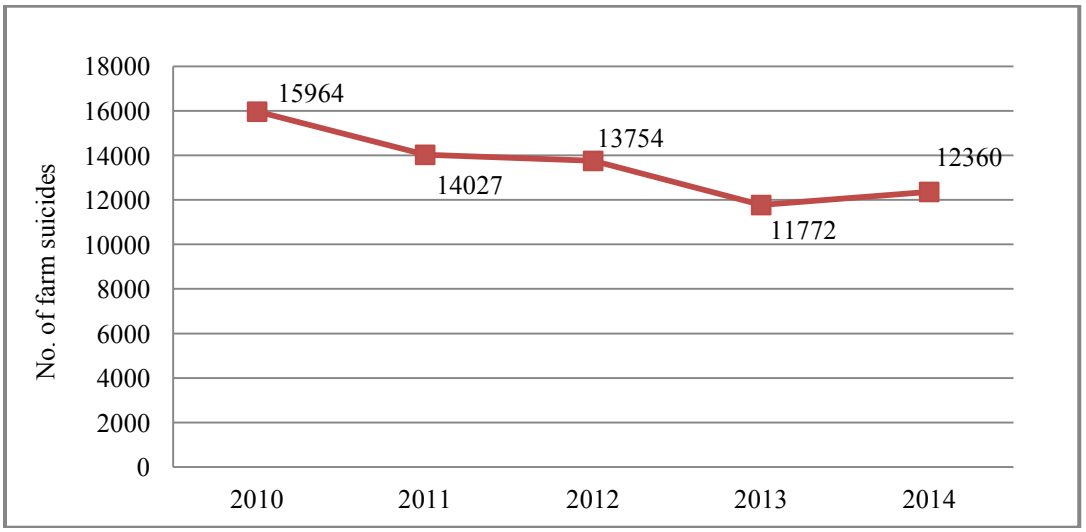

Figure 1: Statistics of Farmers' Suicide (driven by agricultural reason) in India

Data Source: The Hindu, July 24, 2015

4.5 Uprising

A consequence of the growing oppression of the small-scale farmers has resulted, in some areas, in the growth of guerilla groups and public displays of violence. The most well-known instance of this civil-uprising was a clash between organizing laborers and scabs in the Green Revolution area of Tanjore, India, in 1968(Rodriguez 2014). In recent times, India has also seen the rise of Naxalites, a coalition of Maoist intellectuals and landless peasants. This guerilla group has carried on an increasing campaign of assassination and land seizure in favour of the small-scale farmers.

4.6 Health issues in India

Increased use of high-yielding varieties of seeds (hybrid seeds) and chemical fertilizers have negative consequences with regard to soil and the human health. Impact of pesticides on human health is cyclic in nature (Figure: 2). Pesticide dusts get mixed with the soil, water and air and, gradually enter human body through pesticide contaminated food (vegetables and dairy products), drinking water and polluted air followed by kidney, liver, eye and fertility disorders. Water quality problems might create chronic effects (i.e. cancer, reproductive impairments etc.) to humans.

