REVIEW ARTICLE Asian Journal of Dairy and Food Research, Volume 40 Issue 4: 398-407 (December 2021)

Saga of Hunger in India- Challenges, Chances and Resolutions: A Review

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10.18805/ajdfr.R-2183

ABSTRACT

India became independent in 1947, when it was still reeling from the impact of the 1943 Bengal famine and world as a whole was experiencing the brunt of world war second. Thus India was born hungry in a hungry world. The country leaders were well aware of the challenge that India was expected to face in terms of food security and it was Jawaharlal Nehru who said everything can wait but not agriculture. The first president of India Rajendra Prasad after taking the chair, the first thing he did was to hoist the flag at the Indian Council of Agricultural Research, declaring "India's most pressing task would be to conquer the battle of hunger. The Indian population has increased tremendously from 376 million in 1950 to 1380 million in 2020 and it is agriculture and its allied sectors that sustained such a huge population. India still has a significant proportion of population 14% undernourished, 35% children stunted, 20% children underweight, 52% women of reproductive age anaemic. India could bring out green revolution, white revolution and blue revolution in order to provide food security to its people. India presently is not food deficient; it has attained self sufficiency in food production and stands exporters of food. However the irony is that India stands at place 102 in global hunger index with score of 30 that is a matter of concern (Global Hunger Index-GHI, 2019). The problem is in making this food available to the people or access to the food is ensured. India needs nutritional security rather than food security besides transformation in agriculture and allied sectors to become free from hunger. The task is tough and precipitated by Covid-19 pandemic, but not impossible. India has much strength but will need research, extension, implementation and policy framing to have sustainable, nutrition sensitive, climate resilient, integrated and smart agriculture to eliminate hunger.

Key words: Food safety and security, Hunger, Indian agriculture, Malnourishment, Nutritional security, Nutrition sensitive agriculture, Smart farming, Sustainable agriculture.

India was born hungry

Independent India was born hungry in hungry world on 15th August, 1947. On its birth India was still reeling from the impact of the 1943 Bengal famine that left 3-4 million people dead (Maharatna 1996). Globally the scenario was not too different, the world was yet feeling the jerks of world war second that resulted into 39 million deaths in Europe alone and periods of hunger became more common even in relatively prosperous Western Europe. A severe hunger crisis was witnessed in Greece, Netherlands, Dutch, and Germany during World War II. Impacts of hunger were not restricted to the people living in that era but extended to the individuals exposed to hunger crisis in utero. Thus when India became free from the British occupation in 1947, the whole world was suffering from one or the other form of hunger.

In India hunger lay at the roots of much of its public policy in its early years and over 70 years later, we are still a hungry nation. The nature may have shifted a bit with no major famines now but malnourishment remains the real threat today too. India is still struggling to feed its people adequately, according to the UN, India is a home to quarter of the world's undernourished population. Indian leaders and think tanks were aware of the fact that they are going to face tremendous challenge of hunger in coming days after freedom. It was K.A Abbas's 1946 film *Dharti Ke Lal*, one of the first Indian social-realist films, which spread the message of hunger being a big challenge ahead. The interim government led by Jawaharlal Nehru, which took power in September 1946, realising the hunger challenge, selected Dr. Rajendra Prasad "President of the Constituent Assembly" and the first thing Dr. Prasad did was to raise the flag at the Indian Council of Agricultural Research, declaring "India's top concern would be to conquer the battle of hunger. Dr. Prasad was made in-charge of food and agriculture on January 26, 1950. Therefore independent India from the inception of its birth started working towards the food security of its people.

Independence to India deprived it of wheat and rice because a large area of Punjab and Bengal got severed from it. India had to import food from as far as Argentina immediately after independence to feed its people whose staple food use to be rice and wheat (Fig 1). Prime Minister

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How to cite this article: Pampori, Z.A. (2021). Saga of Hunger in India- Challenges, Chances and Resolutions: A Review. Asian Journal of Dairy and Food Research. 40(4): 398-407. DOI: 10.18805/ajdfr.R-2183.

