

Natalie Napolitano  
Quaker Valley High School  
Leetsdale, PA  
India, Factor 11: Malnutrition

## **Malnutrition in India: Sustainability, Sanitation, and Community-Based Solutions**

India is a paradox of food security. Even though it is a high-growth, dynamic Big-Four category economy, it is plagued by constant food insecurity. While the country exports massive volumes of agricultural foodstuffs, its own population suffers one of the worst malnutrition crises the world has seen (“World Child Hunger Facts”). Nearly forty-eight percent, or 61.7 million, of India’s children are malnourished (Worley). India is unique in that it has a large and dense population, but its infrastructure is poor and the society is highly stratified. After the initial successes of the Green Revolution, it is clear that simply increasing food production is not enough to solve India’s food security challenges. By exploring food production and consumption in India, analyzing the factors contributing to rampant malnutrition, and proposing a three-part plan to mitigate the current damages to families, the crises can be solved sustainably.

The typical Indian family is made up of two parents and three children, making a national average of 4.8 per nuclear family. Households, however, are traditionally multigenerational, with grandparents and extended family all living under the same roof (“India”). This family structure is challenged by rapid urbanization, at an estimated 31.6% rate from the 2011 Census (Roy, 2012). One consequence is that divorce amongst the urban middle class nearly doubled in recent years (Dummet, 2011). The demographics of the nation show a young society; more than 50% of India’s population is below the age of 25 (Basu, 2007). Population growth rate is 1.2%, and a total fertility rate per woman is 2.48. With 22% of the population below the U.S poverty line, it is obvious that the number of people born into both poverty and food insecurity will only grow (“The World Factbook: India”). Within this growing society, an ancient hierarchical caste system still exists. It is composed of family lineages associated with particular occupations, and supported by the land ownership system, which locks this resource to the middle castes (“India”).

The Indian education system guarantees a free public education to all children under 14, resulting in a nearly 98% attendance rate. This positive statistic, however, does not reflect the 25% dropout rate and the growing gap between male and female enrollment in primary school (Williams, 2013). Secondary education is not necessarily free; the private sector educates nearly 29% of children, mostly from the upper castes (Desai *et al*, 2009). To further depress the situation, India is also plagued by severe teacher shortages and poor infrastructure. The average number of teachers is three per school, and there is often no sanitary drinking water (Sibal).

India’s constitution grants free healthcare for all; yet, the main health care provider in the country is a private sector. This contradiction underscores a bottleneck in accessing public services, and has a negative financial effect on poor and rural residents. While the central government funds and designs a free public healthcare, the states are responsible for actually delivering health services to the people. Public services are limited, tend to be placed in less desirable areas, and do not attract high quality professionals. This results in a high adherence to private sector, with nearly 70% of the money paid out-of-pocket (“International Healthcare System Profile”). Overall, only 2% of doctors practice in rural areas, home to 68% of population. In addition to problems accessing health care, the poor has trouble paying for it: up to 35% of poor families are facing catastrophic medical expenses that are pushing them below subsistence level (Sekher, 2011).

India has a large agricultural sector made of small-scale and commercial farmers, yielding \$495.62 billion in GDP (“Sector-wise contribution of GDP of India”). The staple crops include rice, wheat, mangos, guavas, sugar-cane, potatoes, and bananas; these crops are farmed by the nearly 52% of India’s population involved in agriculture (“Employment in Agriculture”). Livestock is another important commodity; in 2008, the country had nearly 175 million cattle, the second largest holding in the world (“Country Profile: India”). However, the exotic and nutritious foods are all exported. The standard Indian diet is based on rice supplemented with potatoes or millet (“India”). Storage and distribution networks for agricultural products are woefully inadequate. This leads to poor sales and supply of nutritious specialty foods to farmer’s markets and urban stores, and lack of consumer access to these food distribution centers, contributing to malnutrition.

Nearly 78% of farmers in India are small-holder farmers, with average farm size of 1.33 hectares. They make up only 33% of the cultivated land and produce nearly 41% of the country’s food grains. Thus, the more exotic fruits and mass-produced grains are coming from rich plantation owners who directly export their crops for profit (Singh, 2003). Small farmers follow a basic method of “shifting agriculture,” farming staple grains on a small plot of land until the soil nutrients are exhausted. It is often paired with “slash and burn” methods to replenish the soil. Shifting agriculture makes up 85% of Northeastern practices; this is also an area with the highest rates of malnutrition in the country (“Agriculture Journal”).

