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THE GREEN REVOLUTION OF THE 1960'S AND ITS IMPACT ON SMALL FARMERS IN
INDIA

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University of Nebraska-Lincoln 2010

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The Green Revolution was initiated in the 1960's to address the issue of malnutrition in the developing world. The technology of the Green Revolution involved bio-engineered seeds that worked in conjunction with chemical fertilizers and heavy irrigation to increase crop yields. The technology was readily adopted in many states in India and for some was a great success. However, there were many farmers who could not afford the inputs necessary to participate in the Green Revolution and gaps between social classes widened as wealthy farmers got wealthier and poor farmers lagged behind. This paper discusses how small farmers were affected by the Green Revolution and why the success was not evenly distributed.

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Introduction

The Green Revolution was initiated in India in the 1960's to increase food production and feed the millions of malnourished people throughout the nation. It has been credited with increasing yields in many of the places where the technology has been adopted, but the benefits experienced have been unequal across regions and groups. The goal of this literature review is to look at the Green Revolution to determine how it may or may not have benefitted small farmers in terms of increased productivity and income. Emphasis has been placed on India, one of the recipients of Green Revolution technologies. Being the second most populous country in the world, it is important to understand how farmers are affected since they are responsible for feeding the exceedingly large and growing population of a developing nation.

There are many people in India who live in extreme poverty and suffer from malnutrition, and understanding how to increase agricultural productivity and yields in a way that benefits all farmers is very important. The decades since the dawn of the Green Revolution in India have revealed large disparities in the overall benefits to farmers.

Distribution and practical application of Green Revolution strategies has been uneven geographically as well as across socio-economic classes. Historical property relations across states have affected present landholdings as has the role of the government in different states to support agrarian activity. Geographical distribution issues can be broken down further into ecological barriers, or the viability of the land to accept Green Revolution technology.

Uneven distribution among small and large farmers is apparent in three ways: small farmers' lack of funds to take advantage of Green Revolution technology; insufficient information and resources available to small farmers to effectively apply the technology; and the absence of government support for small farmers. The uneven distribution of Green Revolution

technology has led to increased social disparity among classes. A disproportionate amount of people achieved success with the modern technology that was developed to positively affect everyone.

There are four important effects of the spatial and social disparities caused by the Green Revolution in India. These are: the change from traditional sustainable methods to monocropping and unsustainable practices; violence and a dissolution of the sense of community among farmers; the loss of many small farmers' landholdings to large commercial farmers; and increased suicide rates of small farmers.

Origins of the Green Revolution

In April of 1969, then president of the Rockefeller Foundation, George Harrar called a meeting to address the problem of world hunger. In attendance were 16 leaders from the world's major foreign assistance agencies that were also concerned with agricultural development. One of those in attendance was Lowell S. Hardin, author of "Meetings that Changed the World: Bellagio 1969: The Green Revolution" (Hardin 2008).

The Rockefeller Foundation had already been working with partners in developing countries to develop technology to increase food production. They held the meeting in Bellagio, Italy to emphasize the importance of scientific advancements in farming techniques as opposed to food shipments to poor countries by aid organizations. They presented the positive impacts achieved by the major international agricultural research centers. One of these achievements was the introduction of new varieties of seeds developed by plant scientist Norman Borlaug that were "stocky, disease-resistant, fast-growing and highly-responsive to fertilizer" (Hardin 2008: 471).

The 1969 Bellagio conference was the impetus for the world's agricultural-development

organizations' mobilization of plans for an increase in food production, later termed the "Green Revolution". The Green Revolution quickly spread through the developing world, including the states of India. (Hardin 2008).

There were worries at the meeting about the potential for unintended consequences. These included the possibility of widening the gap between small farmers and large landowners, as well as issues of depleting soil and water resources (Hardin 2008).

This paper investigates these concerns and the effects on small farmers in India by the technologies put forth by the Green Revolution. To accomplish these goals this literature review was conducted by analysis of scholarly journal articles as well as books, websites and magazine articles pertaining to the issue.

Farming Methods Introduced by the Green Revolution

The Green Revolution technology employed the use of new high-yielding varieties of seeds as well as chemical fertilizers. The problem with indigenous seeds was not the fact that they were not high-yielding, rather it was their inability to stand up to heavy applications of chemicals. The new varieties were created in conjunction with the fertilizers to work together with heavy irrigation to produce higher yields. Independently, the seeds as well as the fertilizers were fairly ineffective, but used together they were promised to double or even triple crop yields (Newman 1997).