Submitted: 27-02-2021 **Accepted:** 12-05-2021 **Online:** 22-09-2021

Jawaharlal Nehru took pains to tell his fellow Indians that living on rotis made from a mix of wheat and sweet potatoes and reducing consumption of food can be observed as he observed himself in lieu of food insufficiency. Mahatma Gandhi fervently advocated the removal of all controls on food, allowing a total free market to make food available to its people after independence. However, the then Government, imposed the system of ration cards that we still follow. This intervention was with good intentions of reaching to people with food, making food available at a 'fair price' so that access to food gets improved and to keep a check on the speculative tendencies in the market, Public Distribution System (PDS) was launched by India. Creation of Food Corporation of India and Agricultural Prices Commission in 1965 consolidated the position of PDS. It made government to announce a minimum support price for wheat and paddy and procurement of quantities that could not fetch even such minimum prices in the market. The resultant stocks were to be utilized for maintaining distribution through the PDS and a portion of these were used to create and maintain buffer stocks. However, unfortunately bringing in minimum support prices and purchases by government corporations resulted in our current situation where huge amount of grains is languishing in government warehouses, while consumers still go wanting. Similarly the land redistribution to the farmers has been part of India's state policy from the very beginning (Thorner, 1976). Independent India's most revolutionary land policy was perhaps the abolition of the Zamindari system. Since independence there has been voluntary and state-initiated land reforms in several states like West Bengal, Kerala and J&K with dual objective of efficient use of land and ensuring social justice (Maharatna, 1996; Besley and Burgess. 2000; Basu and Annemie, 2008). Since 1947, India has enacted perhaps more land reform legislation than any other country in the world, it has not succeeded in changing in any essentials the power pattern, the deep economic disparities, nor the traditional hierarchical nature of intergroup relationships which govern the economic life of village society. Indian government policy was particularly a big failure over land reform that precipitated the fragmentation of land holdings which is being identified as one of the main problems in enhancing agricultural productivity through technology interventions.

Strengths that India showcased post independence in food security

After independence recognizing the food scarcity, citizens of India, be it industrialists, housewives, farmers or even astrologers kept coming up with ideas they were sure would solve India's food problem and they were not probably wrong.

Green revolution

It was Monkombu Sambasivan Swaminathan, famous as Father of Green Revolution, who drove Indian agriculture from food deficient to food sufficient country. In 1960 M. S. Swaminathan launched the green revolution that increased the food production in the country tremendously and the intervention was the product of four things,

i. The gene technology that transformed and changed people's understanding of wheat and rice yields.
ii. The services that took the technology to the field like extension services, credit and insurance.
iii. The public policies of input-output pricing like the prices commission.
iv. The farmers' enthusiasm, that was very important in bringing green revolutuion.

Green revolution has increased food production from 50.80 million tons in 1950-51 to 176.40 in 1990-91 to 282 million tons in 2018-19 an increase of 455%. The tremendous increase in staple food production was product of increased yield per hectare through evolving of high producing varieties and increased soil fertility through use of fertilizers. Yield got increased three times in wheat (0.85 tons in 1961 to 2.74 tons 2005) and two times in rice (1.54 tons in 1961 to 3 tons in 2005) (FAO http://economics.cimmyt.org). However at the same time the population of India recorded tremendous increase from 376 million in 1950 to 1380 million in 2020. This population growth witnessed exponential increase during seventies and eighties with growth rate of 2.5 and has decreased to 0.99 in 2020. India was net importer of food grains and depended upon international food aid up to mid-1960s and is now exporter of food grains to many countries and moved millions of

Fig 1: Shortage of food after independence.

people out of poverty (Pingali 2012). This increase in food production may have made India self-sufficient in food production but not food and nutritionally secure because of access to food is still a major issue in India.

Many revolutions successively followed the green revolution aimed at achieving food and nutritional security for huge population and has been achieved to larger extent by the technology interventions in agriculture and allied sectors (Table 1 and Fig 2).

White revolution

It was Dr. Verghese Kurien who pioneered the Anand model of dairy cooperatives and replicated it nationwide and brought in White revolution in 1970 and became famous as Father of White Revolution. White Revolution increased milk production from 20 million tons in 1950-51 to 176 million tons in 2018-19 an increase of 780%. He pioneered the concept of dairy cooperatives and today in India we have over 190 thousand dairy cooperative societies with the northern part of the country highest number of cooperative societies of over 66 thousand (Statista Research Department, Nov 10, 2020). India is world's largest milk producer, it is exporting milk products and has earned 1341 Crores in 2019 (FAO 2020). The milk availability in India per capita per day is 394 g which is much higher than the ICMR recommendations of 280 g.

Silver revolution

Yet another revolution started way back in 1970s has increased the egg production tremendously post independence. Production of eggs was only 10 billion in 1950-51 that got increased to 103.3 billion in 2018-19 an increase of 933%. This revolution was a step forward for making good protein available to the population at affordable prices.

Red revolution

In 1980s red revolution was brought in and production of meat got increased from 1.65 million tons in 1961 to 8.10 million tons in 2019 an increase of 390%. India stands third largest exporter of meat in the world today.

Blue revolution

In 1985-86 India witnessed another success story that increased aquaculture production from 44843 tons in 1960 to 8.9 million tons in 2018 an unimaginable increase of 20127%. India stands 2nd in the world for aquaculture production and this sector is fast growing sector with growth rate of over 9%.