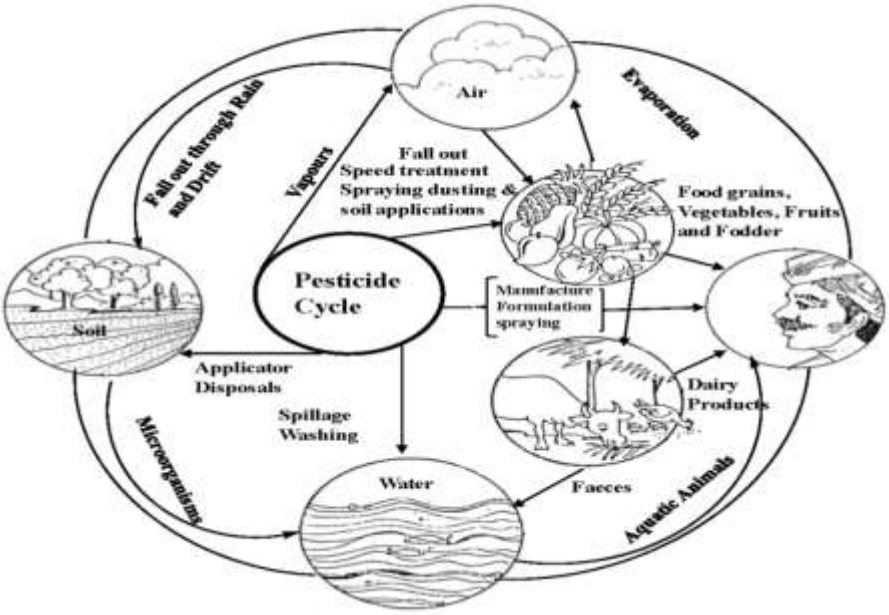

Figure 2: Pesticides Cycle in the Ecosystem (after Kailasa et al. 2013)

Under Green Revolution package technology, construction of canals to encourage agricultural production has resulted in spread and outbreak of mosquito borne diseases such as Lymphatic Filariasis, Malaria and Japanese encephalitis especially in Assam, Uttar Pradesh, Jharkhand and Bihar (MoHFW 2014). West Nile fever is gradually emerging as a health hazard in Punjab. Due to pesticide poisoning in the cotton growing fields of Maharashtra and Andhra Pradesh, cases of different types of diseases such as hepatic disorders, cancer, deformities and neurological disorders are being reported (Singh 2014). Throughout the era of Green Revolution, the use of Nitrogen (N), Phosphorus (P) and Potassium (K) have been increasing in India (Figure:3). Indiscriminate application of nitrogenous fertilizers lowers the potassium content of the food grains, which is essential element to avert the chances of heart attack in human beings by regulating the blood pressure.

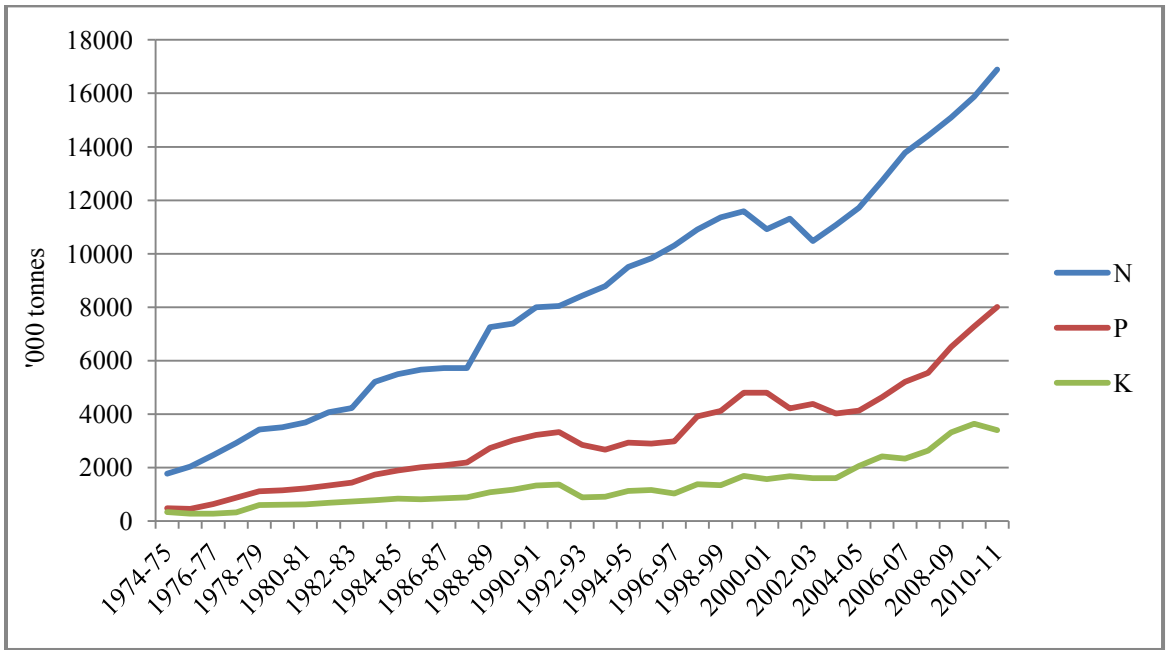

Figure 3: Trend of Fertilizer Consumption (N, P and K) in India: 1974-75 to 2010-11
Data Source: Fertilizer Association of India, 2011