To employ the methods, Punjab was chosen as the initiation site in India. Although it is relatively dry, there had been extensive development of irrigation canals during the colonial period. Additionally, Punjab was home to many large wealthy farmers who would become the first to receive the Green Revolution packages (Newman 1997).

Historical Property Relations in India

Adoption and success of Green Revolution technology in India was affected largely by the historical property relations that had been in place centuries before. These relations varied across the country and were put in place before the British began their colonial rule in India. The British did little to change these systems which created social classes in different states that continue to exist today. The existence of these classes as well as the economic relationships between farmers and the government play a major role in how agricultural development has taken place.

The British began their two hundred year rule in India in the mid 1700s. The main source of government revenue was land tax, and the systems of collecting that tax varied across the country. There were three types of land tenure systems: *Zamindari* or landlordism, *Raiyatwari*, and *Mahalwari* (Banerjee 2005). These systems developed before the era of British colonialism, but the British government did little to change them, so tax collection varied across states (Das 1999). Even after Indian independence in 1948, these systems have still had a significant impact on the villages.

In areas with *Zamindari* tax collection, the liability for the revenue collection of the village was vested in one landlord. This person, the *Zamindar*, had free reign and was able to set the terms for all of his peasants. He was also able to expel any peasants who did not pay their taxes. The *Zamindar* held all of the property rights because of his ability to buy and sell the rights to collecting revenue (Banerjee 2005). Under this system, most of the land was owned by a small number of people. Land had become a commodity that could be bought and sold, and if an individual could not pay their taxes, their land was taken away. This set the stage for social

disparity as those who could not afford land were stripped of their ownership rights (Das 1999).

This type of system was prevalent mainly in Bengal, Bihar, Orissa, modern-day Madhya Pradesh, Tamil Nadu and Andhra Pradesh (Banerjee 2005).

With the *Raiyatwari* system, taxes were collected directly from the cultivator, or *raiya*. This meant that the cultivator actually owned the rights to their land. The taxes were not fixed as they were with the *Zamindari* system, instead they were calculated based on average annual output. Taxes then varied from place to place depending on soil types and were adjusted in response to changes in the productivity of the land (Banerjee 2005).

The third type of tax collection system was called *Mahalwari*. This was typical in the northwest states of India as well as Punjab. With this system the village was jointly owned by a group of cultivators who as a group were responsible for the collection taxes. This system was very flexible and inconsistent; in some cases the groups in charge consisted of many people and in others there was only one or a few in charge, making it similar to *Zamindari* tenure. The members of the group were responsible for a fixed share of the land which was determined either by ancestry or actual possession of the land, in these cases making the system more similar to *Raiyatwari*. Tax rates were also variable and based on a number of different factors. These usually depended on the rent paid by the various classes of tenants as well as the rates that were considered fair for the soil type. They also usually took into account the caste and capability of the tenants to afford irrigation as well as their basic abilities to successfully cultivate their land (Banerjee 2005).

The new technology of the Green Revolution was more readily accepted in areas where “...pre-existing property relations were conducive to capitalist (and peasant) farming” (Das 1999: 171). Those areas that were historically under *Zamindari* tenure have received less of the Green

Revolution technology (Das 1999). In these villages an elite class was created because the *Zamindars* had accumulated a great deal of economic and political power. After Indian independence in 1948 land distribution in these areas was unevenly distributed among farmers. States which were historically under a landlord system have had significantly less public spending in health, education and agricultural technology in contrast to those that had *Raiyatwari*. States that did not have a history of landlordism have seen on average 23% higher wheat yields and infant mortality rates have been shown to be 40% lower than those that had the *Zamindari* system (Banerjee 2005).

Distribution of wealth as well as the success of farmers in different states have been largely affected by how land taxes were collected hundreds of years ago. These effects are important in three main ways. Primarily, wealth distribution determines how many farmers within the peasantry can make risky investments, as in those of the Green Revolution. Also, the prevalence of technological advances depend on the incentives of farmers to participate. That is, those that cultivate their own land are more likely to make large investments in technology where those that are working someone else's land do not have the incentive to do so. Finally, the states that have more peasant landowners see more support for government programs that help small farmers (Banerjee 2005).

