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India, Malnutrition

Accelerate Cuniculture and Alleviate Malnutrition: A Hoppy Ending in India

INTRODUCTION

India is the world's largest democracy with a population of more than 1.2 billion people ("The World Bank in India", n.d.). It's also a rising player in the global economy. On the other hand, India has more undernourished people and the highest burden of child malnutrition than anywhere in the world (Shob, 2020). This isn't a badge any country wants to wear, especially one with a growing economy, rising incomes, and some of the most agriculturally rich lands in the world.

COUNTRY AND FAMILY

India is a parliamentary democracy. This is different than the presidential democracy of the United States because citizens of India elect representatives to a parliament to make laws and represent the people. India is the second most populated country in the world, behind China. Its climate is tropical with fertile plains and arable land. In 2019, India was on the top ten list of produce exports which consisted of rice, soybeans, cotton, and meat (Mishra, 2021). Unlike the United States, where the average farmer owns around 444 acres, the average Indian farm is less than three acres (Sarin, 2019, Shahbandeh, 2021). This changes the options for the idea agricultural products for India.

India has a caste system, which is a type of social stratification. In other words, people are sorted into different levels of society based on the family there are born into. Castes range from the Untouchables, which are descendants of slaves and prisoners, to the caste with the highest clout, the Brahmins, which are the priests. Those in lower castes have lower positions in society and poorer nutrition. The poorest people aren't financially capable of supporting themselves, let alone their family (Saga & Singh 2021). There are also issues with gender inequality. Women are often considered inferior to men, and this correlates to poor nutrition in women, and their children.

Nearly 80% of the Indian are Hindu, a religion mostly thought to be vegetarian. Hindus hold the cow as sacred because it is viewed as a representation of mother nature. There is a stereotype of India being vegetarian, but according to India's National Health and Nutrition Survey, only 30% of Indian women and 22% of men are vegetarians (National Family Health Survey, India, n.d.). A diet with low meat intake is thought to contribute to India's malnutrition crisis (Bruckert, 2019).

CHALLENGE AND IMPACT

Malnutrition is the single most important threat to human society and there are more people, especially children, suffering in India than anywhere in the world. According to the Global Nutriton Report of 2018, one-third of the world's stunted children live in India. India also has 25 million children suffering from wasting, a severe form of being underweight that is a sign of food quantity and quality lacking (2018 Global Nutrition Report, Chapter 2, n.d.).

More than half of the Indian population has anemia, a form of malnutrition that causes fatigue and can affect growth and learning in children who are growing. Nutritional anemia can result from deficiencies of micronutrients such as iron, folic acid and vitamin B_{12}, but iron deficiency anemia is the most common. Recent research has shown that greater than 80% of the Indian population is also at risk of deficiencies in calcium, vitamin A, B12, folate, and the amino acid, lysine and there are also smaller subsets of the Indian population with deficiencies of iron, zinc and vitamin B6 (Ritchie et al., 2018).

India's malnutrition crisis affects individuals, the country, and the whole world. In 2011, the Indian Prime Minister at the time was quoted as saying "We cannot hope for a healthy future for our country with a large number of malnourished children ("India's 'national shame: 4 in 10 kids malnourished", 2012). Malnourishment leads to stunting and wasting, but also disease susceptibility, mortality, lower academic achievement, and overall failure to thrive. Ensuring the people of India receive the proper nutritional balance they need can be difficult, especially in poorer communities. It has been shown that 21% of the people live on around $1.90 a day because of the inequality in the caste system (Alexander, 2020). India has also become very dependent on the production of grain because it is cheaper, however these grains don't produce the key nutrients and minerals that other foods like meat, fruits, and vegetables can (Ray & Suri, 2021).

India's malnutrition challenge is mixed up with cultural, economic, and political issues that literally starve humans from the opportunity to live healthy lives. To alleviate this, solutions are needed for many complex problems with politics, culture and also deal with climate change. However, the solutions to these much bigger problems isn't coming fast enough. Simpler solutions might literally lay in the hands of the Indian people through the raising micro livestock agriculture.

SOLUTIONS AND RECOMMENDATIONS

Meat eating is often frowned upon, and plant-based solutions are offered instead, but food that comes from animals, especially meat, matches what is missing in India's diet because it contains protein, iron, vitamin B12, vitamin D, and other essential nutrients ("From iron to B12: five common nutritional deficiencies among Indians", 2021). As shown in Figure 1, research has shown that countries, like India, with the lowest rates of meat consumption have the highest rates of stunting (Adesogan et al., 2020). Also, people really want to eat meat. When countries become stronger economically, their meat intake goes up. Meat eating is often blamed for poorer health, but meat can be part of a healthy diet because it provides essential nutrients for all ages. Most countries support meat-eating in their dietary recommendations (Dietary guidelines from around the world, n.d.)