Yellow revolution

During year 1986-87 yellow revolution made India self-sufficient in oil production by 1996-97. However, India has not been able to maintain the production as per the demand

Table 1: Increase in food production post independence.

Particulars		1950-51 (million tons)	1960-61 (million tons)	1990-91 (million tons)	2018-19 (million tons)
Population		380 million	459 million	890	1.37 billion
Food grain production		50.8	82.0	176.4	282
Milk production		20	20.38	54	176
Meat production		-	1.65	3.66	8.10
Egg production		-	0.17	1.2	5.24
Fruit production		-	-	96.50	313.35
Fish production	Aquaculture	-	44843 tons	1.02	8.90
	Capture fish	-	1.2	2.86	4.80

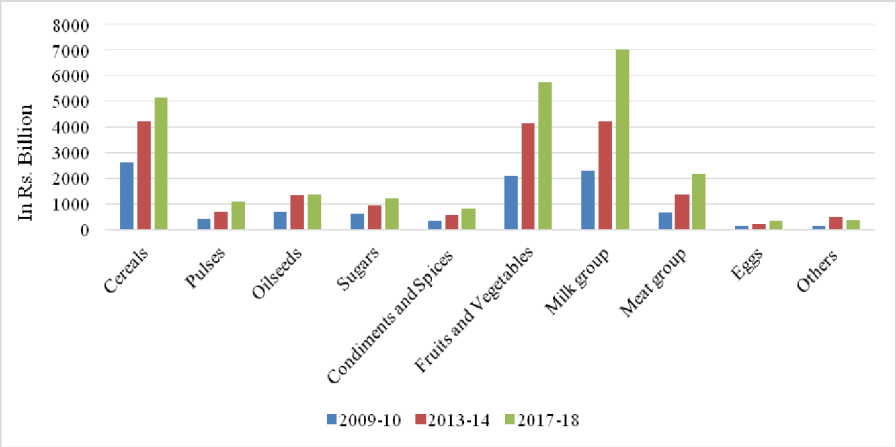

Fig 2: Output of agriculture produce by product categories.

and is presently observing a large gap between demand and availability with per capita availability only 11 g/ person/ day as against the recommended 30 g/person /day.

Golden revolution

Horticulture sector was targeted in 1990 and India had the period between 1991 to 2003 known as the period of Golden revolution. It increased fruit production from 96.50 million tons in 1990-91 to 313.35 million tons in 2019 an increase of 224%. This made India a world leader in the production of bananas, mangoes, coconut and spices and provided sustainable livelihood and nutrition options. Today India has self sufficiency in food production and exports various food grains.

Challenges that India faces to see country hunger free

Hunger index

Despite all these leaps, India is still a home to one quarter of world's hungry. 194 million people in India go to bed hungry which accounts for over 14% of population, of which women constitute 60%. 80% of all hungry live in rural India which ironically stands food producers. India stands at 102 rank in Global Hunger Index (GHI) among 117 countries with a score of 30, that puts the India in a group of serious hunger nations (Fig 3). 25 million babies are born every year of which 18% (4.54 million) are low birth weight and 0.57 million die every year. Of all these deaths, 88.8% die before first birth day. India has the highest burden of neonatal deaths. 45% of under-5 year deaths are due to under-nutrition. India's children are amongst the most malnourished in the world, 20% are wasted, 37% are stunted, 15% under-nourished (Fig 4). 80% women of reproductive age are anaemic, 75% women and children are Vit. A deficient. 70% Indians consume less than 50% RDA of micronutrients and only 9% newborn receive adequate diet.

Malnutrition or under-nourishment

Malnutrition of the children has very serious implications on population as well as national economy (Fig 5). It is the malnutrition that causes neonatal deaths, low birth weight babies, resulting in poor mental health, poor learning and cognitive abilities and poor school performance, increased disease susceptibility, low resistance, high morbidity and mortality (Singh, 2020; Chatterjee *et al*., 2016) (Fig 6). All these factors ultimately lead to poor work capabilities, low output capacity, low income, poverty and reduced GDP. Therefore, a strong, secure and healthy society contributes to the national economy as well.

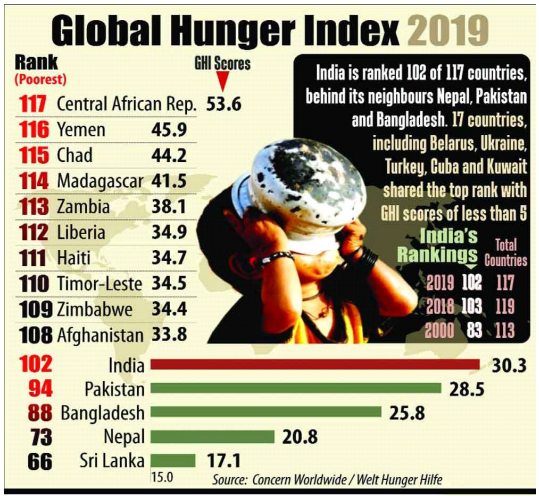

Fig 3: Global hunger index.