State Support of Agrarian Activity

The constitution of independent India in 1948 granted states the power to impose land reforms to alleviate some of the disparities across states that had been created. Success has varied between different areas (Das 1999). The two main fronts for this task involved changing

property relations and providing investments and subsidies for agricultural development (Das 1999).

The first step to even the playing field for farmers and do away with the pre-capitalist obstructions that hindered capitalist farming was to establish tenancy laws and abolish “feudal-type landlordism” (Das 1999: 170). The states that passed these laws focused on tenancy reform, placing a ceiling on land holdings and consolidating land (Banerjee 2005). However, the enforcement of anti-landlord laws was varied in success across regions. Some tenants could not afford to buy their land from the landlords. In most cases, tenants could only afford to buy their land from landlords in areas with commercial farming and Green Revolution technology because many of the farmers in these areas were successful enough to pay for their property rights (Das 1999).

State support also took the form of investments and subsidies. Where the government had invested money in agrarian infrastructure, irrigation and other technologies were more readily available and there was the opportunity to obtain credit with interest rates much lower than those of money-lenders. The presence of public investment increased the profitability of agriculture which lead landowners to make more investments that raised productivity. For example, when the state invests in irrigation in an area, farmers are more apt to invest in the newly developed high yielding varieties of seeds and fertilizers knowing that their chances of high yields are increased (Das 1999).

However, these benefits were rarely seen in the more marginal areas that missed out on the successes of the Green Revolution because commercial farmers had the money and power to sway the government in their favor. Government officials often relied on wealthy farmers for support and political backing. Because of this, subsidies and investments were concentrated in

areas that had already seen success and advancement, and there usually was not much left for agrarian communities that were most in need of state support (Das 1999).

Change From Traditional to Unsustainable Farming Practices

Traditionally, Indian farms were small plots of land protected by windbreaks and tree cover. The farmers employed sound methods of organic husbandry that had been used for centuries. The practices of crop rotation and leaving fields fallow for long periods of time allowed the soil to retain nutrients. Because of this, the demands on the land were low, allowing farmers to establish a stable relationship with the environment. Maintaining a state of equilibrium with the soil enables farms to recover after disastrous events, such as droughts or monsoons (Das 1999).

The natural forest was “delicately balanced and well-adapted . . . to represent an ecologically optimal model for agriculture” (Das 1999: 180). The tree cover protected the soil from excessive heat and served as a safeguard against heavy monsoon winds. The multiple layers of vegetation protected the soil from erosion and allowed rain to circulate through the soil and restore aquifers, which the vegetation could tap into during long dry spells. The diverse mix of vegetation also enriched the soil with a variety of nutrients. All of these components created a highly productive ecosystem that had been functioning and evolving for centuries to withstand the volatile conditions of India (Das 1999).

Up until the Green Revolution, farms in India were subsistence-based and sown with a number of indigenous species of plants. Between each row of crops were other crops, making efficient use of land and water (Rosset 2000).

Biophysicist A.V. Balasubramanian founded the Center for Indian Knowledge Systems as a way to promote traditional Indian agriculture. In his research of small farming communities he found that for each small geographical region, each caste had its own niche in natural resource exploitation and use. Because of this, there was no overlapping and resources were not over-exploited. This allowed small communities to be independent and self-sustaining, giving every person a chance to participate in the region's economy (Newman 2007).

Farmers were then influenced by the Green Revolution and larger farmers who had changed to modern methods such as monocropping, in which they cultivated only one type of crop rather than multiple crops, as is done in traditional agriculture. While monocropping allows farmers to grow more of a certain crop that is usually of higher market value, it has negative effects on the soil as well. Monocropping usually involves clearing large patches of land of trees. Also, farmers who use a monocropping system tend to leave their fields fallow for shorter periods of time, so the soil cannot replenish its nutrients. Different crops have different needs, and planting more than one type gives the soil a chance to recharge what nutrients a certain crop does not need in preparation for the next crop. The soil does not get that kind of a break with a system of monocropping. Additionally, farmers that employ monocropping methods need higher inputs of chemical fertilizers.

The Green Revolution package offered high yielding seeds and the promise of double or triple yields. This involved the application of chemicals to enhance the quality of the soil as well as deter pests and insects. The native crops were unable to stand up to chemical application, so farmers had to purchase the seeds that were developed to withstand heavy chemical applications. The high yielding varieties of seeds had a narrow genetic base, and the farmers were sowing all of their fields with just one type of seed. This resulted in the displacement of thousands of

locally indigenous species as well as agricultural systems that have been build up over generations on the basis of knowledge accumulated over centuries (Shiva 1993). Also, the trees that once protected the fields were cleared, leaving the soil vulnerable to erosion and the plants open to intense sunlight and violent wind.

