Anna Rubsam
Prairie High School
Cedar Rapids, IA
India, Factor 6

Sustainable Agriculture: Taking Action to Reduce Poverty in India

India is a country of great diversity. It contains over 1.1 billion people ("Rural Poverty"), spans climate zones ranging from towering mountains to temperate regions to tropical coasts, and boasts of both urban areas and rural countryside. Though its large cities are most well known to the rest of the world, 800 million people, a majority of the population, live in small villages or on family farms ("Rural Poverty"). India is also a nation of great poverty. Though the total number of poor has been reduced to 27% of the population, poverty still affects over 300 million people. Many of these poor live in India's extensive rural areas, making a rural poverty a great challenge to overcome, and of these rural poor, 30% struggle with chronic poverty ("Rural Poverty"). Most of those living in the rural areas are engaged in agriculture; this is the career of half of India's total workforce (India Dept. of Agriculture 22). A challenge for the rural population is that agriculture is producing less and less of the nation's GDP, making it harder for them to survive. In 1990-91, agriculture made up 30% of the GDP, but by 2010-11, this had fallen to only 15% (India Dept. of Agriculture 22). It is clear that providing for the rural poor is a significant challenge for India that will only continue to increase as the population continues to grow.

Despite the statistics, the obstacles facing India are not insurmountable. The innovations provided by sustainable agriculture, along with cooperation between the Indian government and external organizations, can be instrumental in assisting India's rural poor. But this change will not happen if the world's leaders passively expect others to confront the challenges facing India; aggressive action must be taken to alleviate the poverty that so many Indians live in. Action was something that Dr. Norman Borlaug knew well. From his shuttle breeding programs in Mexico to his university teaching, he understood the value of hard work and persistence to solve problems and produce results. At the ceremony in which Borlaug was awarded the Nobel Peace Prize for his work in agriculture and food production, the chairman of the Nobel Committee, Mrs. Aase Lionaes, remarked about him, "Dr. Borlaug is not only a man of ideals but essentially a man of action…" (Hesser). Following in his footsteps, action is needed in India. With that action, food production can be drastically improved and poverty relieved.

The typical Indian farmer is basically a subsistence farmer, trying to grow enough food to either feed his family or sell to then buy that food. The size of an Indian family varies greatly. According to a survey conducted by the National Sample Survey Organization in 2003, the poorest rural families contain on average 6.2 people, 3.1 of which are children. The better-off rural families contained 3.8 people and 0.8 children ("Average"). This reveals several things about a typical rural Indian family. First, it shows that often the farmer has the responsibility to provide for one or more parents besides himself and his children. Second, it shows that the deeper the family is into poverty, the larger the family that must be provided for, making it even more difficult to do so. Most rural farmers work small, marginal land holdings, with 64.8% owning less than one hectare of land (India Dept. of Agriculture 23). Rice is the most common crop, and is grown in southern and eastern India. Grains such as sorghum and millet are more common in western and central India, though in recent years wheat has also been increasingly cultivated. Other important crops include seeds, nuts, and pulses. Seeds and nuts are used mainly for the making of vegetable oil. Pulses provide a valuable source of protein in the Indian diet because many are vegetarian for religious reasons (Heitzman).

Farming practices in India vary depending on the climate and terrain. In the Himalayas, most agriculture is carried out in either the valleys or on terraced hillside fields. Another common technique in this region is shifting cultivation, where one piece of land is cleared and farmed until its fertility is exhausted, and

then deserted for a new piece of land (Heitzman). In the plains of central India, the traditional style of agriculture is to scatter seeds across a field in an unorganized fashion. The fields are flooded with water as irrigation. Pesticides and fertilizers are used liberally where they are available, without consideration of the needs of the crop, in an attempt for better protection and yields (Madhavan). Double cropping, when one crop is grow right after another, is common because the monsoon usually provides enough rainfall to support two crops. In the Great India Desert area, only 20% of the land is farmed because rainfall is so scarce, and much irrigation is needed. In the southern peninsula of India, the two monsoon seasons generally provide ample moisture for farming, but rule out the possibility of double cropping (Heitzman).