Livestock agriculture may be criticized for other reasons such as sustainability, but it has important social, economic, and environmental benefits that don't seem to get as much attention as it should. Even in a country like India, where many don't think of meat eating as a solution, the data shows otherwise.

Micro livestock farming has been an idea for India and other developing countries because smaller animals have advantages in terms of sustainability, they require less initial financial investment, and many are suitable to raise in high populated areas. Examples of micro livestock include chickens, turkeys, ducks, geese and rabbits. There are even small breeds of sheep and goats that can be considered micro livestock. Cuniculture, is the agriculture practice of breeding and raising domestic rabbits as livestock for their meat, fur, or wool (Wikipedia, n.d.). Expansion and acceleration of rabbit farming for meat production could be solution to help with India's malnutrition crisis.

Importantly, rabbits are not considered taboo to eat in India so societal judgement would not be a barrier as is the case with beef eating. In a paper published in 2005, there were over 400,000 rabbits in India and the authors proposed rabbits, as low-cost animal protein, to improve India's socio-economic and food security challenges (Risam et al, 2005). Raising rabbits in other developing countries has also proven to work well. Research in Kenya and Nigeria has shown that commercial rabbit farming can improve income and livings standards of their people (Mutsami & Karl, 2021), (Mailafia et al., n.d.). Rabbit farming is on the rise around the world. According to the market research firm, Index Box the global market for rabbits is growing. In 2017, globally, Index Box reports it was a 6.4-billion-dollar business (Index Box, 2021).

Rabbits are nutrient dense which means they are high in nutrients and low in calories. Rabbit meat contains 26 grams of protein and 175 total calories per 3.5 ounce serving (FoodData Central, 2019). Rabbit meat is also naturally lean and lower in cholesterol than many other meats and it is packed with vitamins and minerals. A 3.5 ounce serving of rabbit has as much iron and B12 as beef and contains potassium, magnesium, phosphorus, zinc, and selenium (FoodData Central, 2019). Rabbits' fur, pelts and even their manure are valuable by-products that can also be sold or used.

From a livestock agriculture perspective, rabbits are small and efficient. Compared to cattle, whose meat has nutrients similar to rabbit meat, cattle need 6-7 pounds of feed to gain one pound of meat, while rabbits need only 4 pounds of feed per pound of meat ("Rabbit: A great meat animal for small homesteads", n.d.) Rabbits also require less land space than many livestock species and they are efficient at growing on forages that humans can't eat. India has many forages to choose from like cereal, hay and a huge variety of vegetables. Meat rabbits also mature and reproduce rapidly and are usually harvested around five pounds and 10 weeks of age. According to Penn State University, an average doe can birth 25 to 50 live rabbits a year, which will generate 125 to 250 pounds of meat. They can repeat this process until about four years of age when they become infertile (Penn State Extension, 2005).

One important consideration is that rabbits are very susceptible to disease. A common concern, for example, is coccidiosis. However, this can be prevented by a clean cage and keeping their food and water clean. Well ventilated hutches also help prevent coccidiosis and other common diseases. Good animal care can help address a lot of these concerns.

As with other livestock species, the climate can affect how well rabbits thrive. Rabbits originated in the Southern Iberian Peninsula where the average temperature is between 36 and 64 degrees Fahrenheit. While the Indian climate is warmer than rabbit's native environment, most seasons in India are mild enough for rabbits to do just fine. However, summers can be a challenge because they can create high levels of heat stress. From my experience of raising rabbits during hot months in southern Texas, we found that chilling water bottles, putting fans up, and spreading the rabbits out for ventilation were all great accommodations for the temperature stresses. This was a consideration when developing my solution. Therefore, with the advancements in technology that I plan to use, we will have this commercial facility well ventilated with air conditioning to reach the ideal temperature that rabbits need for optimal health and well-being.

Across the world, there have been programs that can help teach small farmers how to improve the care and handling of their livestock like camps, trainings, and other community outreach efforts. These programs often try to implement new technologies to make their jobs more efficient. For example, the Swades Foundation has an objective to incorporate modern technology in these small backyard farms to help innovate them. (Samar Hafeez, 2022) However, these programs take a lot of training and time to reach a small group and sometimes they don't actually end up creating more rabbit farmers. This is noted by Dr. Steven Lukefahr who has lead programs like this. To help prevent this, he encourages trainings to require commitment from the local, grass roots famer who is most dedicated to the true business of rabbit farming and staying in rabbit farming. He notes that sometimes training programs train people who end up leaving rabbit farming for other positions in administration that lose touch with the practical rabbit producer (Lukefahr S D, C. n.d.).