Switching from traditional subsistence farming to industrial monocropping had negative effects on small farmers. They found themselves trapped in the cycle of high interest rates on seeds, fertilizers, and pesticides which they had to buy on credit. Because they were often only working with one dealer, there was no competition and prices were able to remain very high.

Uneven Geographical Distribution of Green Revoution Technology

Thirteen North American agronomists were sent to India to assess the possibilities of technological advancement in agricultural villages. They soon realized that it would be impossible to assist all of India's 550,000 villages. Because of this the Intensive Agricultural Development Program was formed to specially select areas best suited for agricultural development. These areas would then receive the material and financial resources of the entire country for technological advancement (Shiva 1993).

The country of India is comprised of a multitude of different topographies, climates and soil types, or agroecological zones. Because of this, the modern varieties of seeds developed to increase production were not ecologically viable for all regions. The seed types developed simply did not vary enough to be used consistently across the country (Das 1999). This provided the Intensive Agricultural Development Program with the criteria needed to select the different villages that would receive the technological packages developed by Green Revolution scientists (Shiva 1993).

Modern varieties of crops such as sorghum, millet and barley, which grew in mainly semiarid and dry land conditions were not widely developed until the 1980's, and even then there was limited availability of these seeds. The most successful and highly distributed crops were rice, maize and wheat, which needed areas that had high rainfall or sufficient irrigation (Evenson 2003). Of all of these, wheat was the most successful, causing states in the Northwest to fare particularly well because of their irrigation systems (Chakravarti 1973). Not only did this limit opportunities for farmers in arid regions, it resulted in only a portion of land suitable for growth to be utilized. This was due to the lack of irrigation facilities needed to sustain the crops, a consequence of the lack of state involvement (Das 1999), which will be discussed later on.

Farmers who are able to afford irrigation systems are having problems as well. They must use expensive pumps to tap into groundwater reserves, which are depleting rapidly. In some areas, groundwater levels are sinking up to three feet per year (Zwerdling 2009). Today, farms that had begun digging down ten feet now find themselves drilling down more than 200 feet, requiring even more expensive equipment (Zwerdling 2009).

Rather than cooperating with the environment by employing traditional methods of crop rotation and the planting of diverse varieties of crops to solve the problem of uneven geographical distribution, researchers developed strains of crops that would adapt to unsuitable conditions so long as they were heavily irrigated and received applications of expensive inputs of fertilizers and pesticides (Overdorf 2009), which led to disparities between farmers who could afford these technologies and those that could not.

Loss of Small Farms to Large Commercial Farms

The Green Revolution came about as a means to present a solution to resource and food scarcity. However, physicist and ecological activist Vandana Shiva believes that this solution led to the “ecological breakdown in nature and the political breakdown of society [as] consequences of a policy based on tearing apart both nature and society” (quoted in Shiva 1993: 24).

The Green Revolution’s method to increase food production and eliminate hunger is to introduce technologies such as bio-engineered seeds and chemicals that are developed to increase yields. However, smaller farmers have fallen behind and have had to take out loans and sell land to afford the technology of the Green Revolution. These farmers were left impoverished, and there were many reported suicides by farmers too proud to beg. According to agricultural researcher Peter Rosset, there are three important lessons we can take from the Green Revolution:

First, where farmland is bought and sold like any other commodity and society allows the unlimited accumulation of farmland by a few, superfarms replace family farms and all of society suffers. Second, where the main producers of food--small farmers and farm workers--lack bargaining power relative to suppliers of farm inputs and food marketers, producers get a shrinking share of the rewards from farming. Third, where dominant technology destroys the very basis for future production, by degrading the soil and generating pest and weed problems, it becomes increasingly difficult and costly to sustain yields (Rosset 2000: 6).

Monkombu Sambasivan Swaminathan, who is considered the father of the Green Revolution in India, agrees that it may not have been the best plan for Indian agriculture. He attributes this to the fact that the industrialization and monoculture introduced to India by the

Green Revolution have resulted in low water tables and soil that has been depleted of nutrients essential for growth. Additionally, these techniques sparked a vicious cycle in which farmers were forced to spend more and more money on chemicals to counteract what monoculture and heavy fertilizer applications have done to their land. (Laidlaw 2008).