The main barriers to agricultural productivity and economic prosperity in India are rampant poverty and lack of infrastructure. Poverty is directly linked to low agricultural productivity in a vicious cycle. The minimum wage threshold in India is low at 15,000 rupees, amounting to \$233 a month, or less than \$2 a day (“Current Minimum Wage”). Over 22% of the population lives below the poverty line, and 5% are unemployed (“The World Factbook: India”). Large agricultural machinery cost more than the average pay, leading most farmers to use labor-intensive and time-consuming shifting agriculture. Northeastern farmers also lack the funds to buy seeds and fertilizer; this makes mass production difficult and lowers crop prices. The lack of water reserves increases risks of drought, and introduces more uncertainty into farming. Taking loans for fertilizers, seeds, or machinery means dealing with loan sharks who charge 100% interest (equivalent of 20% of the farmers income) to pay it off (“Water: Facts and Trends”). Infrastructure is hampering agricultural productivity in both production and distribution stages. Granaries and other storage facilities are poorly constructed, plagued with vermin and toxic waste, which causes massive loss of harvest. Although road construction is increasing at a compound rate of 5.4%, the surface road coverage is just 33% of the total rural network. These areas are inaccessible during the rainy season (“Rural Infrastructure”). Malfunction in food networks contributes to daily food insecurity (Singh, 2003).

Malnutrition is a pandemic in India and affects all social strata. Malnutrition is a condition in which an individual, generally younger than 5 years of age, is diagnosed with rapid weight loss, iron deficiency, vitamin deficiency, low caloric intake and general fatigue (“Management of Severe Acute Malnutrition in Infants and Children”). While India is ranked 67 out of 80 nations, one of the worst in the world, in hunger by the Global Hunger Index, there is also a paradox of high obesity rates of 21% among women (“India: Nutritional Profile”). High caloric intake of nutrient-deficient food is an emerging problem that impacts public health in developing countries. Nevertheless, this paper will focus on the typical malnutrition patterns affected both by low-calorie and low-nutrient intake. This is a more pervasive problem, contributing to 44% of children under 5 being underweight, 72% of children having anemia, and low-vitamin A levels (“Malnutrition in India Statistics”). Childhood malnutrition is directly linked to maternal malnutrition, as 52% of mothers suffer from anemia. Fetal malnutrition leads to low birth weight, physical retardation, cognitive disabilities, and an increased disease risks (Pathak *et al*, 2010). Malnutrition occurs because of a lack of food which forces the body to begin to feed off fat reserves and the liver. Once this is gone, the body leaches out all nutrients from the muscles in an effort to survive, leaving a disabled human (Szondy, 2017). While recent malnutrition trends show improvement

with only 30% of children affected, these reductions were not uniform across the continent. In Southern states with commercial agriculture and more economic wealth, malnutrition was reduced. In the landlocked northeastern states, however, the number of children with malnutrition increased or stayed the same. These states also rely on subsistence agriculture and have more poverty (“India’s Malnourished Infants”). Given the young demographics of India’s population, and the generational effects of maternal, it is logical to expect the malnutrition population of the north to explode as more women reach reproductive age.

Other major factors contributing to the malnutrition include climate change and a lack of water sanitation. Climate change impacts growing conditions and contributes to loss of yields; there is a 3% to 5% decrease in crop yields for every one degree Fahrenheit increase in ambient temperature (Ruchita, 2017). The reason is that India’s crop production cycle is dependent on the temperatures created by monsoons; changes in the timing of monsoons causes crops to be delayed and fail. Researchers showed that in India, the weather during the growing season has bigger influence on harvests, compared to the moderate influence of soil quality and nutrients (Ruchita, 2017). Predictive scenarios have found that the child stunting is projected to increase 35% more in a scenario with climate change compared to one with no change, underscoring the impending crisis (“India: Climate Change Impacts”). Lack of water sanitation in India is a current problem that causes up to 1600 deaths a day. Nearly 75% of surface water is polluted by both agricultural and human waste (Snyder, 2016).

Exposure to dirty water encourages the spread of communicable diseases; diarrhea, caused by a rotavirus, is the number one killer of children under the age of five (Sunnanarin, 2010). The lack of water quality in India is tied to children’s exposure to fecally-transmitted infections, because 53% of the population defecates in the open. The phenomena of stunted Indian children has been directly attributed to the lack of access to toilets. Rotaviral diarrhea forces the body to shed nutrients and water instead of absorbing them from the ingested food, directly causing malnutrition through malabsorption (“Nutrition Issues in Developing Countries”). In the especially affected Northeastern region, 23% of households lack access to clean water, 32% have no toilet, and 74% have no access to drainage facility (Singh, 2015). Thus, tackling water quality and preventing the spread of the rotavirus is essential to the prevention of malnutrition.