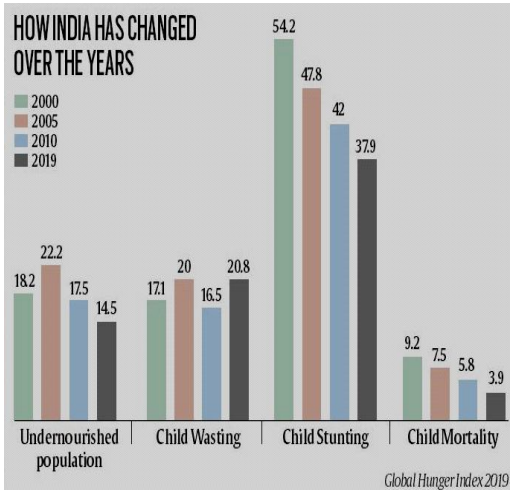

Fig 4: Status of mal-nutrition in India.

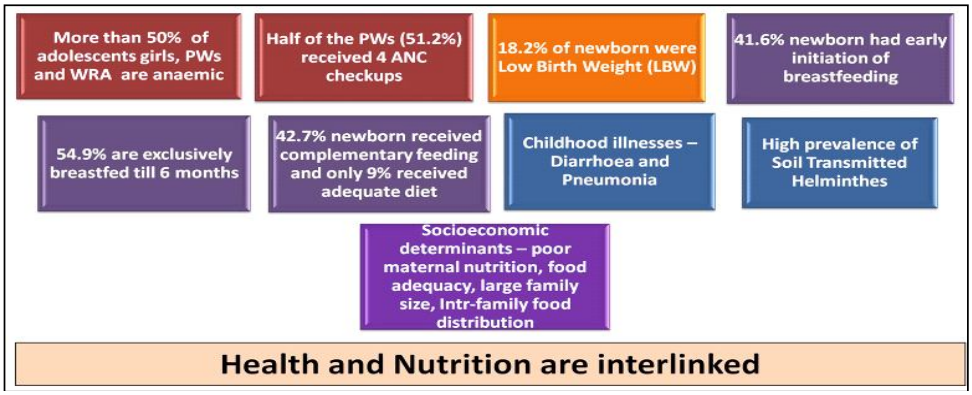

Fig 5: Reasons for high malnutrition in India (Source: NFHS 4).

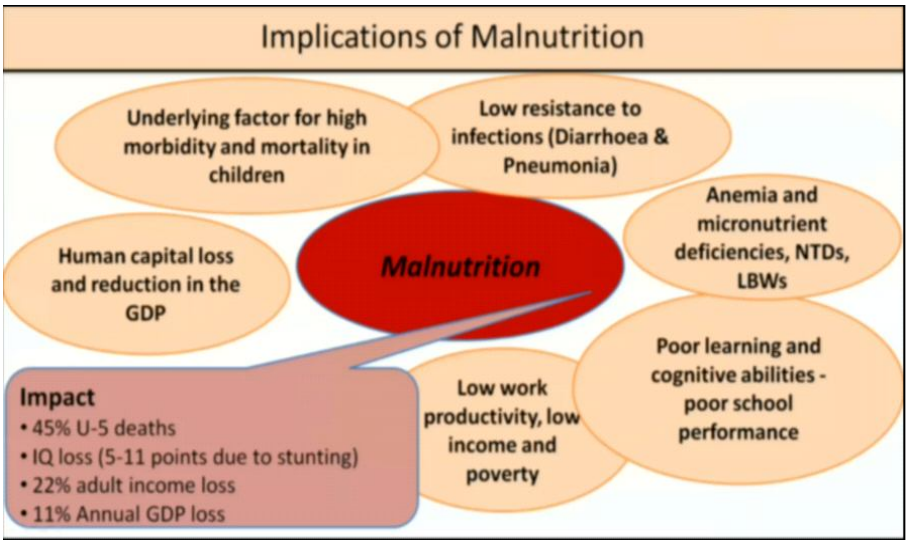

Fig 6: Implications of malnutrition.

Not only the food deficiency is responsible for malnutrition, more calorie intake has lead to various health problems. The rising trend in purchases of snacks, hydrogenated edible oils and 'other processed foods' have been some of the key drivers of increased consumption of unhealthy processed food products. Further, it has been driven by the growing Indian policy focus on promoting food processing, as well as liberalization of FDI in food processing and retailing, which enhanced the availability and affordability of processed foods (Thow *et al*., 2016). There has been an increased intake of sugar, oils and highly processed food in Indian diets with more apparent changes identified in urban India (Gulati and Misra, 2014). Studies have shown that the new dietary patterns are contributing towards a number of non-communicable diseases like diabetes, hypertension and cardiovascular diseases in India, which account for a major share of total deaths in the country (Prabhakaran *et al*., 2018).