Excessive nitrate and potash treatment decreases the proteins and immunity enhancing nutrients in foods, such as carotene and ascorbic acid (vitamin C). Therefore the escalating problem of hypertension, cardiac disorders, malnutrition, night blindness and other eye disorders and, vulnerability to infectious diseases among people is the consequence of Green Revolution. In the rural areas of Jharkhand, Bihar, Odisha, Chhattisgarh and Madhya Pradesh, the common diseases are caused as a result of deficiency of protein in children whereas adults are vulnerable to the diseases such as pulmonary tuberculosis, a serious health problem among poor rural people of India (NCMH India 2005).

5. ECONOMIC EFFECTS OF GREEN REVOLUTION

Green Revolution has influenced India's economic life to a great extent, as is evident from the following points:

5.1 Increase in agricultural production and productivity

Sharp increase in agricultural production has been the major direct effect of the green revolution. Wheat production has increased from 11.1 million tons in the Third Plan (annual average) to 63 million tons in 1995-96 (Singhal 2013). The second phase heralded when it spread to other crops. The productivity of agriculture, as measured in terms of yield per hectare, has increased. Wheat production has increased from 8.8 million tonnes in 1965-66 to 184 million tonnes in 1991-92 (Ambrsh 2014:141). The productivity of other food grains has increased considerably. There have been 71 per cent increase in case of cereals and 52 per cent increase for paddy over the period 1965-66 and 1989-90 (Joginder 2016:71). The index number of productivity on agriculture (Base year 1969 - 70) increased from 88.9 in 1965-66 to 156 in 1991-92, indicating an increase of about 100 per cent in productivity over the period (Marijeki 2014). Although food

grain production increased considerably but the green revolution has no significant impact on coarse cereals, pulses and few cash corps.

5.2 Impact on employment

This new agricultural strategy has created ample of employment opportunities in the agricultural sector. The new technology require frequent application of water, fertilizers, insecticides, double cropping, food processing and marketing which provided employment to unskilled and semi-skilled rural people (UN Documents 2005). However, as mentioned earlier, rural, small-scale farmers have received the short end of the stick when it comes to making money in the Green Revolution. It is this lack of money that has sent many of them into poverty and even cost them their jobs. When small-scale farmers fail to compete with the larger farms, they generally sell off or mortgage out their land. When they are no longer able to make their payments, their ownership of the land is taken from them and in some cases the farmers and their families are evicted and thus unemployed (Sebby 2010:17).

5.3 Dependency on the industrial sector

Another important aspect of the new agricultural technique is the stress it lays, on making agriculture dependent on industries for its raw materials (Singhal 2013). In the matter of input requirements, the traditional Indian agriculture was self-sufficient but the new strategy emphasizes use of industrial products as agricultural inputs. The new strategy also encourages a direct role of the multinationals in agricultural development (Pingali 2012: 12305-12306).

5.4 Ploughing back of profit

The Green Revolution technology enabled the farmers in raising their level of income. Wiser and efficient farmers ploughed back their surplus income for improving agricultural productivity followed by further improvement in agriculture. As per a study made by Punjab Agriculture University of Ludhiana, farmers in Punjab plough back about 55 per cent of their income for agricultural progress (Mondal 2015).

5.5 Industrial growth

Green Revolution introduced large scale farm mechanization which created demand for different types of machines like tractors, harvesters, combines, threshers, diesel engines, pumping sets, electric motors etc.(Sharma 2007:210). Besides, demand for chemical fertilizers, insecticides, weedicides, pesticides etc. increased considerably. As a result, industries producing such items progressed rapidly. In addition, several agricultural products are used as raw materials in various industries, known as agro based industries e.g. sugar, textile, vanaspati etc.