Many factors contribute to the high levels of poverty among rural Indian families. One of these is the size of the farms themselves. As stated previously, 64.8% of farmers own less than one hectare of land, which increases to 82.8% who own less than two. Often this land is only marginal in quality (India Dept. of Agriculture 23). This makes it extremely hard for farmers to grow the quantity of food necessary to sustain their families. Another impediment to agricultural productivity is the water supply. For those living in central India, who depend upon the monsoon to provide water for their crops, droughts and water shortages can ruin the crops and contribute to their poverty ("Rural Poverty"). For those living in the desert or in areas where water is more scarce, the need to irrigate extensively provides another challenge that they must overcome in order to produce good crops.

Infrastructure is also an obstacle to rural farmers. Without adequate roads, railways, and other forms of infrastructure, rural farmers have no way to take their crops to market. They also lack such modern farming machinery as tractors and harvesters. Even if these implements were to become available, poor farmers are not in the financial position to be able to make the initial investment required to obtain them, though they would increase yields and profits in the long run (India Dept. of Agriculture 24). Farm mechanization would also relieve the burden of manual labor characteristic of traditional Indian farming.

In some situations, farmers do not lack access to resources, but in fact use them to a damaging extent. This also contributes to lower crop yields and overall poverty. Some farmers, having access to pesticides, use them liberally and without considering the need of the crop. These chemicals then enter the soil and are detrimental to the plants' health (Madhavan). Irrigation can also become a problem when farmers use available water to simply flood their fields. In fact, about 70% of the water introduced to fields is wasted and not used by the plants (Madhavan). Not only is this a poor use of India's limited water resources, it also causes the plants to become water logged and leads to soil erosion, decreasing the fertility of the soil.

While there are many ways to approach the agricultural problems that India is facing, a growing movement worldwide is focusing on sustainable agriculture. Sustainable agriculture is defined to be using farming practices that provide society with food while also taking the environmental impacts of those practices into account (Tilman et al.). Sustainability is becoming increasingly important as nations across the globe, including India, deal with limited natural resources that their current practices are damaging. But sustainable agriculture is important not only for the preservation of resources; it can also be very effective in increasing productivity and yields when used correctly. Thus, sustainable agriculture is a very beneficial option for the rural farmers of India because it can allow them to improve their yields and incomes while protecting their land for future generations to also be able to thrive.

To begin this discussion of sustainable agriculture is it necessary to point out the problems that result from the utilization of agricultural practices that are *not* sustainable. These occur in the usage of four main things: water, fertilizers, pesticides, and land. By looking at the consequences of unsustainable agriculture in these areas, the necessity of implementing more sustainable practices becomes extremely clear. It is also then easier to investigate the possible ways that sustainable agriculture can have positive effects on the rural farmer's ability to grow crops, obtain food, increase his income, and provide the country with greater food availability.

The first area in which sustainable agriculture practices are currently not employed is in water usage. As was stated earlier, water is scarce in various parts of India at different times, and the lack of water availability is one contributor to India's farmers, who rely heavily on irrigation. So much water is used for irrigation that India's water table is beginning to be depleted. One reason for this depletion is that the efficiency of irrigation is very low, at only 35% for surface water and 65% for groundwater (India Dept. of Agriculture 13). The common practice of flooding the fields is to blame, because much of the water then runs off and is wasted. Sustainable agriculture provides several options for more efficient water use. One of the most effective is drip irrigation, which focuses on applying smaller amounts of water to the roots of crops, where is can be most easily absorbed by the plant. This technique has been tested on fruit and vegetable crops and found highly successful. Data collected when this technique was used in India shows that drip irrigation can reduce the amount of water needed to irrigate by 25-60%. Even more impressively, the same data shows that drip irrigation can also improve yields. Results ranged from modest 10% yield increases to dramatic 60% increases (India Dept. of Agriculture 160). Clearly, the use of more sustainable practices regarding water has the potential for impressive outcomes.