Malnutrition has a huge impact on economic and agricultural activity by affecting the most vulnerable of society. Much of India’s subsistence agriculture relies on intense manual labor during a limited time of growing season. Since malnutrition causes weakness and the inability to work, causing agricultural productivity to lessen. In urban occupations, sick days taken due to malnutrition may contribute to individuals sinking deeper into poverty, creating a vicious cycle of poverty and sickness. The majority of individuals affected by anemia and malnutrition are children under the age of five and childbearing women. Since these individuals are already disenfranchised by a patriarchal Indian society and their needs are not adequately addressed by schooling or political rights, it makes their prospects in society even more affected by their health circumstances.

Solving the malnutrition crisis in India, which kills one child every minute, will help ensure the country economic prosperity and better public health policies (“World Child Hunger Facts”). People who were previously unable to work on their family farms, or children who were too weak to attend school, will now be able to contribute to their family’s economic prosperity. Women and children, as members of the community who were most affected, will benefit from specific programs that help their nutrient levels. Improving infrastructure and helping small farmers produce more high-quality, nutritious food for themselves are the cornerstone of solving malnutrition problem. Indian communities may work with the national government as well as the U.N, non-profits, private companies, and the national government to help allocate funds for outreach programs, sanitation policies, and supporting sustainable agriculture.

I propose a three-part plan to fix the malnutrition crisis in India that includes: 1) use of nutrient fortification in small farms, 2) novel technologies to improve water sanitation and reduce the spread of the rotavirus, and 3) support of expectant mothers to help reduce malnutrition in their children. These recommendations will meet the following United Nation's Sustainable Development Goals: 2) End hunger, achieve food security and improved nutrition, and promote sustainable agriculture; 3) Ensure healthy lives and well-being for all ages; 6) Ensure water and access to sanitation for all; 9) Build resilient infrastructure and foster innovation ("Sustainable Development Goals").

Nutrient fortification is a focus of current government programs and they should be expanded to better address iron and protein deficiencies. The current National Food Security Act (NFSA) was initiated in 2013. The NFSA ensures 5kg of food for 80% of India's population; most of the time, women order their pick of food. While the NFSA generally only provides wheat and rice, there is an option for nutrient-fortified cereal. India has nearly one billion mobile subscribers and has over 200 million active users, showing that a media campaign is feasible (Rai, 2016). A media campaign to make Indian women aware of both the benefits and availability of nutrient-fortified cereals will ensure that this little-known option comes out of the dark. It is also important to expand some state programs to the national level; a southern state, Tamil Nadu, provides high-protein eggs three times a day to children in school. This state also has one of the lowest rates of malnutrition and anemia ("Tamil Nadu"). Adapting this program in the north would allow lower malnutrition rates and improve school attendance in that vulnerable region. This can be accomplished through co-opting with Heifer International; by creating an option for chickens in schools, individuals can donate avians to rural schools, and children can learn how to take care of poultry as well as use the products in their daily lunches. Finally, incorporating a more palatable emergency nutrition option into the Ready-To-Use Food program (RTUF) will allow for managing malnutrition in severely affected areas. This can be accomplished by mass-producing a newly-invented nanoparticle powder from MIT. This nutrient powder can be mixed with milk, since the water is not sanitary, and spices to make it palatable to Indian children (Szondy, 2017). This invention will make treating severe malnutrition easier because now severely affected children can be stabilized before taking part in sustainable nutrition programs.

To improve dietary content of micronutrients not found in nutrient-fortified cereals, it is recommended that the government shift away from a chemical and market-based approach to a farm-centered and food-based approach. The current policies of India promote iodized salts and vitamin A drops; while these are useful in many cases, there have been findings of residual toxicity from the samples. Instead of relying on chemically-based solutions, a program for vitamin A rich sweet potatoes should begin (Nitya, 2017). Not only is this a more natural and healthy way of distributing the vitamin, but it is also a good source of fiber and complex carbohydrates for optimal nutrition. One concern with sweet potatoes is that they will not be palatable to the average Indian family. Sweet potatoes, however, are utilized in some Hindu religious festivals and are commonly boiled and eaten with salt. Therefore, providing farmers with seeds to grow nutritious sweet potatoes should allow for them to easily become a staple crop (Loebstein, 2009). However, many families also tend to fry sweet potatoes, which contributes to the obesity epidemic in India. To ensure that healthy ways of consuming the tuber are practices, the Central Directorate of Hindi can collaborate with the Bollywood industry to incorporate healthy sweet potato recipes into the movies. This will make sweet potatoes more accepted in their un-fried form. To replace the iodine drops, foods can be bio-fortified with iodine spray. A 2015 study found that an aerial foliar spray containing potassium iodine on top of newly planted seeds resulted in good market quality plants with a statistically significant assimilation of iodine in the edible plant (Lawson *et al*, 2015).. The use of this kind of natural bio-fortification that does not necessitate genetic modification is preferred because genetically modified seeds are highly regulated by both international and Indian standards, making them difficult to use for the regular Indian farmer. The proposal for these measures could include a need to subsidize the cost of sweet

