

Kayla Shepardson
Plateau Valley High School
Collbran, CO, USA
India, Malnutrition

India: A Solution for Malnutrition in Urban Populations

According to the United Nations, “Food production must double by 2050 to meet the demand of the world’s growing population.” This is to say that we must produce more food than we ever have before, all while ensuring that people receive proper nutritional value from the food that is produced. In the following pages, I will examine and propose solutions for malnutrition in the country with the largest population in the world, India.

Ranking number one in the world for population, India is rapidly growing. While exact data differs from source to source, it’s a fact that India’s population has surpassed everyone else in the world. As of June 2023, India’s population had increased from 1.417 billion in 2022 (The World Bank, “*Population, Total Data*”) to an incredible 1.428 billion in 2023 (Worldometer). Given that the population increased by 11 million in just one year, it is clear that the population is not going to decline anytime soon. Of those 1.4 billion people, 64% live in rural areas, and 36% live in urban areas. Compared to the U.S., India has an impressively large population living in rural areas. While that is a good thing, India’s population density is 481 people per square kilometer, or 1,264 people per square mile, meaning that the urban population is so dense that it makes up for the population that lives in rural places. This extreme density is mostly accounted for by the slums. The slums are urban areas with extremely high density and terrible living conditions. To complicate population issues in India, 49% of the urban population lives in the slums (World Bank). This means that almost a quarter of the population does not have adequate housing and nutrition. The slums are often filled with weak and temporary housing and are usually the homes of those who are unemployed or underpaid. The current minimum wage in India is only 178 Indian rupees, so many people are only earning \$2.16 for an eight-hour workday. That means that per hour, they are making only 27 cents. People earning the minimum wage do not have enough money to feed themselves, let alone a family. This minimum wage was set in place by India’s Democratic Republic, which consists of 3 branches, just like the U.S., Britain, and Canada. India’s government has been trying to solve the nutrition crisis and has been enacting many programs and partnerships in an attempt. However, it is obvious that it is not just one man’s job. While agricultural production has been rising, it is all in rural areas. The impoverished people in the inner city have little way to access food, especially with the issue of affording it. With 60% of the land being cultivated, the needs of the people are still somehow seldom met. The major crops are cereal grains such as rice, wheat, and maize (World Bank). Most farmers raise their crops on 2.6 acres, or about two football fields, of land. Many farmers experience crop loss during India’s infamous monsoon season, where floods and high winds are prevalent. However, due to the diverse geography, the climate of India depends on specific locations, making it difficult to inflict widespread improvements across the country.

India’s family dynamics are also a contributing factor to malnutrition. While the fertility rate in India has decreased recently, it is still practicing replacement-level fertility, which means that each average couple has two children. Even though this rate is beneficial, the fact that India is practicing replacement-level fertility still means that the population will not decrease anytime soon. The typical family size is 4.1 people, including parents. Most of these families live in houses of only 499 square feet. According to Atul Thakur in *The Times of India*, 32% of urban Indian families live in a house of 253 square feet or less, and 39% of rural households live in houses smaller than 312 square feet. With every house size tallied up, the average space each person has in India is estimated to be around 100 square feet. Given that the US standard for prison cells is 10’x10’, most Indians are living in the same space conditions as US prisoners

(Thakur). Forty-three percent of jobs are in agriculture, 31% are in services, and 26% are in industry (World Bank). Insufficient for families to meet their basic needs, the average annual salary in India is only ₹3,87,500, or \$4,639.54 per year. Complicating family economics further, healthcare in India is inadequate and expensive, but at the same time, primary education is free.

The typical family diet consists mainly of rice, wheat, and many other cereal crops. In a study of Indian diets, it was found that “the average daily calorie consumption in India is below the recommended 2,503 kcal/capita/day across all groups compared, except for the richest 5% of the population.” In this same study, it was found that the majority of people in India gain too many of their calories from carbohydrates and much too few from protein (Sharma, et al.). This could be partially explained by the fact that many traditional Hindus do not eat meat (“dietary practices”). Instead, they eat legumes, nuts, and other high-protein vegetables. This diet is still insufficient for their nutritional needs though, and a change is necessary. Most families get their food from supermarkets, many get their food from corner shops, and few buy food online (Statista). The main barrier that typical families face to obtaining healthy, nutritious food is overpopulation, because there simply isn’t enough nutritious food available for all its residents.