The use of fertilizer is a second area where current farming practices in India do not meet the standards of sustainable agriculture. Though India's fertilizer usage is relatively low when compared to other nations, it has been steadily increasing since their independence from Britain (Heitzman) and is an area presenting major challenges to sustainable agriculture. When fertilizers are available, they are applied indiscriminately to the crops, since the intense cultivation of the land in India leads to more nutrients being removed from the soil than are able to be naturally replenished (India Dept. of Agriculture 57-58). While it is true that having an insufficient supply of nutrients in the soil is a problem since it decreases productivity, using too much fertilizer is at least as much of a problem. It creates an imbalance of nutrients in the soil that also serves to decrease productivity (India Dept. of Agriculture 79). Excess fertilizer is also washed into India's water supplies, causing more aquatic plants to grow than is normal. The plants use up the oxygen in the water, making it harder for the fish and marine life, important sources of food, to survive (Tilman et al.). Addressing the typical use of fertilizer in India is necessary to improve or avoid these situations while still preserving crop productivity. A possible technique to do this is called "precision farming," and it is based upon only using the resources that are specifically necessary for the crop. When applied to fertilizer, precision farming advocates soil tests to discover the nutrients that are deficient, then only applying these fertilizers in the amount needed, instead of many fertilizers in great excess (Tilman et al.).

The situation in India in regard to pesticides is very similar to fertilizers. For many farmers, they are not even available, and thus their crops are susceptible to insect damage. However, the farmers who do have them use them in large amounts. While this is beneficial to the crop by protecting it from insects, it can also be detrimental, because the chemicals not used by the plants can enter the soil and decrease its fertility. This then decreases the productivity of the farmer (India Dept. of Agriculture 26). Pesticides are also like fertilizers in that they enter the water supply through field runoff. It is possible that these unnatural chemicals can be damaging to human health when they are consumed (Tilman et al.). Thus, the possible benefit of insect protection from pesticides is negated by decreased soil fertility and health risks when they are used too heavily. Precision farming once again addresses these problems with its theme of only using what the crop needs. The farmer can evaluate what pesticides to use based on the crop he is growing, past insect threats, and current conditions. This would eliminate much unnecessary pesticide usage while maximizing the ability of pesticides to increase crop yields by protecting them from damage.

A technique known as "precision farming" has the capability of addressing all three problems of water, fertilizer, and pesticide use at the same time. It is based upon only using the resources that are specifically needed by the crop. In regard to water, precision farming recommends drip irrigation or other methods that increase the efficiency of irrigation while providing the water needed for the crop. In regard to fertilizer, it relies heavily upon knowing the nutrient availability of the soil and then using fertilizer to

supplement the nutrients that are deficient (Tilman et al.). In regard to pesticides, precision farming suggests only using the chemicals that are needed for the specific crop, time of year, and level of the pest threat. In this way, an emphasis on precision farming could bring about better use of India's resources while also increasing yields, benefitting the farmer's income and the national food availability.

A final area in which sustainable agriculture is currently not being used in India is in the usage of land. Since many farmers have such a small area to farm, with which they hope to sustain their families, they have to use the land very intensely. For them to allow proper fallow periods so that the soil can rest and rebuild its nutrient base, they would be compromising their ability to produce a sufficient quantity of food for their families. However, this is also harmful to them, reducing the productivity of the land and negatively impacting food production. Sustainable agriculture practices can address these problems. Utilizing longer fallow periods would lead to more fertile soil and less dependence on fertilizers to produce a good crop (Tilman et al.). For those farmers who can't afford to leave their land unplanted, crop rotation can be used to prevent a single crop from depleting the soil of one nutrient while allowing another to build up (India Dept. of Agriculture 29). Another way in which Indian farmers can use the maximum potential of their land is through intercropping. A developing technique in India, intercropping is when two or more crops are grown in the same area at the same time. For India's poor farmers, this could mean an increase in income by allowing them multiple harvests from one patch of group. It could also help the soil maintain its nutrient balance and fertility, as well as improve pest control and water efficiency (Tilman et al.). An example of this would be in coconut or banana orchards, where it would be very possible to grow yams or spices below the trees without any negative consequences for either of the crops (India Dept. of Agriculture 160). These several sustainable practices could improve yields, incomes, and food supply while preserving India's resources.