Presently, water resources are scarce and expensive in India. Large farms benefit because they can afford canal irrigation, whereas small farmers need to resort to taking out loans with high interest rates to irrigate their fields. Keith Griffin wrote in 1979, “The growth in inequality in rural areas stem in large part from the fact that small, poor peasants who have restricted access to credit, technical knowledge and the material means of production are unable to innovate as easily or as quickly as those who are landed, liquid and literate” (Griffin 1979: 216).

A survey in 1967 showed that in Punjab, the showcase state for the Green Revolution, 65% of Punjabi farmers owned fifteen acres of land or less, and their land only accounted for about 34% of the total land of the state. The rest of the land was owned by the minority of farmers who owned twenty acres or more. While a majority of farmers in Punjab farmed ten acres or less, it was shown that only farmers that owned at least twenty acres could afford to purchase the new inputs of the Green Revolution (Newman 1997). In short, small farmers were just not equipped to keep up with the pace of the Green Revolution.

To obtain credit, farmers need to have a secure tenancy or own land, which makes them more viable for investment and provides an asset on which credit can be acquired. Liquid assets are essential for purchasing commercial inputs of seed and chemicals as well as enabling a farmer the stability to hold out and wait for the most opportune time for sales and purchases.

Farmers who are illiterate have less access to knowledge and information regarding commercial inputs, as well as the ability to learn about proper usage and techniques.

Small farmers also suffer the effects of heavy fertilization taking its toll on the land and destroying the soil. New seeds are dependent on large quantities of fertilizers, which decrease the presence of nutrients in the soil such as nitrogen, phosphorous, iron and manganese. To counteract this, farmers must apply even more fertilizers to make up for the lack of important nutrients and aid the growth of the plants (Zwerdling 2009). Furthermore, pesticides and herbicides lead to resistant species, creating further need for chemical applications. Farmers are finding it harder to stay ahead of these growing costs, but they have become dependent on the new technological inputs.

The Green Revolution favored expensive technological investments for the “best endowed farmers in the best endowed areas, and directed away from resource prudent options of the small farmer in resource scarce regions” (Shiva 1993: 45). Because of scarce resources, competition increased among farmers--further widening gaps between social classes as well as geographical regions as discussed above.

In a system where purchasing expensive equipment is necessary for a farmer to stay competitive, small farmers often must rely on unofficial creditors and money lenders. These business men loan money and charge exorbitant interest rates, sometimes as much as double the interest rate that banks charge. In the village of Chotia Khurd, Daniel Zwerdling reported that farmers are paying interest at rates as high as 24% (Zwerdling 2009).

Traditionally, agricultural knowledge and customs in India were shared among the people that had been passed down through social and cultural structures and practices. With the introduction of the Green Revolution and the commercialization of agriculture, farmers were

faced with a difficult shift from traditional agricultural knowledge to a more modern methodology. Farmers now rely more on market-led fads as they are impacted by the growing competition among agri-businesses. Because of this, agriculturalists are constantly in competition--causing the need to purchase new commercial varieties of seeds, pesticides, and fertilizers.

These new agricultural methods do not necessarily come equipped with the training and knowledge necessary to effectively implement them. Professor A. R. Vasavi drew on data from the India's National Sample Survey number 49 which pointed out the lack of public agencies in rural India as well as the lack of training and education to a significant portion of people (Vasavi 2005). "Only 8.4% of agriculturists had accessed information from the Krishi Vigyan Kendras (Farmers Science Centres); 17% received information from other agriculturists and 13% from agricultural input dealers" (Vasavi 2009: 99).

Furthermore, the reports indicated that many farmers have encountered problems with their farms because of their lack of knowledge of pesticide use and commercial inputs. Soil tests must be conducted to determine the correct amount and composition of fertilizer and pesticide mixtures. A large amount of small farms have missed out completely in this process, leaving them ignorant of what they should be using on their fields (Chakravarti 1973). In fact, the leading cause for increasing debts of agriculturists was the inappropriately large amount of pesticides they sprayed on their fields (Vasavi 2009). When this was not the case, farmers would apply too little to their land to save money, causing the fertilizers to be virtually ineffective. In other cases farmers would wait until their field was infested before buying pesticides, which also defeats the purpose of these chemicals (Chakravarti 1973).