Land holding

The very important issue with the country in reducing hunger is available land and land holdings. India has only 2.3% of the world's land with 17% of world's human population (2nd largest population in the world). In India 91% farmers are marginal and small farmers with less than 2 hectare of farm land that infact limits the technological interventions in farming, a major constraint in increasing crop production.

Soil status

Further the soil has fatigued, organic matter status has declined and micronutrients are deficient. The problems of soil acidity, salinisation and sodification are very common. Soil organic carbon has reduced to 0.3-0.4%, which is four times less than the ideal of 1.5%. India has highest agriculture water withdrawals, 2 times higher than China and 6 times higher than USA and it is projected that India will have 20% water depletion by 2022. Expansion of deserts, soil erosion, water scarcity and extreme weather phenomena as a result of climate change are becoming particularly apparent in countries that already suffer from hunger and poverty.

Farmer's plight

Besides deteriorating soil conditions for optimal food production, the farmer's plight too precipitates the situation of food insecurity. Ironically, 40% of farmers which are producers themselves are food insecure. People engaged with agriculture farming are more as labourers rather than cultivators, in 1960-61, 76% farmers were cultivators and only 24% labourers but as of now only 45% are cultivators and 55% are labourers. Further 46% of India's total workforce is engaged in agriculture which in turn contributes only 17% to GDP, that in other terms means more input and little output, an inefficient system. There is an increasing trend in urbanization and India is expected to lead the world in urbanization which means people engaged in agriculture will get reduced and agriculture produce will suffer a lot given the low land holding structure of India. It is argued that the projected 50 per cent increase in demand for agricultural production from 2013 to 2050 (FAO, 2017) has to be achieved despite the ongoing degradation of natural resources and the serious implications of climate change on agriculture which in itself is a big challenge.

People associated with farming are losing interest in it because there is no proper market link and many a times farmers do not get even the production price to their produce. Lack of storage facilities particularly for perishable produce further aggravates the farmer's plight and farmers sometimes lose everything. India's total storage capacity is 70.5 million tons as against requirement of 80.5 million tones that too is mostly in Utter Pradesh for potatoes. Available cold storage capacity is less than the half of the required, only 29.7 million tons cold storage capacity as against 61.7 million tons. Transportation of food grains is not efficient

and more than 30% of grains supplied through the public distribution system is lost because of inefficient storage and transportation system in India. Studies have shown that farmers have low price realisation and there is huge wastage in the supply chain due to fragmentation, poor storages and inefficient information flow (Negi and Anand, 2016; Pingali *et al*., 2019, Gokarn and Kuthambalayan, 2017). Studies also show that India has not been able to reach its full export potential due to fragmented supply chain and gaps in mitigating the demand of importing countries (Mukherjee *et al*, 2019; Goyal *et al*., 2017).

Indian agriculture farmers do not have insurance and credit facilities for their produce which makes them more vulnerable to economic losses. Minimum support price, yet talked enough but is not effectively been worked out and implemented.

Livestock sector

Similarly in livestock sector, India keeps high proportion of low yielding indigenous livestock with no effective policy to address the issue. Artificial insemination for improvement of local germplasm with improved and exotic germplasm has not achieved promising success and India still has only 40% AI success. Embryo transfer technology has yielded scores of research papers in peer journals but has not been impressively implemented in the field with the result there has not been much improvement in the productivity per animal. India has a huge potential of exporting livestock products owing to large livestock population but again due to lack of standard quality control mechanism, inability to adhere to the food safety standards and poor cold chain mechanism, India has not made success in increasing the global market for livestock products that stands only 2%.

Gender inequity

Women form an integral part of the agricultural sector and in India women make up a majority of the agricultural workforce and are often compelled to work to meet their families' basic needs. While their contributions are recognized as central to the food and nutrition security of households and communities, their work is not recognized or supported adequately by public policy and social institutions. Indian women manage agricultural work on family farms and receive no income, are usually overworked and have no wage-linked benefits (Rao, 2012). Apart from agricultural work, both household work and child and elder care responsibilities remain assigned to women within existing gender divisions of labour (Springer *et al*., 2012), with the additional task of caring for their men. Women continue to face inequality across key development indicators including health, education and nutrition; discriminatory laws and high levels of precarity in terms of income, employment conditions, safety and well-being. Gender inequity in India is a big challenge in attaining zero hunger as women are main players in Indian agriculture and their views, ideas and suggestions in agricultural farming are not being taken to board. Violence against women is a structural barrier to the attainment of food and nutrition security *via* a range of pathways; i. withholding food or restricting funds to purchase food (Usta *et al*., 2013); ii. controlling when and how they eat (Lentz, 2018), iii. pushing women into high-risk behaviour to secure money for food (Rao, 2019) or iv. normalization of physical violence related to the non-performance of food-related work (food production, shopping, cooking *etc*.) (Bellows *et al*., 2015; Chilton *et al*., 2013).

