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### **Increasing organic agriculture in rural India to combat environmental degradation and poverty**

Bordered by the Arabian Sea and the Bay of Bengal to the south, by Pakistan to the west, and by Burma to the east is the subcontinent of India. India is the largest democracy in the world with an area of approximately one-third the size of the United States but more than three times the population. The economy of India has grown rapidly over the past decade and poverty has been on the decline since 2005. Even so, India is home to one-fourth of the world's poor and hungry population, and 30 percent of Indians are chronically impoverished. (Rural Poverty Portal)

India's landscape varies widely from deserts in the west to mountains in the north, along with plains in the south and along the Ganges River, which runs through northeastern India. Yearly tropical monsoons and flash-floods are characteristic of the south while the climate of northern India is temperate. Agricultural families make up 53 percent of the population in India. (Central Intelligence Agency) They and their crops are highly susceptible to environmental changes such as droughts and floods.

Over half of Indians are employed in agriculture because there are very little job opportunities outside of the agricultural sector. Low productivity and crops of poor nutritional standards lead to 43 percent of children under five being malnourished, the highest percentage in the world. (CIA) Rural Indians, as in other countries, are at a much higher risk for food insecurity than their urban counterparts. Three quarters of the Indian population lives in rural areas, and a vast majority of those families are employed in small-scale, subsistence farming.

Eighty-five million Indians live in rural, undeveloped communities. Only one-fourth of the people in those rural communities live in puccas, or permanent dwellings, and only 21 percent of rural people have improved sanitation facilities. This leads to a high risk of infectious diseases such as bacterial diarrhea, the cause of almost one million of the deaths of children under five in India.

Because the majority of Indians live in rural areas, the typical family in India is a rural farm family. Indian families usually live in tropical or semi-arid areas and are composed of four to five members; a mother, father, and two to three children. Even though vegetarianism is popular in India due to religious taboos, it is a loose form of vegetarianism and some meats still make their way into the Indian diet. Coastal regions eat fish, pork is sometimes eaten in the west, and lamb and beef are eaten in northern India. Vegetables, rice, and spices are the bases of Indian foods, and in southern India coconuts are a large part of the diet. Rural Indians rely more on grains for their nutrients and tend to use spices to make undrinkable water bearable.

Schools and high-quality education are not readily available in rural India. Rural children must walk miles to get to school, and the education available is of low quality. The teachers in rural India lack training and don't give their full effort due to low wages. Rural schools also aren't able to provide an education in basic technology which is essential for today's job market. (Qureshi "Review of Rural Education") Extracurricular activities and sports are also lacking in rural schools and the schools cannot afford furniture, meaning that children must sit on the ground. Children who do not go to school tend to spend their lives working in agriculture because that's all they've ever known. While education is lacking in rural India, urban India has many schools and children are picked up by buses. Urban schools also have plumbing and electricity unlike rural India, and the teachers are much better qualified as well,

creating a better learning environment. Urban schools overall are of a higher quality than rural schools in India.

Access to health care is also drastically different in India among rural and urban populations. In rural India there is almost no access to health care, while quality healthcare is readily available in urban India. Urban families are able to go to a nearby doctor or hospital because 70 percent of Indian hospitals are located in urban areas. In rural India however, people in need of medical care must walk at least 20 kilometers to reach a hospital, so traditional cultural remedies and practices, such as acupuncture, are relied on. ("Healthcare in India") Rural Indians also don't have the money to pay for hospitals or healthcare and are therefore reliant on government funding for the little healthcare they do have. There are very few doctors in India as a whole compared to countries like the United States. India has .599 doctors per 1000 people while there are 2.672 doctors per 1000 people in the United States, showing the limited amount of healthcare available in India.

Families in rural India typically own less than two acres of land, although there are 15 million landless families in India who participate in sharecropping. (Styslinger "Helping India's Landless") Sharecroppers work in fields that are used for cash crops such as tea and cotton. Common subsistence crops in India are divided into two groups based on when they are farmed. Rabi crops are sown in autumn, harvested in spring, and include barley, legumes, and wheat. Kharif crops are harvested in the winter and include rice, millet, and sugarcane. To be able to sustain themselves farmers attempt to harvest one crop per year and they make a profit if they are able to harvest two. Farmers in rural India also own goats and buffaloes and sell milk and offspring.