potato seeds in microloans for farmers (especially targeted in vitamin-A deficient areas) and should be coupled with an aerosol iodized spray. To sponsor this project, I propose that Non-Governmental Organizations (NGOs) collaborate with India's Ministry of Agriculture to apply to the Power of Nutrition--which has over a billion dollars with the World Bank for malnutrition--fund in hopes of subsidizing the cost of additions to a microloan package to farmers in India. Microloan non-profits, like the Bangladesh Rural Advancement Committee (BRAC), could extend their operations to the northern Indian farmers. Since the cost of these additional bio-fortification materials would be subsidized by the Power of Nutrition, there would be a fairly low-risk environment for the companies. Collaboration with the Ministry of Agriculture is important, as this green-lighting of the proposal will allow for the NGOs to work more effectively.

To improve water sanitation and to stop diarrhea-causing infections, open defecation must be addressed. Plumbing infrastructure and water treatment facilities are limited to urban areas, require significant government investment, and are not always plausible due to water shortages. Additionally, much of the population is impoverished, highly dense, and has long-standing cultural attitudes when it comes to defecation. On the other hand, open defecation disproportionately affects rural women, as it makes them vulnerable to crime. Therefore, safe self-containing latrines are the best solution for underdeveloped and rural areas. The government of India must create an entrepreneurial opportunity with Non-Governmental Organizations, one example of which is Wherever the Need, to subsidize the creation of eco-sanitation/compost toilets. The type of toilet creates an organic compost within five months that is roughly pathogen free; the smell is managed by another tube that separates urine and feces to prevent the chemical reaction that exacerbates the smell. The large-scale implementation of such toilets will both improve living conditions, and allow for villagers to use a natural fertilizer instead of the expensive chemically-based fertilizer ("Women's Eco-Sanitation Toilets: India"). The NGO and the government should cooperate and try to place these toilets in the vicinity of rural temples and villages that traditionally are centered around farming and do not have a toilet. Compost toilets, however, are expensive, ranging from fifteen hundred to eight thousand dollars ("Composting Toilets"). To pay for such implementation, NGO's can either move to implement one of the compost toilet designs that is already funded by the Gates Foundation, or they can move to extend the USAID program to include a sanitation program. Safe yet private location will help ensure cultural acceptance and continued use. As the demand grows, private companies can expect to make income on manufacturing and servicing eco-sanitation toilets in India.

To support expectant mothers, it is important to connect them to additional nutrition and quality prenatal care, in a way that is economically possible and culturally sensitive. In addition to nearly 56% of women in the reproductive age being anemic and 33% being underweight, there is a caloric needs increase in pregnancy of extra 300 kcal/day needed to support the developing baby ("Malnutrition Affects Pregnant Women, 2015"). Currently, only 39% of births are attended in India (Laus *et al*, 2011). One way to connect women with resources is through medical NGOs and nonprofits. While Indian midwives are certified self-employed professionals, there are a number of certification programs available, like the Child and Postpartum Association in India. Medical NGOs could sponsor local women to become certified through both education and fee waivers. By becoming certified, they would create a network that reaches childbearing women in places where infrastructure and communication is limited. This network can also accept nutritional donations from NGOs, and distribute nutritional supplements. The other way to connect women with prenatal services is indirectly through a government registry of marriages. According to a Supreme Court Ruling in 2006, all marriages must be registered with the state; this registration, however, costs nearly a thousand rupees. Poor families cannot afford a fee and avoid registration (PTI, 2014). As a result, only 47% of women are married under an enforceable legal contract ("Country Profiles"). Waving the marriage registration fee for low-income residents will increase marriage rates in that population. Upon the registration, the new family can be provided with information on local midwife network, and sign up to receive prenatal supplementation from governmental or non-

profit initiatives. Improving nutrition and health outcomes in mothers will have a positive impact on the next generation.

All of Indian society can benefit from the proposed measures. Through the use of naturally bio-fortified foods, farmers can have an easily cultivated and nutritional source of food. Women who are disproportionately affected by malnutrition can be supported by a nationwide system of midwives, which will give supplements to the women and their unborn children. Not only will supporting women's health allow for the new generation to benefit from the proposed measures, but the women themselves will have more autonomy due to a renewed vigor and health. Farmers and children alike will be benefited from compost toilets that create sanitary conditions that prevent the spread of the rotavirus and receive natural fertilizer. Solving India's food security paradox would offer a model that may be adapted to other countries to help the most vulnerable in this global society.

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