Agriculture system in India is not designed to promote health. There is more focus on increasing productivity and not the nutritive quality that is why India may be food secure but not nutritionally secure. Little priority for health sector in India has put it at the bottom of the GHI list. A meagre 1.4% of GDP is spend on healthcare in India that otherwise stands 17% in America, 8% in Britain and 3% in China with world's largest population. India is far behind the world average for physicians (0.6 V/S 1.3/ 1000) and hospital beds (0.9 V/S 3/1000). Indians are the sixth biggest out-of-pocket health spenders in the low-middle income group of 50 nations (Vipul 2017; Swagata, 2017). Compounded by high out-of-pocket expenditures, health-care expenditures exacerbate poverty, with about 39 million additional people falling into poverty every year as a result of such expenditures (Balarajan *et al*. 2011).

The governments mostly do not align their policies to the needs of the poorest population. There is lack of strategies to promote agriculture in the country in such a way that no-one goes hungry. Corruption is one of the greatest obstacles to development, land grabbing is a big problem.

Chances, the India has to become hunger free country

We have discussed in length about the challenges India does confront in achieving zero hunger in the country. At the same time India has to identify the opportunities that can be explored and availed to see India food and nutritionally secure. Some of the opportunities that can be explored and researched for ameliorating the hunger in India include:

a. Genetic diversity

India has 12% plant, 17% animal and 10% fish genetic sources of the world. This treasure with the India can be exploited to have the best competent, efficient, high producing and resilient varieties of crops and livestock to make India hunger free nation. Nutrition-sensitive and climate-smart agriculture interventions can tap local potential to promote agricultural productivity that meets nutritional requirements.

b. Climatic diversity

India has all the 15 climates of the world and 46 soil types that can be exploited to have food production in all the climatic and soil niches with nutritionally diverse foods. India is looking for designated areas with a specific type of food production depending upon the soil and climate conditions of that area. India has, long days and sunshine hours that is suitable for the cultivation round the year.

c. Irrigation potential

India has roughly half of the cultivable area rainfed without any proper mechanism of irrigation. India has scores of large rivers and water bodies that can be exploited and managed to irrigate the land for food production. This will also improve the utilization efficiency. Thus there exists great scope in increasing irrigated area, gross sown area and hence assured food production.

d. Work force

India has low age dependency ratio 49.2% that means India has a good proportion of population in a workable age. This opportunity with the India is a great asset to face challenges. Today, India is one of the youngest countries in the world with more than 62% of the population in the working age group (15-59 years) and more than 54% of the total population below 25 years of age (Times of India, 2020).

e. Livestock resources

India is a cattle wealthy nation. Highest livestock population with great diversity makes India a potential country for animal products exportation. India has a long coastline that confers it a potential to strengthen the national economy through blue revolution. Milk, meat, fish and their products have a promising demand in many countries. India has to build up the export policies and quality control mechanism to invite exports of various food products.

f. Welfare measures

Although the national government has not strengthened the agricultural sector through better prices, assured procurement or investments in climate-proofing, several state governments in India have sought to ameliorate rural distress and other related effects of agrarian stagnation through welfare measures. Leaders in this respect are the states of Tamil Nadu and Andhra Pradesh with 55 and 48 welfare schemes, respectively.

g. Sanitation and health services

Reaching the goal of nutrition security is equally dependent on state provisioning of clean drinking water, sanitation and reliable health services. Sanitation, in the Clean India Campaign (Swachh Bharat Abhiyan), is interpreted as universal access to toilets. Although this is undoubtedly important, inadequate attention has been paid to the disposal of solid and liquid wastes that contributes to the growing burden of infectious diseases (India State-level Disease Burden Initiative Collaborators, 2019). Similarly, whereas universal health insurance (Ayushman Bharat) may support curative care, primary health care provisioning remains weak, which is key to disease prevention. The responsibility of health and nutrition security has been placed with low-paid and poorly trained women community health and nutrition workers, with little power in their local, rural contexts (WHO, 2019). There remains great opportunity with Government of India to adequately support and empower these workers to perform their roles, both through skill-building and strengthening of referral and back-up health services.

