

Millie Leubner

Arapahoe High School

Littleton, CO, USA

India, Sustainable Agriculture

Solving India's Food Insecurity with Sustainable Agriculture

Food insecurity—the condition of not having access to sufficient food, or food of an adequate quality to meet one's basic needs, according to Oxford Languages—is a global issue. Solutions to hunger and malnutrition are growing increasingly complicated as climate change exacerbates existing problems. Sustainable agriculture—the use of farming methods that protect and ensure that resources will be available for the future—will be critical to eradicating food insecurity. Food insecurity is especially pressing in India, a country noted for its high rates of hunger.

India has historically been known for its massive population and extreme poverty. These issues have undoubtedly commingled to cause its current hunger crisis. India's food deficiency has been classified as “serious” by the Global Hunger Index. With a population of almost 1.5 billion, this grade is concerning. India is a large exporter of rice, cotton, sugar, and wheat. In recent years, India has been increasing its exports of aquaculture—the controlled cultivation of aquatic organisms. India is a dominant contributor to the world's food supply and, ironically, is currently leading global food production. While the world is reliant on India's crops, the country faces its own internal struggles regarding food insecurity. Hunger and malnutrition appear in many demographics and locations in India. Two thirds of female rural residents are anemic (Saha et al.) and “...maternal and child undernutrition disproportionately burdens the poor, especially the urban poor...” (Nguyen et al.). In 2013, India enacted the National Food Security Act. This act “expands the number of households receiving subsidized food grains from the government...” (Krishnamurthy et al.). However, this policy has not affected the rates of food insecurity. As of 2022, 45% of senior citizens experienced food insecurity and almost 50% were malnourished (Kandapan et al.). Future policies must analyze current population data to target the largest and most food insecure demographics. Only 35% of Indians live in urban regions—the remaining 65% live in rural areas (PIB Delhi, Economic Survey Highlights Thrust on Rural Development) and 60% of India's land is cultivated. Because so much of India's population lives in rural areas, it is important to understand how this distribution affects farm size, family structure, and income. The typical rural family in India has 2 children. Many Indian farms are small, averaging 1.12 hectares (Telangana). Reflecting farm sizes, the average farming household's income is just 10,218 rupees (PIB Delhi, Income of Farmers): a mere 122.21 USD.

To improve living standards for this large group of rural Indian families, the government must prioritize policies targeting food insecurity. By analyzing neighboring countries who have had more success, India can understand how similar policies have fostered more substantial change. Bangladesh, located on the eastern border of India, implemented the 2020 National Food and Nutrition Security Policy which “encourage[s] welfare, food security, healthy diets, and nutrition improvements” (Ministry of Food). Consequently, Bangladesh is self-sufficient in the production of its most consumed crops. So long as Indian policy is ineffective in decreasing the prevalence of food insecurity, the country will continue to feel food insecurity's impacts in the form of undernutrition. Indians will not receive the produce, vitamins, and minerals necessary for a healthy diet, becoming underweight or obese as a result. With such a low household income, Indian farmers may struggle to efficiently keep harvest yields high. They may not have the capital to invest in high-efficiency machinery or fertilizer. As a result, farmers will use less-productive techniques that have potentially detrimental impacts on long-term soil fertility and air quality.

It will be imperative to increase India's production of healthy crops, both for its population and for a growing world population. With this growth, sustainability must be a primary focus to ensure the cultivation of nourishing crops for years to come.

India is encountering two substantial problems that are undeniably intertwined: high rates of food insecurity among its population and its stagnation in achieving the United Nations Sustainable Development Goals—despite the rapidly approaching deadline of 2030. In 2016, the United Nations created 17 Sustainable Development Goals (SDGs) for member countries to achieve by 2030. The UN reports and measures each member's commitment and advancement by analyzing policy efforts and totaling them into the Sustainable Development Goal Index. India's SDG Index score is a mere 63.5/100 and ranks 112th out of the 166 participating countries. The SDG of Zero Hunger is defined by the objective to “end food insecurity, improve nutrition and promote sustainable agriculture” (“Sustainable Development Report 2023”). India's government has not officially endorsed the SDGs, integrated them into a formal strategy, or mentioned them in recent government budgets.