In many areas of India, sustainable practices are already being carried out and proven to be successful. Not only do they produce results as good as when lots of pesticides and fertilizers are used, but the farmers in fact are increasing their incomes because they don't need to invest in such costly inputs. For example, Balbeer Singh is a man who lives on a farm near Dehradun, Uttaranchal. Though he at first embraced using lots of fertilizers and pesticides on his crops, then his yields began to fall and his produce was of a worse quality than it had been. Desperate for a solution, he adopted an organic style of agriculture, switching to entirely natural ways of fertilizing and controlling pests. Since then, his yields have risen, and the quality of his produce has improved even beyond where it started. The soil quality was improved, and his income rose because he had no need to pay for chemicals (*Sustainable* 24-25). Another example of sustainability finding success in India is happening in Andha Pradesh, where many communities are adopting non-pesticidal management. Instead, they use bio-products and traps to catch pests. The switch has brought many positive results, including an improvement in soil fertility and an increase in profits due to lower costs. In addition, new livelihoods have been created as many people, especially women, become vendors of the new natural products (Misra 23). It is clear that not only in sustainable agriculture beneficial for the environment and preserving natural resources, but that it also is practical and advantageous for poor, rural farmers.

There are several factors that may have ramifications on the welfare of typical rural Indian families and their attempts to implement sustainable agriculture in the years to come. One of these is India's burgeoning population. With a current population of over one billion people and an annual growth rate of 1.5% ("Geography"), an increasing amount of people in the same amount of space will provide challenges in many areas of life. The water available for farming will decrease due to the increased need for drinking water, the greater demands of industry, and additional energy production (India Dept. of Agriculture 36). This means that adopting more sustainable practices in regards to water will become even more of a necessity, so that a decrease in the total water supply doesn't result in a decrease in total food production. In fact, a greater population means that food production will need to increase so that

food security can remain stable. Sustainable agriculture, if implemented on a large scale, could provide the boost that would make this possible.

Climate change is another factor that could have a large impact both on sustainable agriculture and on the general well being of the poor Indian farmer. Climate change tends to bring greater fluctuations in weather, making both warm and cool temperatures more extreme. In India, this would increase the risk of droughts and floods that could destroy or severely damage crops. It could also cause irregular monsoon patterns, disrupting the water supply that so many Indian farmers are depending on to grow their crops (India Dept. of Agriculture 49). With these greater risks, farming would be even more of a challenge to farmers who already have no safety net to sustain themselves through a poor crop or series of crops. Climate change and its accompanying warmer temperatures could also cause sea levels to rise, allowing saltwater to infiltrate the groundwater and contaminate it (India Dept. of Agriculture 41). Not only would this lead to a smaller supply of drinking water, but it would also decrease the supply of water available for agriculture. In this case, sustainable agriculture would become extremely necessary for more efficient water use, so that though less water is available, it can be used with the same or better impact as before.

If sustainable agriculture is to be implemented in India, there are several challenges that will need to be addressed. The first step is that more research needs to be conducted about the effectiveness of various sustainable practices in India, fine-tuning them to the specific region, resources, and climate. This will allow for a higher rate of success once they are implemented. It will also be necessary to work with farmers on a very local basis to develop the resources that they will need for sustainable agriculture to be feasible and practical, such as soil maps. Already the National Resource Management Division has created maps of nutrient deficiencies, soil erosion, and soil fertility for different regions of India at the national and state levels (India Dept. of Agriculture 145). However, since soil conditions can vary even from one farm to the next, ideally every Indian farmer should have soil maps of their farm. Then they will be able to make informed decisions about the irrigation and fertilization necessary for their crops, resulting in both higher yields and less waste of water and fertilizer.

The other major obstacle that India will have to overcome is getting the information about sustainable agriculture to their rural farmers. The government of India already has a website where there is an abundance of information about weather, nutrient deficiencies, and fertilizer recommendations, but most farmers do not have Internet access. Teaching sessions and printed materials could help to deal with this problem, but India's agricultural extension services are admittedly weak. Thus strengthening extension is a next step towards acceptance and implementation of sustainable practices. Extension has already been proven effective: India's Agricultural Finance Corporation found that 52% of farmers who received extension services learned something, and that 25% saw an increase in production and income resulting from the new practices they learned (India Dept. of Agriculture 185-6). By making Internet access more available to farmers so that they can benefit from the information posted there, and by increasing the role of agricultural extension in instructing farmers about sustainable practices, India could see real improvements in their food security.