In the political economy of the Green Revolution, it is evident that large, wealthy farmers in India have more influence in politics than do small farmers. Griffin made this point years ago when analyzing the Green Revolution:

“The ends as well as the means of government policy usually are largely determined by the government’s sources of support. In most states this support comes from local elites and economic policy is designed to further their interests . . . Seldom has a government attempted deliberately to mobilize the groups that comprise the ‘wretched of the earth’, i.e. Those who lack the privileges of power and the resources necessary for material progress” (Griffin 1979:176-77).

The wealthy landholders are often the creditors and political bosses that make important decisions, or they have heavy influence on those that are by providing them financial support. This makes it impossible for small farmers to share in any of the control because they lack the amount of land ownership and caste status to change their situation--when it comes down to it, the government is more prone to protect the interests of those whom they rely on to provide support when it is needed.

In the 1970’s and 80’s a large number of small farms, unable to keep up with the competition, shut down. There were 1,375,382 landholdings in Punjab in 1971, and this number fell to 1,027,127 by 1981. This decline of nearly 25% of the farms of Punjab led to a shift toward large farms (Shiva 1993). In 1984 24% of small farmers and 31% of marginal farmers were living below the poverty line (Singh 1984). There was also a study done by the Johl Committee, who gathered in 1985 under the leadership of economist S.S. Johl to assess agricultural systems in India, that showed that while from 1977-1979 there was an increase in per hectare income, there was a decline in financial returns from farming in Punjab. The

introduction of external inputs was only possible by the introduction of credit which led to the indebtedness of many farmers because of rising costs of chemicals and the necessity to apply more and more to fields as the soil continues to degrade (Shiva 1993).

In 1984 there were a lot of cases in which small landowners who still technically owned their land had leased it out to wealthier farmers and then subsequently worked the very same land as a laborer, enabling them to get at least some money out of the land, since they could not afford to purchase the inputs needed for Green Revolution agriculture (Singh 1984).

The increase in profitability of agriculture caused many landlords to take a new interest in farming, evicting tenants so that they may farm the land themselves. This made less land available to small farmers, as large farmers and landlords were increasingly repossessing the land for their own use. Even if they did not evict the tenant, many times landlords would charge higher rent or crop share or rotate the tenants among the different plots of land so they were not able to acquire any rights to their land (Singh 1984).

Violence and Dissolution of Community Ties

Vandana Shiva has focused her research on the issues in Punjab, India caused by the Green Revolution. The violence that was occurring in the 1980's when Shiva wrote the first edition of her book *The Violence of the Green Revolution* (1993) was being contributed to conflicts between religious groups, namely the resurgence of the Sikhs. Shiva suggested that the conflict between religious groups in India was not solely to blame, and that focus should be placed on the unrest that was caused by the Green Revolution and its ecological and political demands. Farmers were left discontented and indebted as the result of degraded soil, and pest-ridden crops. This resulted in disillusionment and tension between the farming community and a

newly centralized state taking charge of agricultural policy as well as agricultural commodities' prices, finance and credit (Shiva 1993).

The displacement of native plants and agricultural systems that had developed over centuries of local knowledge by modern techniques resulted in decentralized knowledge of traditional farming techniques, causing further fissures among the farming communities. Farming was their livelihoods and the way that they connected with each other.

Changes toward external inputs not only had negative consequences for the ecology of the villages, they had social implications as well. Before the Green Revolution, agriculturalists relied on mutual relationships within their villages. After the introduction of Green Revolution technology they found themselves solely dealing with banks and agribusiness, thus weakening relationships within villages (Shiva 1993).

The farmers of Punjab found themselves in the midst of increasing conflict that was converging and intensifying tensions. There was class conflict, pauperization of the lower peasantry, conflicts over water resources and mechanization displacing labor. There was also conflict related with religious and cultural relations among different peoples. The Green Revolution commercialized all relations and "created an ethical vacuum where nothing is sacred and everything has a price" (Shiva 1993: 174). Tension also developed related to the center and state sharing political and economic power (Shiva 1993).

Before the Green Revolution, farmers relied on internal inputs and organized locally. This changed after the Green Revolution to centralized control of farming and external inputs. Because of this, social relations began to disintegrate, there was no longer a sense of community and violence had become rampant. In 1986, 598 people were reportedly killed due to violence

among farmers. In 1987 the number grew to 1,544 and in 1988 3,000 lives were lost to violence in Punjab (Shiva 1993).