The Indian government must develop and execute more policies geared towards solving the SDG of Zero Hunger. As rice is one of India's major exports, any rice production sustainability will have a substantial impact. Indian farmers regularly burn their rice fields to clear remaining crop waste for the next harvest's sowing, intensifying air pollution. One method to boost environmentally friendly agriculture is through the Happy Seeder. The Happy Seeder is an agricultural machine that sows wheat in leftover rice stubble that would have otherwise been burned. This machine eliminates the burning of fields and gives farmers an additional crop to harvest. Moreover, it incorporates organic matter into rice fields for long-term soil fertility. Although the Indian government already has a subsidy in place that pays 50% of the equipment cost, small farmers have been reluctant to purchase the machine. India offers a larger subsidy of 80% for rural inhabitants, cooperatives of farmers and similar groups (Verma). However, even with the 80% subsidy, the Happy Seeder still has an exorbitant price for small farmers: 30,000 rupees, or ~359 USD. Factoring in the cost of fuel, the reality that the machine will only be used once annually, and the fact that it takes 3-4 years for soil fertility levels to increase, there are more drawbacks than benefits. “Machines are generally owned by [commercial] farmers” (Mander) who can afford this expensive machinery—further increasing the disparity between commercial and small farming. This efficiency disparity results in an income gap within farmers. To maximize the positive effects of the Happy Seeder, the Indian government must implement a marketing strategy that advertises the benefits of sharing machinery between small-scale farmers—which include splitting excessive costs across multiple farming households and a higher return-on-investment per person. India has the capital to start an advertising plan for the Happy Seeder. India spent over 132,000,000 USD on both digital and print government advertising in 2018, yet only ~34,000 USD in 2022. This drop in funding is most likely due to the pandemic. As the country reinvests in governmental advertising, there is an opportunity for India to focus on sustainable agriculture practices. Pairing this technology with appropriate subsidies creates a unique opportunity for rural Indian farmers.

Perhaps a more specialized solution lies in fish-waste valorization. Valorization, as defined by the Cambridge Dictionary, is “the act of making something valuable or useful from an existing substance.” India is one of the world's leading exporters of seafood. In 2021, India ranked third in the world for fish production and “about two-thirds of the total amount of fish is discarded as waste, creating huge economic and environmental concerns” (Coppola et al.). Fish-waste valorization is the process of converting fish sludge—bones, fins/scales, feces, and viscera—into an agricultural fertilizer. Other countries have used this raw material on crops but “sludge is often so sodden with water that it is uneconomical and not concentrated enough to transport and use directly as bio-fertilizer” (Baarset). To maximize the effect of fish waste fertilizer, Indian farmers can treat sludge and convert it into a potent dry fertilizer. To produce dry fertilizer, fish waste is filtered numerous times then treated with various drying techniques resulting in a fertilizer with 90% dry material (Brod et al.). This process requires facilities and

labor which would total roughly 426,860 USD (Brod et al.). If the facility were government-run, the Indian government could include it in its annual budget and enact strategies to yield profits. Facilities can charge fisheries for the removal of fish waste and byproducts. Then, they can sell valorized fertilizers to local farms at a reasonable price. Additionally, a strategically placed manufacturing site can serve a large region. Subsistence and commercial farmers will be able to boost crop yields, producing more food, decreasing wastage, and improving sustainability. The Indian government must encourage this process by offering machinery subsidies, tax cuts for facilities, and benefits for employees like increased wages, greater insurance, or improved healthcare. These policies will lessen the economic burden of investing in valorization sites and incentivize their construction. Unfortunately, government-led solutions will cost a substantial amount in addition to the heavy financial burden of a large, poverty-stricken population. However, improvements in sustainability often have the effect of creating economic opportunities for citizens. These facilities can employ impoverished Indians and offer a steady income that encourages economic activity—like purchasing food—and a higher quality of life. India must invest in its population in order for it to thrive. An article by Reuters details the economic inequality crisis in the country today. As of March 2024, “The wealth concentrated in the richest 1% of India's population is at its highest in six decades... India's richest citizens [own] 40.1% of the country's wealth” (Reuters). Enacting higher taxes for the extremely rich would begin redistributing wealth in India—and would increase funding for national sustainability. In fact, a recent study by Earth4All and Global Commons Alliance found that 74% of Indian respondents were in favor of such taxes. This 74% of Indians have the power to sway elected officials—their role is to vote for leaders who will prioritize India’s future. With more investing power, valorization facilities are just one of the many positive sustainable opportunities for India.