6. INDIAN GOVERNMENT'S STEPS REGARDING THE IMPACT OF GREEN REVOLUTION ON SOCIO-ECONOMIC LIFE

Although India had become self-sufficient in basic food grains—wheat and rice—after Green Revolution, in recent years India has been facing recurrent spells of shortages in essential items like lentils, edible oil, sugar and onions resulting in their knee-jerk imports at exorbitant prices (Narain and Kumar 2015). Experts feel the immediate need to focus on increasing food production by rationalizing priorities in the agriculture sector. Growing population and so is the growing demand of food, lack of proper irrigation cover to a large part of our cultivable land,

expansion of industrialization at the cost of agricultural land, erratic behaviour of climate are threatening the food scarcity.

In order to handle long term sluggish agricultural growth in India, Govt. has called for a second Green Revolution with "an entirely new approach, and an entirely new set of technologies" (Singh 2015). A new approach termed as "precision agriculture" i.e. precise application of water, pesticides and fertilizers will be the key strategy which will help the farmer to save important inputs, and also will reduce impacts of green revolutionized agriculture on the environment and public health. In Tamilnadu, a new mobile phone application called MITRA is being developed. This application will be operating on the basis of data from the local department of agriculture and will give site-specific recommendations to farmers regarding the correct dose and type of fertilizer and pesticides (Singh 2015). It is able to operate offline and thereby is also beneficial for those farmers who live in the remote areas and do not have access to internet. Farmers will also have online access to the soil quality reports prepared by soil testing laboratories in India (Ministry of Agriculture 2015). In addition, gadgets such as optical sensors and leaf colour charts are becoming famous for guiding farmers regarding the use of urea. If used incorrectly, nitrogen fertilizer can affect groundwater storage and emit of greenhouse gas and nitrous oxide. Touch screen kiosks, agriclinics, private kiosks, mass media and Kisan Call Centers have already been setup by the Government.

7. Conclusion and Recommendations

In order to get rid India of the grip of food crisis during 1960s and 1970s, The Government of India introduced the 'Green Revolution' which aimed to achieve self-sufficiency in the production of food grains. Traditional farming methods were replaced by mechanical farming characterized by machines, high-yield seed varieties, fertilizers and pesticides. The Green Technology almost quadrupled wheat and rice production; thereby India's fertile areas are being transformed into granaries. With increasing production, India was no more dependent on the foreign food aid shipments and also repaid her loans. However, a few decades down the road, gradually it becomes evident that the benefits of the Green Revolution are bringing unanticipated and unintended harmful effects of chemicals on the environment and human health through soil, air and water pollution. It also intensified the social and income disparity among farmers. Inability to repay huge loans and failing to bear the predicament of lost livelihood, farmers have nothing to do but to choose the way of committing suicide.

In order to follow this World Bank favored model of agriculture, Andhra Pradesh and Karnataka made huge investments into agro-industrial development followed by environmental catastrophe and destruction of millions of rural livelihoods. Introduction of the land grant system by the agricultural research and education facilitated the first Green Revolution. Now, the second Green Revolution is being planned to cater the requirements of American corporate interests.
In a country like India where land holdings are isolated and meagre, the major challenge is making agriculture more sustainable and agricultural techniques affordable for the marginal and small farmers. Amidst such situation, India is planning to introduce a second Green Revolution that will likely to push small farmers out of agriculture altogether. In the Green Technology flooded areas of Punjab, Haryana, parts of Uttar Pradesh, Andhra Pradesh, Karnataka and Tamil Nadu, agriculture is suffering from severe sustainability crisis. Desertification is engulfing Punjab and Haryana. The monoculture methods of contract corporate farming are destroying

land productivity capacity and biodiversity and thereby affecting long term sustainability of those regions.

In such crisis situation, it would be erroneous or even dangerous to think that U.S. backed second Green Revolution, that is being graciously welcomed by the Government of India, will not leave behind damaging consequences any more. India has urgently to address these issues now, in order to avoid another major food crisis in near future. What India requires is an agricultural system that will be truly sustainable - a system that will produce good yields, bring self-sufficiency, protects the environment and health.