There is an opportunity to create a teaching-based, community commercial rabbitry to support backyard farmers in expanding to larger scale rabbit production. This type of rabbitry could possibly be developed with a university to add trustworthiness for marketing and promoting the rabbit meat. Texas A&M Rosenthal Meat Science Center could be an inspiration because this is a university teaching meat lab that also sells to the public and is now even selling their branded products through local retailers. This would be a state-of-the art commercial facility with the best farm equipment for raising meat rabbits. Experts in breeding, animal health, economics, meat quality and marketing would support the program. It would be a high-tech facility with a hands-on support system for small farmers. It would be more than an educational training center because it would be designed to be a profit-share business because rabbit meat would be sold to the public. It would be thought of like a small-business start-up. Based on phone interviews with Dr. Lukefahr, it would be important to make sure farmers had "skin in the game", personally putting in work to see the business grow. Recruiting the most serious rabbit farmers would help with this. Dr. Lukefahr also emphasized the important role women could play because they are the primary caregivers for their family and also are responsible for small farming in many families. Women would be encouraged to participate.

Local farmers could receive start-up grants to maintain hutches (doing the work themselves) and also to buy rabbits with good genetics. As their operations grow and the rabbits are harvested and sold to the

public for profit, the farmers would have the opportunity to take loans to further expand their ownership of their herd and continue to grow their business. The goal would be for them to eventually outgrow the community rabbitry to start their own operation or start cooperatives with other farmers. Because internet access is increasing in rural India, education could also be provided virtually for those who lived too far to participate in the live activities.

The Food and Agriculture Organization of the United Nations (UNFAO) sponsors a program called Farm Field Schools (FFS). FFS is a learning course on how to become an independent and profitable farmer. The goal for FFS is to introduce agriculture into other countries that are struggling to understand how to raise animals for their benefit (Farmer Field School Guidance Document - home | Food and ..., n.d.) he FFS program could be a good educational program for this rabbit project. However, there would be a need for funding partners, likely from the private sector because building a state-of-the-art rabbitry is expensive.

A pharmaceutical company, like Elanco, may make a good partner for this project. Elanco is one of the world's leading animal health pharmaceutical companies. Their products improve the animal health, production, and profitability. In an Elanco press release on October 18, 2021, Elanco's CEO, Jeff Simmons was quoted as saying "At Elanco we are grounded in our purpose and our deep commitment of being a force for good in the world" (Elanco Animal Health, n,d,) Elanco has also recently partnered with the Food and Agriculture Organization of the United Nations, in another public private partnership, on ways to end hunger and promote meat as a nutrient dense option ("FAO ready to follow up on the UN Food System Summit", n.d.) Rotary International could be another potential interested funding partner. Dr. Steven Lukefahr stated in phone interviews that the Rotary International has also supported similar activities in Nepal but the current idea to build a community based commercial rabbit facility had not been done yet to his knowledge. One consideration that could foster acceptance within the Indian community is the endorsement from a domestic partner. As I mentioned above, the Swades Foundation is a suitable candidate because their mission is to help rural communities become more sustainable agriculturally. Also, this foundation is located in India, so this naturally could make the farmers more likely to trust them. (*Rural Development Ngo in India* 2022)

My proposed solution using cuniculture was reviewed by the World Food Prize Foundation experts, and they noted that scaling up rabbit farming is a "feasible, high-impact solution that is well defended". However, they also pointed out that complex malnutrition problems may require attempts using multiple approaches (D. Morgan, April 11, 2022) drastically different, but alternative solutions to cuniculture are also worth considering. One, as controversial as it may seem, is to normalize beef eating. The other is quite the opposite, a plant-based meat alternative with a nutrient profile that mimics red meat sources. This currently solution has recently received a lot of attention by critics of livestock agriculture

Even though many people believe otherwise, beef-eating is common in many Indian religions including Hinduism (H. Samar, 2022) The idea of normalizing beef eating may seem outrageous, however, there are drastic trends supporting the idea that beef eating is becoming more of a social norm in India. Consider this staggering fact: India was the 5th largest consumer of beef in the world, followed by the US, China, the EU and Brazil (*World Beef Consumption: Ranking of countries (USDA),* 2022) In 2022, compared to

2021, consumption of carabeef (meat from Asian domestic water buffalo) and beef (meat from bovine) rose nearly five percent (*India: Livestock and products semi-annual* 2022) As is the case with beef eating in countries around the world, it is a controversial food. The politics of beef eating in India are tangled up in the caste system with many from the lower caste defying the caste system by boasting about their beef consumption. There is a fight for Indians to "have their steak and eat it too" and the data support that India is already on its way to becoming more accepting of beef intake. The nutrients in beef are similar to rabbits and could help close the nutrients gaps raised in this paper. Despite some of the societal and religious barriers, a major advantage of beef eating over rabbit consumption is that beef is already much more available in India.