Resolutions to have hunger free India

Nutrition sensitive agriculture

Nutrition-sensitive agriculture is an approach that seeks to ensure the production of a variety of affordable, nutritious, culturally appropriate and safe foods in adequate quantity and quality to meet the dietary requirements of populations in a sustainable manner. Now when India is self sufficient in food production, the priority should be nutritionally rich and diverse foods. It is high time to use technologies like Biofortification, fortification, food diversification, soil enrichment, crop diversification that can lead to nutritional security. We need to have our food baskets with varieties of food items that can ensure nutritional demands of a person. There is need to include non-grain items *viz* fruits, vegetables, beans and animal products to the food basket. India is not adequately prepared to meet the requirements of dietary diversity, without enhanced trade. Diversification on a large scale (implementation at regional or national level) can help enhance availability of diverse foods in markets and reduce prices of nutritious foods. Integrated farming systems (legume-based cropping systems including crop rotation and intercropping, rice-wheat farming systems) favour both diversification and sustainable intensification of production. Home gardening with emphasis on nutrient-dense varieties of vegetables and fruit trees and small-scale integrated farming systems (mixed crop-livestock-aquaculture systems) have potential to improve diet quality and raise levels of nutrition for producing households. In addition to protein and energy, animal source foods are excellent source of selected micronutrients like iron, zinc, calcium, vitamin A, vitamin B-12 and various essential amino-acids.

Use of neglected and underutilized species (NUS)

From a food system perspective, dietary and production diversity need to improve to address malnutrition. NUS are under-explored that offer tremendous opportunities for fighting poverty, hunger and malnutrition. Director General FAO highlighted, the crucial role of NUS in the fight against hunger and are a key resource for agriculture and rural development (FAO, 2012a). Historically, underutilized plants have been used for food and other uses on a large scale and, in some countries, are still common, especially among small or marginal farmers in rural areas where many are traded locally and a lucky few NUS are nutritious, climate resilient, economically viable and adapt to local conditions, especially in marginal areas. NUS have made their way to export niche markets around the world (Akinnifesi *et al*., 2008). NUS have high nutritional value and can be an essential source of micronutrients, protein, energy and fibre, which contribute to food and nutrition security.

Sustainable intensification

There is no problem in the genetic potential of crops or production inputs, instead, the problem lies in the degradation of natural resources and their yield-related functions. Therefore, closing the yield gap, a different concept of sustainable intensification, has been coined by FAO (www.fao.org/ag/save-and-grow). Sustainable

intensification means achieving the highest possible production, applying all necessary technologies, while keeping the environmental impact below the threshold of natural recovery (United Nations, 2015). Conservation agriculture is based on key principles including minimum tillage, retaining a permanent soil cover and crop diversification (Suraj and Behera 2014). Precision agriculture is an emerging example that utilizes data on spatial and temporal variations in the agroecosystem to make accurate agronomic decisions without wasting resources and time.

Encouraging local production of diversified foods to be available locally can be a way out to eliminate hunger from the country. Up-gradation of local germplasm, identification and propagation of indigenous nutritious plant and animal species that are more resilient and adapted to local conditions can make India free from hunger. Selection and production of species and varieties should be based not only on yields but also on nutrient content (concept of nutrient productivity), thereby enhancing the nutrient supply of agricultural products, especially for micronutrients. Community-level initiatives for supporting the saving and exchange of seeds (community seed banks, village seed fairs, smallholder seed enterprises) and protecting ecosystems (community-based natural resource management, reforestation, promotion of micronutrient-rich forest foods) should be practised to enhance availability of and access to genetic resources, Strengthening local food systems and empowering local people in local production of nutritious, adapted and diversified cultivars. Locally available foods must find place in the food basket of its locals and its distribution to immediate areas to reduce wastage and cost.

Accessibility to food

Global food security is today more of an issue of access to food than its availability. Average dietary energy supply adequacy (ADESA) shows that minimum nutritional requirement per capita, is above sufficient levels globally (FAOSTAT) and yet, more than 800 million people across the globe are undernourished and malnutrition. This implies grossly uneven distribution of food resources and emphasizes the urgent need for correcting distortions in food markets. It is a major issue that can be addressed by providing effective, efficient and economical public distribution system, transportation system, cooperative system and marketing system. Development of quality infrastructure for food storage, cold stores, cold chain facilities and logistic services are of prime importance to ensure accessibility of population to food. Accessibility to food is linked to many aspects and a holistic approach is needed to ensure accessibility of population to food. It includes increasing purchasing capacity, reducing poverty, minimising food wastage, abolishing fragmented marketing with commission agents and middlemen mafia. One of the key issues leading to food losses and wastage is that the production and consumption hubs are located in different regions across the entire country for example for three key commodities - potato, onion and tomato, which are core to Indian diet, the production and consumption hubs are far away, therefore, there is a need for efficient logistics and supply chain networks, both in terms of physical infrastructure and technology to manage and match the demand and supply to ensure accessibility of people to the food.