Increase in Suicides

Because of the building distress related to these issues of the Green Revolution, many farmers are committing suicide by ingestion of pesticides. The number of suicides in 1966 was 37,848, making the suicide rate 7.6 percent. Five percent of these suicides were caused by poverty or economic reasons. The suicide rate in 2000 was reported to be 10.8 percent, with about nine percent being related to poverty, unemployment or bankruptcy/change in economic status (National Crime Records Bureau).

In his 2009 article A.R. Vasavi focuses his studies on the states of Andhra Pradesh, Karnataka, Kerala, Maharashtra and Punjab. On average these states have had the highest number annually of reported suicides. Vasavi reported that suicides in places like Maharashtra were becoming so common that the prime minister visited the region to grant monetary packages to the farmers. Suicide notes had been written to the government in many cases, as the act became of a political nature; one in which the farmers were trying to make a statement about the conditions in which they were living (Vasavi 2009).

In the reports of suicide from the five states Vasavi studied, most of the victims were entering into Green Revolution agriculture which brought on the challenges of increased commercial agriculture such as production, credit, marketing, knowledge and the climate of the market. The small farmers that entered into the Green Revolution market were unable to keep up with the economic and social pace. Most of the suicide victims, Vasavi notes, were from the “Backward Classes” and low caste groups--which increased the problems of economic

marginality. There is also a notable number of suicide victims that were of castes that traditionally did not practice agriculture. These caste members had to switch to agriculture because of its presence in the local market and the displacement of rural products by industrial products. These new cultivators had found themselves incurring large debt in their attempts to avoid impoverishment (Vasavi 2009).

Studies have been done to analyze the sources of the distress that causes agriculturalists to commit suicide, and several factors have been associated. These broad factors are:

“the integration of Indian agriculture into the world market, increasing costs of production, inadequate institutional support . . . deceleration in rural growth, decline in wages, growing indebtedness and unemployment, frequent loss of employment, [and the] frequent loss of production . . .” (Vasavi 2009: 95).

Agriculturalists get non-institutional credit from agribusiness agencies, who give loans to farmers as well as from new money lenders and creditors, which includes relatives and friends working in the urban sectors. Inability to repay debts has become a subject of ridicule and humiliation for agriculturalists, and many of those who committed suicide did so after experiences of humiliation or ostracism (Vasavi 2009).

Vasavi writes,

“In summary, the increasing commercialisation of agriculture, the subscription to the dominant Green Revolution model, the range of risks, and the knowledge dissonance indicate the impact of the Green Revolution for marginal areas and for marginalized agriculturists” (Vasavi 2009: 99). The Green Revolution brought about an increasingly commercialized version of agriculture that was difficult for small farmers to keep up with. Because of this, they encountered increasing

amounts of debt, insufficient means of support, and the incapacity to care for the needs of themselves and their families. This resulted in distress and humiliation which often pushed these farmers to suicide.

Babu and Lakshmi published a study in which they studied the correlation of chemical pesticide use and suicide. They compared four villages in the state of Andhra Pradesh in India before and after they stopped pesticide use through a non-pesticide management program introduced by a local NGO. They also used four randomly selected villages similar in size and land characteristics that did not stop using chemical pesticides as controls. The villages in the study consisted of a majority of small farmers (Babu and Lakshmi 2009).

In 2000, Socio Economic and Cultural Upliftment in Rural Environment (SECURE), a local NGO stepped in to re-introduce non-pesticide management (NPM) to the small village of Punnukula. NPM involves returning to the fundamentals of diversified crops and utilizing natural resources that were locally available to manage pests. This proved to be successful as both yields and incomes increased while costs of production decreased by 2003. Because of this success, NPM was implemented in 3 other villages and pesticide use was stopped completely by 2003 (Babu and Lakshmi 2009).

From 1998 to 2006 there were 17 suicides in the villages using NPM practices and 23 suicides in the villages that continued to use pesticides--but only three suicides occurred in the former after the installment of NPM. Farmers that were interviewed from the NPM villages unanimously agreed that the cost of cultivation has decreased while their income has increased, erasing the debts of many (Babu and Lakshmi 2009).