For more research to be conducted in India and greater extension services offered, several groups will be critically important. First, the Indian government itself will have to play key role. As the director of agricultural extension, the government will have to increase its support of extension services so that more farmers can be reached with the information they need. Scientists both from within Indian and from outside nations will be needed to perform research on using sustainable techniques in India. The Indian scientists themselves will most likely prove to be the most able to perform this task since they already know the people and resources that they are dealing with. Already, groups such as the Center for Sustainable Agriculture are encouraging the switch to sustainable agriculture and seeing amazing success (Misra 24). However, the impact that outside organizations could have in this area shouldn't be underestimated. The German Center for Sustainable Development is doing impressive work in India

through its projects such as Sustainet (*Sustainable* 12-13). But when it comes right down to it, India's poor rural farmers themselves hold the most sway over whether or not sustainable agriculture will have an impact on increasing the food supply. They are the ones who will have to take the risk of stepping away from their traditional practices and committing themselves to a new style of farming, having the faith that will benefit both them and future generations. This is a view that Norman Borlaug was a strong believer in; one his focuses during his lifetime was training young, local scientists in his agricultural methods so that they could spread his ideas throughout their country. He understood that he and his small group of associates couldn't change the country by themselves; many people all working together were needed (Hesser). When the strategy of sustainable agriculture is applied in India, being supported the government, outside organizations, and the farmers themselves, real improvement will begin to be seen.

Works Cited

"Average Size of Rural Households Declines." *Business Standard*. Business Standard, 5 Apr. 2006. Web. 20 Mar. 2013. <http://www.business-standard.com/article/Economy-Policy/Average-size-of-rural-households-declines-105040601086_1.html>.

Hesser, Leon F. *The Man Who Fed the World*. Dallas, TX: Durban House Publishing, 2006. Print.

"Geography, Agriculture, and Economy." *Rural Poverty Portal*. International Fund for Agricultural Development, n.d. Web. 28 Dec. 2012. <http://www.ruralpovertyportal.org/country/geography/tags/india>.

Heitzman, James, and Robert L. Worden, eds. *India: A Country Study*. 5th ed. Washington, D.C.: U.S. GPO, 1985. *Country Studies*. Library of Congress, 22 Mar. 2011. Web. 21 Jan. 2013. <http://lcweb2.loc.gov/frd/cs/intoc.html>.

India. Ministry of Agriculture. Department of Agriculture and Cooperation. *State of Indian Agriculture 2011-12*. Government of India, n.d. Web. 2 Jan. 2013. <http://agricoop.nic.in/SIA111213312.pdf>.

Madhavan, N. "Bang on Target." *Business Today* (2012): n. pag. *Business Today*. Business Today, 19 Aug. 2012. Web. 27 Jan. 2013. <http://businesstoday.intoday.in/story/innovation-agriculture-precision-farming/1/186624.html>.

Misra, Savvy Soumya. "Riding High." *Down to Earth* (2009): 21-28. *Center for Sustainable Agriculture*. Center for Sustainable Agriculture. Web. 22 July 2013. <http://www.csa-india.org/sites/csa-india.org/files/coverstory_yenabavi.pdf>.

"Rural Poverty in India." *Rural Poverty Portal*. International Fund for Agricultural Development, n.d. Web. 28 Dec. 2012. <http://www.ruralpovertyportal.org/country/home/tags/india>.

Sustainable Agriculture: A Pathway out of Poverty for India's Rural Poor. Eschborn: Deutsche Gesellschaft Für Technische Zusammenarbeit, 2006. *Sustainet*. German Council for Sustainable Development. Web. 22 July 2013. <http://www.sustainet.org/download/sustainet_publication_india_part1.pdf>.

Tilman, David, Kenneth G. Cassman, Pamela A. Matson, Rosamond Naylor, and Stephen Polasky. "Agricultural Sustainability and Intensive Production Practices." *Nature* 418.6898 (2002): 671-77. *Nature*. Nature Publishing Group. Web. 31 Dec. 2012. <http://www.cedarcreek.umn.edu/biblio/fulltext/t1860.pdf>.