India must strengthen its efforts to combat its devastating food insecurity. Additionally, the country must adopt sustainable agriculture techniques to ensure the consistency and longevity of its exports. One method is to increase the usage of the Happy Seeder in rice cultivation to preserve soil fertility. This machinery can also replace the traditional practice of burning rice stubble after a harvest—reducing smoke and ash pollution. Another solution is to incentivize the valorization of fish byproducts to recycle previously wasted materials into fertilizer. Small and subsistence farmers can purchase this nutrient-rich natural fertilizer for their crops—making the most out of available resources. Implementation of one or both solutions will increase India’s sustainability in growing food for both its population and global exports. With a rapidly growing world population, paired with climate change, food sources must be dependable, and India will be able to responsibly support global food security. India has the opportunity to become an example for the world by using its distinct population makeup to tailor policy to suit its unique needs.

Works Cited

Baarset, Hallstein, and Alexandra Pounds. "Valorizing aquaculture waste into bio-fertilizers and pet feed - Responsible Seafood Advocate." Global Seafood Alliance, 28 October 2021, <https://www.globalseafood.org/advocate/valorizing-aquaculture-waste-into-bio-fertilizers-and-pet-feed/>. Accessed 12 April 2024.

Brod, Eva, et al. "Drying or anaerobic digestion of fish sludge: Nitrogen fertilisation effects and logistics." NCBI, 7 June 2017, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5639799/>. Accessed 12 April 2024.

Coppola, Daniela, et al. "Fish Waste: From Problem to Valuable Resource." National Center for Biotechnology Information, 19 February 2021, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7923225/>. Accessed 9 April 2024.

Kandapan, Binayak, et al. "Food Insecurity and Malnutrition among Indian Older Adults: Findings from Longitudinal Ageing Study in India, 2017-18." NCBI, 3 August 2022, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9361951/>. Accessed 4 April 2024.

Krishnamurthy, Prasad, et al. "What Can State-Level Reforms Tell Us About India's National Food Security Act?" USDA ERS, 3 March 2014, <https://www.ers.usda.gov/amber-waves/2014/march/what-can-state-level-reforms-tell-us-about-india-s-national-food-security-act/>. Accessed 4 April 2024.

Mander, Manav. "Happy Seeder unviable investment for paddy farmers as cost outweighs benefits." Tribune India, 6 November 2023, <https://www.tribuneindia.com/news/ludhiana/happy-seeder-unviable-investment-for-paddy-farmers-as-cost-outweighs-benefits-559839>. Accessed 7 April 2024.

Ministry of Food. "Bangladesh National Food and Nutrition Security Policy Plan of Action 2021-2030." Government of the People's Republic of Bangladesh, September 2021, [https://mofood.portal.gov.bd/sites/default/files/files/mofood.portal.gov.bd/page/1f722343_5fdb_494d_8b62_31fc14abc1da/nothi_81_2022_12_22_91671701102%20\(2\).pdf](https://mofood.portal.gov.bd/sites/default/files/files/mofood.portal.gov.bd/page/1f722343_5fdb_494d_8b62_31fc14abc1da/nothi_81_2022_12_22_91671701102%20(2).pdf). Accessed 4 April 2024.

Nguyen, Phuong Hong, et al. "The double burden of malnutrition in India: Trends and inequalities (2006–2016)." NCBI, 25 February 2021, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7906302/>. Accessed 4 April 2024.

PIB Delhi. "Economic Survey Highlights Thrust on Rural Development." Ministry of Finance, 31 January 2023, <https://pib.gov.in/PressReleasePage.aspx?PRID=1894901>. Accessed 31 March 2024.

PIB Delhi. "Income of Farmers." Ministry of Agriculture & Farmers Welfare, 16 December 2022, <https://pib.gov.in/PressReleasePage.aspx?PRID=1884228>. Accessed 12 April 2024.

Reuters. "India's richest 1% has highest concentration of wealth in decades, study shows." Reuters, March 20, 2024, [https://www.reuters.com/world/india/indias-richest-1-has-highest-concentration-wealth-decades-study-shows-2024-03-](https://www.reuters.com/world/india/indias-richest-1-has-highest-concentration-wealth-decades-study-shows-2024-03-20/#:~:text=NEW%20DELHI%2C%20March%2020%20(Reuters,the%20World%20Inequality%20Lab%20found.)