Various agricultural practices are used throughout India because of both the types of crops and regional differences. For instance, in India shifting cultivation is widespread among a northeastern tribal group, the Jhuming. Shifting agriculture is the process of cutting down all trees in a plot of land and burning the excess vegetation, then using that plot for two to three years until the land loses its' fertility, then farmers move on to repeat the process on another plot of land. .

Dry cultivation is a common agricultural practice in southern India, it is used for crops that require large amounts of water such as rice. Irrigation systems are not used in dry cultivation, farmers rely on the monsoon rains to provide their crops with enough water. In the past decade India has experienced four droughts where monsoon rains were not nearly as plentiful as they normally were. These droughts caused the failure of crops, leaving a large population of India hungry.

Droughts are going to become more frequent and more intense in the coming years according to scientists. This is due to climate change occurring from the release of greenhouse gases into the atmosphere. Recurrent droughts and water shortages prevent farmers from harvesting productive crops and feeding themselves and their families. Farm animals are also affected and are not as profitable for a farmer during droughts due to decreased milk production and a decline in the health and value of offspring.

Lack of infrastructure also causes the loss of crops. Silos and irrigation systems are not widely used in India because small-scale farmers do not have the funds to spend building and maintaining those structures. When farmers don't have adequate storage systems their crops spoil, this leads to the loss of up to 40 percent of farmers' produce. In the United States, Canada, Australia, and New Zealand combined only 7.75 percent of crops are lost due to inadequate storage. ("Wasted," NRDC) The absence of irrigation systems in India also hinders agricultural productivity; when crops are not provided with enough water they either die or give a much smaller yield than if the crops had a plentiful amount of water.

Small farm sizes limit the value and availability of mechanized farm equipment and techniques. Farm machinery is expensive and the care required is also not affordable for the typical subsistence farmer in India. Farmers are not able to afford modern farming equipment because of their low productivity, and their low productivity is partially caused by the lack of mechanized farming techniques in rural India. Instead animal and man-power are used and have lower yields than mechanized farming. If farms in India were larger mechanized equipment could be utilized to produce more food.

The lack of sustainable agricultural practices seriously hinders the ability of the typical family to be agriculturally productive. Depletion of nutrients in the soil and poor yields are consequences of practicing irrigation-free farming, environmentally degrading agricultural practices, and misuse of fertilizers.

Shifting agriculture is still practiced in northeastern India. It is an environmentally degrading technique that depletes the soil of nutrients and contributes to deforestation in India. The large amount of land needed to provide enough food for a small group of people is another way shifting agriculture is an unsustainable method, the crops grown don't provide the farmers with very much produce, so to grow enough food they use a large amount of land. Shifting agriculture is a major factor contributing to environmental deterioration.

Currently shifting agriculture is practice by around 4.4 million families in northeast India, the majority of those families residing in the state of Nagaland. Between 1.73 million hectares and 7.4 million hectares are being used in shifting agriculture, it varies by agency. (Tripathi and Barik "Shifting Cultivation") This is about four percent of the total arable land in India. Shifting agriculture contributes to the degradation of one million hectares of land every year through the depletion of soil nutrients and deforestation.

The amount of land used for shifting agriculture is steadily increasing, and the number of years a site is left to fallow is decreasing. Vegetation is not able to grow back fast enough to replenish the soil with enough nutrients to support crops, speeding the rate of soil erosion and degradation while also decreasing the amount of food the land is able to produce at a good quality.

Irrigation-free farming practices contribute to inadequate production levels by partially causing crop failure. Without irrigation farmers rely on unpredictable monsoon rains which are unequal across the country. Crops are not provided with enough water to grow to their full potential and as a result either die or are not of high quality. Farmers who do not have access to irrigation systems have to sell more of their surviving crops to create an income, decreasing the food available to their family, contributing to food insecurity.