Malnutrition plagues roughly 14.37% of the population of India. That’s 194.4 million individuals who do not have access to adequate food (Singh). Malnutrition rates aren’t going down either; they are just steadily rising with the population. Gender, caste (social hierarchy), politics, and diet all contribute to malnutrition, so it is extremely difficult to pinpoint one root cause. The urban slum has the worst malnutrition rates; however, overall, urban populations are more overweight, and rural populations are more underweight (Singh). The people most likely to be malnourished are women and children. Given that many women do not have access to education, they do not know what proper nutrition looks like and, therefore, can’t teach their children. Narrowing this category even further, people in the “lowest wealth quintile are most likely to be undernourished” (Singh). While the caste system is no longer as prevalent in India, marginalization still happens to the same people as it used to. Many communities have poor access to education or a complete lack thereof. However, the current situation is an improvement from the past. In the past few decades, there have been many programs started by the government in an effort to improve nutrition and food security. For example, POSHAN Abhiyan, also known as the National Nutrition Mission, was started in 2018 by the prime minister in an effort to provide nutritious food, especially to children, adolescent girls, and pregnant or breastfeeding mothers (Kumar, 2022). This initiative is only one among many others. While India has been attempting to solve the hunger crisis, more assistance definitely won’t hurt.

There are many potential solutions to malnutrition being researched around the world. While few of them are based on India’s particular situation, they could very easily be applied. The Ayurved Research Foundation, for example, has been researching hydroponically starting rice and then transferring it into traditional paddies. According to Tarun Upadhyay and Abha Saxena, early conditions for rice propagation are crucial to healthy rice with high yields; “using unhealthy seedlings can reduce yield by at least 10%.” This means that the studies of the Ayurved Research Foundation could potentially improve the yields of rice crops by 10%; this would therefore lower the rates of malnutrition and improve the financial standing of many rural rice farmers. The only issue with this solution is that after the plant starts are transferred to the traditional paddies, they still use just as much water and soil. As a similar solution, Jin Ko Him created a vertical rice farm using aeroponics, which has been proven to decrease water usage by 90–95% compared to conventional practice. While Jin Ko Him’s design was based on parallelograms and took up quite a bit of ground space, his idea would be transferable to an even more space-efficient building in inner cities. This system was built in the Philippines in 2013, which had very similar nutritional deficits to India. While there is little data to determine the true effectiveness of this building, it can be inferred that it could improve nutrition on a large scale (Meinhold).

One of the most commonly researched solutions to malnutrition is biofortification. Penelope Nestel et al. define biofortification as “enriching the nutrition contribution of staple crops through plant breeding.” Research concerning biofortification has skyrocketed in recent years, and it is proving to be a viable option to ensure not only food security but nutritional security as well. A large reason that many people in India are malnourished is that they don’t have access to nutritional food, only food with low nutritional value. According to “Ensuring Nutritional Security in India through Wheat Biofortification: A Review” (Kamble et al.), India and the United Nations are working toward the biofortification of wheat in order to provide more nutrients without changing the diets of Indians drastically. Wheat is mainly biofortified with zinc and iron. Zinc is linked to many functions in the body, including emotional regulation, taste and smell, and wound healing. Iron is essential in the production of hemoglobin, a protein that helps carry oxygen around the body. The lack of iron in Indian diets gives cause for the overwhelming number of anemia cases found in India, and biofortification gives a potential fix for that. Biofortification also includes the enhancement of biological processes such as photosynthesis, photorespiration, and the Calvin-Benson Cycle, also known as the Calvin Cycle, and therefore improves yields. The Calvin Cycle is the crucial second, light-independent reaction in photosynthesis. As researched by Dr. Andrew John Simkin, a professor at the University of Essex, overexpression of many of the proteins involved in the Calvin-Benson Cycle can increase the final biomass of many plants. However, further research has distinguished that not all plants respond to the same proteins similarly. For example, tobacco and tomato plants benefit from the overexpression of SBPase (sedoheptulose-1,7-bisphosphatase) by improving yields by more than 30%. In wheat, however, the overexpression of SBPase was shown to improve the seed yields by 30% (Simkin, 2019). While biofortification using an improved Calvin-Benson cycle can be a great solution, the diverse effects of each of the proteins involved make it an unreliable solution.