[20/#:~:text=NEW%20DELHI%2C%20March%2020%20\(Reuters,the%20World%20Inequality%20Lab%20found.](https://www.reuters.com/world/india/indias-richest-1-has-highest-concentration-wealth-decades-study-shows-2024-03-20/#:~:text=NEW%20DELHI%2C%20March%2020%20(Reuters,the%20World%20Inequality%20Lab%20found.) Accessed 20 August 2024.

Saha, Somen, et al. "Non-iron Deficiency Anemia in Rural Indian Women: A Cross-Sectional Study." NCBI, 29 August 2022, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9520231/>. Accessed 4 April 2024.

"Sustainable Development Report 2023." Sustainable Development Report 2023, <https://dashboards.sdindex.org/profiles/india>. Accessed 4 April 2024.

Telangana Micro Irrigation Project. Department of Horticulture, 2023, [https://horticulturedept.telangana.gov.in/horticulturetelangana/\(S\(3auigoseptlsohb2eaeno0pf\)\)/newhome.aspx](https://horticulturedept.telangana.gov.in/horticulturetelangana/(S(3auigoseptlsohb2eaeno0pf))/newhome.aspx).

"VALORIZATION definition | Cambridge English Dictionary." Cambridge Dictionary, <https://dictionary.cambridge.org/us/dictionary/english/valorization>. Accessed 7 April 2024.

Verma, Sanjeev. "Crop Residue Management: Crop Residue Management: Over ₹3.3K Crore Spent, RS Informed | Chandigarh News." Times of India, 10 February 2024, <https://timesofindia.indiatimes.com/city/chandigarh/crop-residue-management-over-33k-crore-spent-rs-informed/articleshow/107572517.cms>. Accessed 7 April 2024.

Works Referenced

"Agricultural land (% of land area) - India | Data." World Bank Open Data, 2024, <https://data.worldbank.org/indicator/AG.LND.AGRI.ZS?locations=IN>. Accessed 7 April 2024.

Benu, Parvathi. "Government spending on advertisements slightly up in FY23 after years of decline." The Hindu BusinessLine, 25 July 2023, <https://www.thehindubusinessline.com/data-stories/data-focus/government-spending-on-advertisements-slightly-up-in-fy23-after-years-of-decline/article67115855.ece>. Accessed 8 April 2024.

The Business Standard. "Ten year action plan for Bangladesh's first integrated food and nutrition security policy." The Business Standard, <https://www.tbsnews.net/bangladesh/ten-year-action-plan-bangladeshs-first-integrated-food-and-nutrition-security-policy>. Accessed 7 April 2024.

"Food Insecurity - Healthy People 2030 | health.gov." Office of Disease Prevention and Health Promotion, <https://health.gov/healthypeople/priority-areas/social-determinants-health/literature-summaries/food-insecurity>. Accessed 7 April 2024.

Global Hunger Index. "'India.'" Global Hunger Index, <https://www.globalhungerindex.org/india.html>. Accessed 4 4 2024.

Haines, Julia, and Steven Ross Johnson. "These Are the World's Largest Countries by Population." U.S. News, 23 January 2024, <https://www.usnews.com/news/best-countries/slideshows/the-25-largest-countries-by-population?slide=26>. Accessed 31 March 2024.

Indian Chamber of Food and Agriculture. "India Food 2024." Untitled, 2024, <https://eoi.gov.in/ashgabat/?pdf18382?000>. Accessed 7 April 2024.

Lu, Marcus. "Mapped: Ocean Fishing and Aquaculture Around the World." Visual Capitalist, 17 November 2023, <https://www.visualcapitalist.com/cp/ocean-fishing-aquaculture-map/>. Accessed 8 April 2024.

Ministry of Statistics and Programme Implementation. "Estimated number of households, average household size and sex ratio (no. of female per 1000 male)." Government of India, <https://www.mospi.gov.in/estimated-number-households-average-household-size-and-sex-ratio-no-female-1000-male-4>. Accessed 12 April 2024.

PIB Delhi. "India's seafood exports touch an all-time high in FY 2022-23; grow 26.73% in quantity terms and 4.31% in value terms over FY 2021-22." PIB, 14 June 2023, <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1932317>. Accessed 7 April 2024.

"Sustainable Agriculture | National Agricultural Library." National Agricultural Library, <https://www.nal.usda.gov/farms-and-agricultural-production-systems/sustainable-agriculture>. Accessed 8 April 2024.

"What is aquaculture?" National Oceanic and Atmospheric Administration, 9 August 2016, <https://www.noaa.gov/stories/what-is-aquaculture>. Accessed 7 April 2024.