At the other end of the solution spectrum is the launch of plant-based alternatives. There are many business models across the world that could be used to supply India with adequate plant-based protein options. Companies like Beyond Meat and Impossible Foods are well known US based companies that have gained a lot of public attention and have large scale production. Recently there has been more attention about Indian based start-ups specializing in plant-based solutions to malnutrition. It seems like India is a county with great opportunity for these products as there have been estimates that the market size of the plant-based meat industry was $5.6 billion in 2020 but was expected to grow to 8.3 billion by 2025 (Bhandary, 2022). One concern about this possible solution is that even in the US, where there are many resources and creative marketing and advertising campaigns to make sure these products succeed, they still are disappointing investors. Just this year Forbes called the meatless market "lifeless" (Sorvino, 2022) Another concern is that many of the plant-based meat products are highly processed with added sodium and fat. Some nutrition experts question whether or not they can be used by the body, or nourish humans, as well the same way real meat can.

CONCLUSIONS

India's appetite for meat eating is an opportunity to alleviate its malnutrition crisis. Although societal trends are changing, some meats have more barriers to acceptance than others. However, accelerating the rabbit market in India is an opportunity to increase access to this nutritious meat. Alternative solutions could include normalizing beef eating or developing plant-based meat alternatives for India, but these solutions bring about other considerable challenges. A public-private partnership that creates a community-based cuniculture facility with a teaching focus in hopes for a profitable commercial rabbitry provides a viable solution for growing rabbit production and helping improve life in India.

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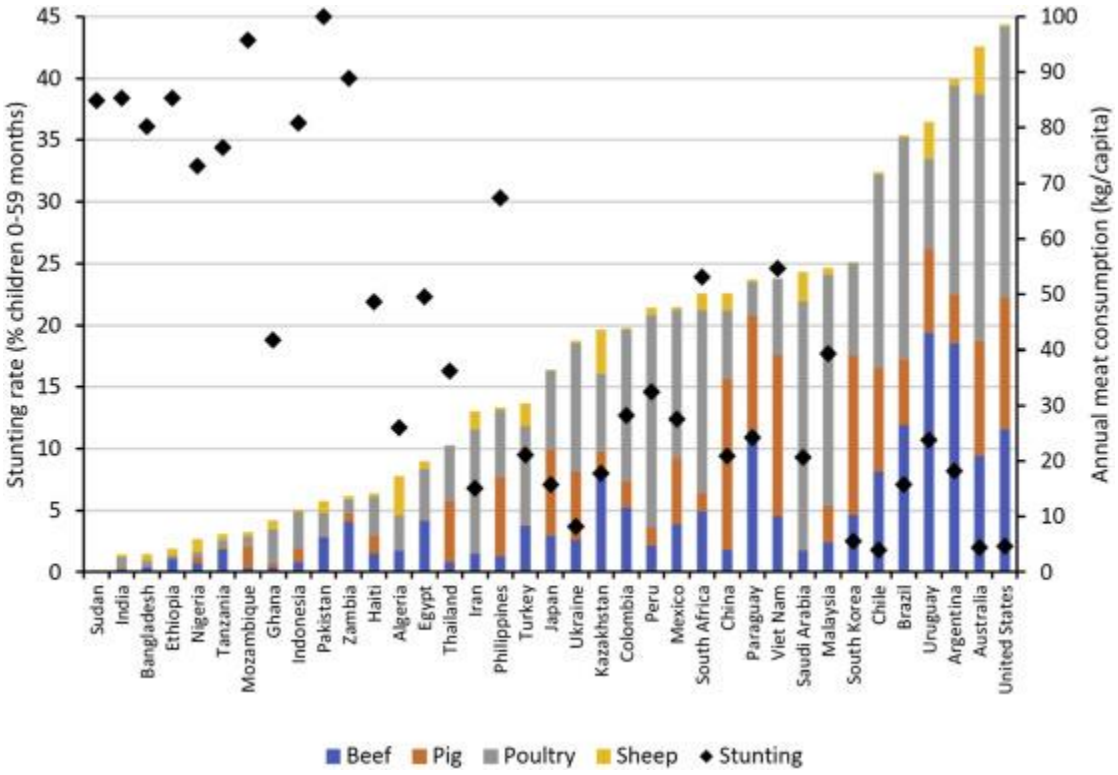
Figure 1. Meat consumption per capita and stunting rate estimates in different countries (Adapted from OECD (2018) and UNICEF-WHO-World Bank (2017). Sourced from https://reader.elsevier.com/reader/sd/pii/S2211912419300525?token=11608B95017A9F6CB08B573D0DC0505C4370A35D778652FF7F8492914C7D363F301D32A2CB31C667CF0127988AD03761&originRegion=us-east-1&originCreation=20220205234654



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