While none of these proposed solutions can fix the malnutrition crisis in India in and of itself, it is possible that these solutions combined could work. I suggest a solution using new infrastructure with a purpose similar to the Colorado State University Spur Campus building in Denver, Colorado. The Spur Campus is an educational facility with the purpose of educating inner-city children and adults. By utilizing vertical aeroponic farms inside buildings that go up instead of out, we will be able to provide the inner city slums with freshly grown produce and better nutritional education. The first few levels of these farms would be filled with free education geared toward people living in slums and people making the minimum wage. These educational centers would be similar to the Spur Campus, utilizing interactive and playful tools to teach children and adults alike about nutrition and their own bodies. On the upper levels of the buildings, vertical, sliding aeroponic walls will be used in order to produce as much food as possible in a small space. There would be a few floors in between the education center and the farm, which will be used as a store. This process should effectively cut out the “middleman” and sell food to customers with as little of an upcharge as possible. Employees will be paid community members in order to put profit back into the community. The first building will be built in Patna, Bihar, because Bihar has the highest population of malnourished people, and Patna is the main city in Bihar. This project would be started and supported by a nonprofit, and with any luck, this project could be funded by the Indian government, the World Bank, and organizations geared toward solving malnutrition. Some examples of these organizations would be the Elenor Crook Foundation, the Child Nutrition Fund, and the Bill and Melinda Gates Foundation. While the initial investment would be sizeable, the results would radiate throughout communities. The building would be run on a nonprofit basis, employing community members and selling produce at the lowest cost possible. For maximum success, the Indian government would need to provide grants for construction; however, without their support, the project would likely still be possible. Other necessities would be loans, space, and building permits. This project would be sustainable because it would be fully heated and cooled by renewable energy. Due to the reinvestment of money in the community, it would also sustain urban communities and improve the financial standing of many people who live in the slums. Plus, it would improve the nutrition of the community and, therefore, solve malnutrition gradually. By including biofortified crops, we can also maximize the yields and nutritional value of the crops grown in the vertical farm and, as a result, come even closer to solving

malnutrition in India. This solution would be best implemented in conjunction with the programs that India has already started.

India recently became the country with the highest population in the world. This means that in the fight to produce twice as much food as we do now in the next 26 years, we must start there. With India practicing replacement-level fertility, the population is not likely to go down anytime soon. With that said, an incredible 14% of that population is malnourished (Singh). While there is no particular way to raise the minimum wage, we can still produce more food and, therefore, sell it for less. While this will help reach more people and prevent malnutrition, not everyone knows what a healthy diet looks like, so we must teach those who don't know how to properly fulfill their body's nutritional needs. Facilities that educate, produce, and sell nutritious food are a promising solution to this malnutrition problem.

References

Aleksandrowicz, L., Green, R., Joy, E. J. M., Harris, F., Hillier, J., Vetter, S. H., Smith, P.,

Kulkarni, B., Dangour, A. D., & Haines, A. (2019). Environmental impacts of dietary shifts in India: A modelling study using nationally-representative data. *Environment International*, 126, 207–215. <https://doi.org/10.1016/j.envint.2019.02.004>

Daniyal, S. (2022, October 17). *The India Fix: Why isn't India's shocking malnutrition problem shaking up its politics?* Scroll.in.

<https://scroll.in/article/1035156/the-india-fix-why-isnt-india-s-shocking-malnutrition-problem-shaking-up-its-politics>

Dietary Practices. (2014, March 6). Geriatrics.

https://geriatrics.stanford.edu/ethnomed/asian_indian/health_risk_patterns/diet.html

Education in India: A Detailed Analysis. (n.d.). Unacademy.

<https://unacademy.com/content/bank-exam/study-material/general-awareness/education-in-india-a-detailed-analysis/#:~:text=Human%20Resource%20Development.->

Ghia, C., & Rambhad, G. (2023). Implementation of equity and access in Indian healthcare: current scenario and way forward. *Journal of Market Access & Health Policy*, 11(1).
<https://doi.org/10.1080/20016689.2023.2194507>

Habitat for Humanity. (2017). *What is a Slum? Definition of a Global Housing Crisis*. Habitat for Humanity GB.