Low crop yields are influenced by the low nutrient content of soils. The consumption of fertilizers increased between the 1960s and 1990s, and has been steady since the beginning of the 2000s. The average amount of fertilizer used is 167.2 kilograms per hectare when all of India is considered, but the amount varies by region. (World Bank) North India tends to use more fertilizers while east and west India fall below the all-India average. Farmers in the United States use less fertilizer than those in India, with an average of 109.4 kilograms per hectares but, American farms use fertilizer more efficiently and correctly. Even though fertilizers are used, soil fertility has become an issue because of deficiencies of major nutrients such as nitrogen and potassium. The use of organic fertilizers such as manure is also popular throughout India, but the amount used is only one fifth of the ideal amount, contributing to soil nutrient deficiencies.

In India, only 30 percent of farmland is using irrigation systems. With the majority of rain falling in just four consecutive months during monsoons crops that are not grown with irrigation systems are left

without enough water for the remaining eight months. Since there are not enough irrigation systems many crops fail or do not yield to their full potential in India.

Present irrigation systems are weakening and eroding, diminishing their effectiveness. Over one-third of water transported is wasted through leaks; crops are not getting enough water inducing crop failure. Increasing water shortages mean that the water the farmers are able to get must be used to full potential, which is not likely to occur with the current irrigation systems.

Increasing the number of families who practice sustainable agricultural methods would decrease environmental degradation and increase agricultural productivity and quality. Families need more food and the implementation of sustainable agricultural practices would not only create more food, it would aid in decreasing the amount and seriousness of environmental degradation.

Eliminating the gap between nutrient consumption of plants and the replenishing of nutrients through fertilizers and crop rotation would not only improve soil nutrient deficiencies, crop yields and food quality would improve. The income of the typical farmer in India would grow due to a higher surplus from increased crop yields and families in rural India would be healthier.

If even half of the farmers in northeast India adopted an agricultural method such as crop rotation rather than shifting agriculture the level of deforestation in India would decrease dramatically and preserve the environment, increasing the productivity of the land agriculturally. Deforestation contributes to land slides and flooding through the decreased ability of the soil to retain its position and water. The inability of soil to retain water and position also decreases the productivity of the land because plants are not able to grow well in dry, loose soil. Desertification is another result of deforestation and decreases the amount of land available for agriculture. A decrease in deforestation would decrease the amount of soil wasted in desert-like areas, having positive effects for India in food production.

Agriculture across India is dependent on rain, especially in southern India. The monsoon rains provide approximately 80 percent of the total water crops receive, which falls over a period of about four months during the rainy season. During droughts monsoon rains are lighter, negatively impacting agriculture. Droughts are increasing in number and severity due to climate change, meaning disaster for small-scale farmers in India who rely on the success of their crops to feed their families. Organic agriculture tends to be less susceptible to droughts than conventional methods. (Reynolds)

Population growth impacts agriculture through supply and demand. Farmers can only produce so much food, and if they aren't able to increase their productivity at the same rate as population growth the supply of food will not meet the demand. India's population is growing by 1.312 percent per year, it may seem like a low number but with India's population it is much larger than it actually sounds. (CIA) Based on that figure India's population will grow by about 16 million this year.

An increase in population also means an increase in the number of small farms. Farms are divided into smaller subunits, sometimes between children or they are sold, and small farms are not able to take advantage of the land efficiently. Agricultural production decreases for that area of land, bigger farms are able to use resources and machines effectively and practice better agricultural practices, making them better for the environment and agricultural production.

Agricultural productivity in rural India could be increased through the use of sustainable agricultural methods such as organic agriculture and crop rotation techniques. Synthetic fertilizers and pesticides are never used, ecological processes are relied on instead, and crop rotation is one of the focal practices of organic agriculture. It is better for the environment, has higher crop yields, and is less expensive for the

common farmer. However, organic agriculture has not been prevalent until the past decade due to the lack of knowledge of organic practices and the Green Revolution.

The Green Revolution was a movement by the Indian government to promote the use of genetically modified crops and use farming practices that produced more food, such as double-cropping. It led Indians away from traditional methods of farming. Initially the Green Revolution was successful in increasing production, but has not succeeded in its primary goal, making India self-sufficient in food.