REFERENCES

Ambrsh (2014) "Impact of Globalization and Indian Agriculture", Global Journal of Multidisciplinary Studies, Volume 3, Issue 12, pp. 137-147.
Douthwaite et al. (2001) 'Technology Exchange', *EJB Electronic Journal of Biotechnology*", Universidad Católica de Valparaíso, Chile.
Douthwaite, B. (2001), "The role of science in sustainable agriculture", *Social Issues Research Centre* [Online], 20 June, Available: http://www.sirc.org/articles/sustainable_agriculture.shtml.
Dutta, A. (2014) 'The Green Revolution and its Violence', *Modify Lifestyle* [Online], Available: http://modifylifestyle.com/green-revolution-violence/.
Faridi, R. (2010) *India's Green Revolution:Successes, Failures and Second Green Revolution*, [Online], Available: https://rashidfaridi.com/2010/07/11/indias-green-revolutionsuccesses-and-failures/
Joginder (2016) "Globalization and its Impact on Agriculture", *International Journal of Advanced Research in Management and Social Sciences*, Vol. 5, No. 9, pp.67-72.
Kailasa, S.K.et.al. (2013) *Recent Developments on Mass Spectrometry for the Analysis of Pesticides in Wastewater*. INTECH Open Access Publisher.
Kaur, M. (2010) 'The Paradox of India's Bread Basket: Farmer Suicides in Punjab', *PRAXIS The Fletcher Journal of Human Security,* Vol.XXV, pp.39-60.
Kaur, P. (2015) 'Why Punjab farmers are driven to suicide', *The Tribune*.
Ministry of Agriculture (2015) *Union Agriculture Minister launches PGS-India, Soil Health Card and FQCS Web Portals*, Press Information Bureau, Government of India.
MoHFW (2014) *National Vector Borne Disease Control Programme Annual Report 2014-15*, Ministry Of Health & Family Welfare Government of India, New Delhi.
Mondal, P. (2015) 'Impact of Green Revolution on Indian Economy', *Youth Library* [Online], Available: http://www.yourarticlelibrary.com/green-revolution/impact-of-green-revolution-on-indian-economy/40232/.
Nangju, D. (2001) 'Agricultural Biotechnology, Poverty Reduction, and Food Security', *Asian Development Bank*, Manila.
Narain Y. and Kumar S. K. (2015) 'Time for a Second Green Revolution', *Indian Express*, 26 June.
NCHM (2005) *NCMH Background Papers Burden of Disease in India National Commission on Macroeconomics and Health Ministry of Health & Family Welfare*, Government of India, New Delhi.
Pingali, P. L. (2012) 'Green Revolution: Impacts, limits, and the path ahead', Proceedings *of the National Academy of Sciences*, *109*(31), pp.12302-12308.

Rodriguez, T. (2014) *Effects of the Green Revolution on Rural, Small-Scale Farmers and Relevant Case Studies*, [Online], Available: https://hnrs353.wordpress.com/case-studies-exploring-human-development-and-social-changes-caused-by-the-green-revolution/effects-of-the-green-revolution-on-rural-small-scale-farmers-and-relevant-case-studies/.
Sebby, K. (2010) "The Green Revolution of the 1960's and Its Impact on Small Farmers in India", Environmental Studies Undergraduate Student Theses, Paper 10, University of Nebraska.
Sharma, P. (2007) Human *Geography: The Economy*, Delhi: Discovery Publishing House.
Singh, B. (2015) 'For a second Green Revolution in India', *The Hindu*, 15 August.
Singhal, N. (2013) 'Essay on Impact of Green Revolution', *Important India* [Online], 20 November, Available: http://www.importantindia.com/8406/essay-on-impact-of-green-revolution/.
UN Documents (2005) *Chapter 5: Food Security: Sustaining the Potential*, Our Common Future: Report of the World Commission on Environment and Development.
World Public Library (2016) 'Green Revolution in India', *World Heritage Encyclopedia* [Online], Available: http://www.worldlibrary.org/articles/green_revolution_in_india.