<https://www.habitatforhumanity.org.uk/what-we-do/slum-rehabilitation/what-is-a-slum/>

Kamble, U., Mishra, C. N., Govindan, V., Sharma, A. K., Pawar, S., Kumar, S., Krishnappa, G., Gupta, O. P., Singh, G. P., & Singh, G. (2022). Ensuring Nutritional Security in India through Wheat Biofortification: A Review. *Genes*, 13(12), 2298.
<https://doi.org/10.3390/genes13122298>

Kumar, V. (2022, December 17). How we can reach the unreachable: Tackling malnutrition in India. *The Times of India*.
<https://timesofindia.indiatimes.com/blogs/voices/how-we-can-reach-the-unreachable-tackling-malnutrition-in-india/>

Meinhold, B. (2013, March 18). *Aeroponic Vertical Farm: High-Yield Terraced Rice Paddies for the Philippines*. Inhabitat - Green Design, Innovation, Architecture, Green Building | Green Design & Innovation for a Better World.
<https://inhabitat.com/aeroponic-vertical-farm-high-yield-terraced-rice-paddies-for-the-philippines/>

Minhas, A. (2022, March 17). *India - where consumers buy groceries 2019*. Statista.
<https://www.statista.com/statistics/980088/india-where-consumers-buy-groceries/>

Nestel, P., Bouis, H. E., Meenakshi, J. V., & Pfeiffer, W. (2006). Biofortification of Staple Food Crops. *The Journal of Nutrition*, 136(4), 1064–1067.

<https://doi.org/10.1093/jn/136.4.1064>

Nguyen, P. H., Scott, S., Headey, D., Singh, N., Tran, L. M., Menon, P., & Ruel, M. T. (2021).

The double burden of malnutrition in India: Trends and inequalities (2006–2016). *PLOS ONE*, 16(2), e0247856. <https://doi.org/10.1371/journal.pone.0247856>

Puri, S., & Anand, D. (2015, August). *The State of Nutrition of the Marginalized Community in India*. Research Gate.

https://www.researchgate.net/publication/281592381_THE_STATE_OF_NUTRITION_OF_THE_MARGINALIZED_COMMUNITY_IN_INDIA

Salis, S., Virmani, A., Priyambada, L., Mohan, M., Hansda, K., & de Beaufort, C. (2021). “Old Is Gold”: How Traditional Indian Dietary Practices Can Support Pediatric Diabetes

Management. *Nutrients*, 13(12), 4427. <https://doi.org/10.3390/nu13124427>

Sharma, M., Kishore, A., Roy, D., & Joshi, K. (2020). A comparison of the Indian diet with the EAT-Lancet reference diet. *BMC Public Health*, 20(1).

<https://doi.org/10.1186/s12889-020-08951-8>

Shira, D. (2023, October 26). *A Guide to Minimum Wage in India*. India Briefing News.

<https://www.india-briefing.com/news/guide-minimum-wage-india-2023-19406.html/#:~:text=According%20to%20the%20latest%20data>

Simkin, A. J. (2019). Genetic Engineering for Global Food Security: Photosynthesis and Biofortification. *Plants*, 8(12), 586. <https://doi.org/10.3390/plants8120586>

Singh, A. (2022, December 1). *Understanding the malnutrition crisis in India*.

[Www.feedingindia.org](http://www.feedingindia.org).

<https://www.feedingindia.org/blog/understanding-the-malnutrition-crisis-in-india/#:~:text=India%20is%20the%20largest%20contributor>

Takur, A. (2017, August 28). Most Indian homes smaller than prison cells. *The Times of India*.

<https://timesofindia.indiatimes.com/india/most-indian-homes-smaller-than-prison-cells/articleshow/60250531.cms>

Thakur , A. (2008, November 5). *33% of Indians live in less space than US prisoners | India News - Times of India*. The Times of India.

<https://timesofindia.indiatimes.com/india/33-of-Indians-live-in-less-space-than-US-prisoners/articleshow/3753189.cms>

The World Bank. (2022). *Population, total | Data*. Worldbank.org.

<https://data.worldbank.org/indicator/SP.POP.TOTL?locations=IN>

The World Bank. (2024). *World Bank Group - International Development, Poverty, & Sustainability*. World Bank. <https://www.worldbank.org/en/home>

Upadhyay, T., & Saxena , A. (2019, November 18). *Hydroponics rice paddy nursery: An innovative twist on growing rice in India*. Ricetoday.irri.org.

<https://ricetoday.irri.org/hydroponics-rice-paddy-nursery-an-innovative-twist-on-growing-rice-in-india/>

World Bank Open Data. (n.d.). World Bank Open Data. Retrieved April 25, 2024, from

https://data.worldbank.org/indicator/SL.IND.EMPL.ZS?contextual=employment-by-sector&locations=IN&name_desc=false

Worldometer. (2023, July 16). *Countries in the World by Population (2024)*. Worldometers.info;

Worldometer. <https://www.worldometers.info/world-population/population-by-country/>