Effective and precision irrigation system

50% of the land is irrigated and 50% remains rainfed in the country that leaves a good scope for increasing the food production through increasing irrigation. India does have great rivers with rich source as Himalayas that can be harvested for irrigation of farmlands. India needs to build infrastructure for its channelling to different areas across the States. Most parts of the India receive monsoon rains that can be harvested, stored and then distributed across the States to irrigate farmlands in the country. There has been little rather no change in arable land which was 155 million hectares in 1961 and 156 million hectares in 2016 but of course decrease in per capita holding from 0.34 hectares in 1961 to 0.12 hectares in 2016. Similarly India needs to develop crop varieties that have less water withdrawals.

Sustainable food value chains

An effective food system transformation will necessitate firm commitments at the international and national levels to promote the required policies and investments at national and local levels. In practical terms, this would need to include four main dimensions: (i) underpinning healthier populations by enabling access to nutritious and healthy food for all; (ii) guaranteeing sustainable food production, processing, trade and retailing; (iii) mitigating and adapting to climate change; (iv) improving smallholder farmer livelihoods and resilience by enhancing prosperity in farming and rural communities. FAO has developed guiding principles on sustainable food value chains which can be used as a framework for upgrading value chains (FAO 2014b).

Minimising wastages

Wastages do happen from food production to consumer's plate and this loss if reduced can alone make India free from hunger. Use of efficient strategies at the farm level, efficient transportation system from farm to stores and consumers and ultimately proper utilization by the consumers without wasting much can do wonders in eliminating hunger from the country. In India food losses occur mainly at early stages of the food value chain. Strengthening the supply chain through the direct support of farmers and investments in cold chain infrastructure, transportation and safe packaging could help to reduce the amount of food loss. Post-harvest handling, processing and storage contributes to a secure food supply and thus of nutrients throughout the year. It also reserves the quality of harvested raw material as it moves along the food supply chain from the producer to the market; reduces losses and makes fresh produce available in local markets as well as in distant locations.

Food processing and value addition of food products

Out of the total agricultural output, the share of food processing sector in India was only 46.87 per cent in 2017-18. Comparatively, the share for other developing countries such as Brazil (70 per cent), Malaysia (80 per cent) and Philippines (78 per cent) is much higher (Reserve Bank of India, RBI-2020). One of the effective methods to preserve the surplus food particularly perishable items and make it available to the consumers in the country or outside the country is to process the food. Value addition is one of the effective strategies to preserve the foods, to utilize the non-conventional foods and to fetch more. The strategy can be effectively utilized to make use of agriculture by-products, which is only 25%.

Research and innovations

Research and innovations will always remain effective tools in any system to face the challenges. The nations which are using innovative techniques are economically and technologically ahead. In India we have our own demands in agriculture farming system. Our landholdings are very little and thus need to have farm machinery and technologies that favour our small farm lands be it in seed sowing, land tilling, crop planting, thrashing, chopping, harvesting *etc*. There is need for more investment on applied post-harvest management research/technologies, policy change to focus on infrastructure development including cold storage, refrigerated transportation and efficient distribution systems *etc*. Research and data collection, data analysis is most important in contemporary scientifically advanced world to keep pace with the increased demands. Weather predictions, disease prevalence, disease forecasting and application of artificial intelligence in agriculture production and management is dependent on data collection and analysis.

Awareness among consumers

Awareness is must in present scenario of globalization. Consumer is presented with varieties of food items claiming lot many nutritional benefits with high pricing for the product. There is need to aware the consumer through target campaigning. There is need to educate the consumers about the requirement of different varieties in the food basket according to the physiological status, age, sex and physical activities of the consumers. Pregnant ladies, lactating mothers, neonates, juveniles, athletes, women and men have different food requirements and they must be made aware of their nutritional needs and food varieties that can fulfil their nutritional requirements so that a healthy society is ensured.

Strict implementation of product standard specifications and food safety standards

India has a huge potential of export of agricultural and livestock products but has not achieved much progress in it simply because of lack of standard product specification and certification. Quality control is a major issue with the products that have an export market. Therefore India has to ensure quality control of agricultural products through establishment of high end analytical laboratories, sanitation procedures, SPS, traceability and observance of standard safety measures that can boost the export of food items from India in the global market and make its economy flourishing.

Regional trade cooperation and liberalization in agriculture products

India is the biggest partner in SAARC, however, the regional trade cooperation between the countries is very meagre may be because of undue regulatory restrictions, procedural and infrastructural barriers to trade or due to certain political reasons. India needs to strengthen the trade agreements with neighbouring countries to make diversified food available to the population at reasonable and affordable rates. Thus India needs strong liberalized trade policies, political will and firm resolve. India has to increase intra-regional agriculture trade (Nagesh and Joseph, 2020).

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