Rotating the crops that are planted in a field replenishes the nutrients in the soil. Rotations can involve two or more crops and a year of fallow where no crops are planted. Although in India it would be more beneficial to rotate another crop rather than having a year with no produce. By preventing the depletion of nutrients higher yields are achieved and the failure of crops is much less likely. Higher yields occur through the efficient use of nutrients and energy between crops and animals. It is more sustainable than methods where the same crops are used every year and the same nutrients are depleted.

Crop rotation and organic agriculture also combats soil erosion. Topsoil is covered for a longer amount of time with crop rotation so it is anchored by roots and not exposed to erosive forces. Organic practices rebuild soil structure and increase the soil's ability to retain nutrients, making up for the lack of synthetic fertilizers. This contributes to higher yields through better quality soil, and less environmental degradation.

Not only is soil erosion and nutrient depletion avoided, organic agriculture has a smaller impact on the climate than traditional agricultural practices. Compost and animal manure is used rather than synthetic fertilizers and pesticides in organic agriculture so there is less pollution of groundwater and carbon dioxide emissions are lower. Safer groundwater means that more families will have access to clean, potable water. More carbon is stored in the ground instead of being released into the atmosphere and contributing to global warming and having a negative impact on the climate.

Lower production costs are another benefit of organic agriculture. The expense of fertilizers is circumvented through the use of animal manure mixed with compost and seed is also less expensive because they cannot be genetically modified. While traditional seeds have slightly lower yields, farmers are paid more for their produce, and can use that money to buy more food, more land to grow crops, and other products that will benefit farming families. The yield difference is not significant, and genetically modified yields start to decrease due to declining soil quality. (Rasul and Gopal "Sustainability")

Using a variety of crops and animals balances available nutrients and space to increase yields and decrease the possibility of crop failure. Organic agriculture is also best used in agricultural areas that use rain as their main source of irrigation, like India. The yields increase and the price of production decrease, leading to higher profits for farmers and increased food security.

Less than one percent of Indians practice organic agriculture because rural farmers have not had opportunities to learn and implement organic agriculture. Educational programs that teach Indians about organic agriculture and the benefits it can provide should be organized by the Indian government. Rural Indians would be able to provide better and more food for their families if they adopted organic practices and used animals in their agricultural practices as well.

The organization of these programs would rely on the involvement of farmers and their families, and the availability of organic seeds and biofertilizers. Community seed banks should be built to preserve seeds that are certified as organic and they should have fair prices that are reasonable for poor, rural farm families. Biofertilizers are being distributed, but in order to have a noticeable impact the level of

distribution needs to increase dramatically. Farmers have to be willing to change their current practices as well.

Currently the Foundation for Organic Agriculture and Rural Development is promoting the organic production of coconut and cocoa in two states of India. Their goal is to reduce poverty and increase food security for one thousand families. This project could be expanded to include more crops, like rice and other cereals, and be expanded to more of India instead of focusing on the states of Assam and Nagaland.

The FOARD works with the state governments and press to promote organic agriculture. It also holds public events and training sessions while arranging access to markets for farmers. Farmers are trained and given a way to sell their produce, easing the change in farming practices.

For educational programs and training sessions to be effective the people who are training Indians must be trained themselves. This training and the money to provide services and starter kits will need to be funded through donations of other countries, international organizations, and private funding. The Indian government could co-finance programs to spread awareness of organic agriculture with The World Bank. The World Bank would be able to provide assistance in the coordination and planning of educational programs and supplies for farmers.

In addition, The World Food Programme could teach the Indian government how to educate Indians about good nutrition and organic agriculture, and the government can use the aid of Indian citizens to spread organic agriculture to rural areas.

Organic agriculture has been shown to produce better quality food, increase self-sufficiency, and is more sustainable than conventional methods in Bangladesh, a country with very similar conditions to India. The soil was more fertile, farmers were able to rotate more crops and were able to perform organic agriculture with more profits and better results overall. (“Sustainability”)

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