Conclusion

The creators of the Green Revolution seemed to have had the best intentions at heart--they were working to develop technologies that would increase productivity of farms in developing countries to combat hunger and poverty. They were not completely unsuccessful, either--the modern varieties of seeds that they produced did, in many cases, increase yields and increase profits for farmers as well as reduce prices to feed the hungry. However, with these gains were major setbacks.

As Norman Borlaug, the “father” of the Green Revolution, summed up in a speech given thirty years after receiving a Nobel Peace Prize for his work in 1970:

“...increased food production, while necessary, is not sufficient alone to achieve food security. Huge stocks of grain have accumulated in India, while tens of millions need more food but do not have the purchasing power to buy it” (Borlaug 2000).

The lack of a stable agrarian system in India has made it difficult for Green Revolution technology to impact everybody positively. This is because of a rigid social structure which makes it difficult for those without money to improve their social conditions. Those with more money (and therefore more land) can afford the seeds and chemicals necessary to compete in the Green Revolution market. Farmers with less money cannot afford to buy the necessary technology and resort to money-lenders to purchase on credit. They then find themselves in debt and paying exorbitant interest rates. They buy the technology on credit to keep up with large farmers and stay competitive in the market, but the debt alone negates any possible financial success they can achieve by adopting Green Revolution technology.

Once a farmer does acquire the tools necessary to compete in the post-Green Revolution market, he or she is then trapped in a cycle that is nearly impossible to break. The modern

varieties of seeds that were developed for the Green Revolution require heavy irrigation and applications of chemicals to be successful. Once a farmer applies these chemicals to the soil, the soil degrades and is left depleted of essential nutrients. To make up for that loss, the farmer needs to use even more fertilizers to make up for what is lacking. Additionally, the use of pesticides leads to the creation of pesticide-resistant pests. This vicious cycle leads to the need for more chemicals to keep up with the changing chemistry of pests and pesticides.

Ultimately, the ideas and concepts of the Green Revolution may have seemed beneficial for all, but when deployed it is evident that this is not the case. To be truly effective at eliminating poverty and hunger worldwide, researchers need to develop a system that works with the land, rather than against it. It is impossible for technology to ever completely control the land and as humans we are not able to completely control nature. That being said, the cycle that farmers find themselves in when they begin to utilize Green Revolution technology is not easily broken, and the dependence has led many into indebtedness and further impoverishment.

Dr. R. H. Richharia, an agronomist and former director of India's Central Rice Research Institute began to study traditional methods of farming in the 1970's. He did his research in remote regions of Madhya Pradesh where farmers had not adopted Green Revolution Technology. He was astonished by the high skill levels of the farmers in this region as well as the vast knowledge the people had about the different indigenous species of rice they were growing. Their yields were equal to if not greater than those of the high yielding varieties being used in other parts of the states. They also had a variety of species, each regarded for different specialties such as high yield, superior cooking quality, or taste, among other traits. After this study, even a Green Revolution supporter like Richharia was beginning to realize that traditional agriculture was not as inefficient as it had been made out to be (Newman 2007).

The argument for the Green Revolution was that India's people were starving, and if they could grow more food, the problem could be solved. Historians like Amartya Sen point out however, that famine in India was not for the absence of food, but rather the inability of people to acquire food. During the later half of the nineteenth century, several severe famines struck India. The colonial government initiated the Famine Commission in 1880 to investigate the problem and find a solution to change conditions. Surprisingly, the commission found that every province was actually experiencing a surplus of food. The problem was not with under-production at all; the people were just unable to afford the food that was being produced around them. These surpluses mean that India was in fact capable of feeding itself before industrial agriculture was introduced (Newman 2007).

David Hopper, economist for the Rockefeller Foundation who was a primary backer for the Green Revolution stated in the Foundation's "Strategy for Conquest of Hunger" that:

"national governments must clearly separate the goal of growth from the goal of social development and political participation...These goals are not necessarily incompatible, but their joint pursuit in unitary action programs is incompatible with development of an effective strategy for abundance. . ." (quoted in Pearse 1980: 79).

In 2001, India had an epidemic of deaths due to starvation in more than a dozen states. This was the first time this had happened since the 1960's. In that same year, India had such a surplus of grains the government proposed dumping a significant portion of it into the sea to make room for the next year's harvest (Newman 2007). It is clear that the time has come for a plan for social development rather than a strategy for abundance. The Green Revolution may have been successful in increasing yields in many areas, but conditions have not improved for many of the farmers that need help the most.

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