Food System in India. Challenges, Performance and Promise

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1 Introduction

Looking into the future, towards 2030 and beyond, the challenge of feeding India's growing population is going to be a major task. According to the UN Population Prospects (2019), India will be the world's most populous country by 2027, surpassing China. Currently, its population is about 17.7% of the total world population, and it will increase from 1.38 billion (2020) to 1.5 billion in 2030 and 1.64 billion in 2050 (United Nations 2019). By 2030, 600 million Indians are expected to live in urban areas and will require a continuous supply of safe and healthy food from hinterlands. This challenge is further compounded by limited availability and the deteriorating quality of natural resources such as land, water, and air. On top of this is the challenge of climate change, with rising temperatures and greater frequency and intensity of droughts in western and southern India and floods in northern and north-eastern India (IPCC 2018).

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Despite India's economic progress over the past two decades, regional inequality and malnutrition problems persist. Simultaneously, trends in overweight and obesity, along with micronutrient deficiency, portend an emerging public health challenge. There is a need to examine the interactions among India's economic development, agricultural production and nutrition through the lens of a "food systems approach."

Structurally, Indian agriculture is dominated by small and marginal land holdings. About 86.2% of holdings are less than 2 hectares (ha) that account for 47.3% of operated area (Agriculture Census Division 2015–16). And there has been a continuous decline in the average land holding size, from 2.3 ha in 1970–71 to 1.08 ha in 2015–16. This raises a fundamental policy question: how to design a food system that ensures not only sufficient availability of food, feed and fibre for India's large population, but also good nutrition, and that is environmentally sustainable and globally competitive? Achieving all of these goals seems a tall order for any government. But the efforts are on, not by government alone, but also by the large private sector, through long-term multi-stakeholder partnerships. When such partnerships are organised around crop value chain clusters, economies of scale are achieved, thereby improving efficiency and competitiveness. This has resulted in several successes, yet there are still many challenges, and one needs to continuously innovate with new technologies, institutions, and policies for better outcomes. This chapter attempts to do precisely this, dwelling on the holistic approach towards India's food system with a special focus on three aspects:

(i) Is India producing sufficient food, feed and fibre for its population in a globally competitive and environmentally sustainable manner?
(ii) Is India marketing its food with low intermediation costs and low food losses? This refers to post-harvest value chains, from farm to fork.
(iii) Is India producing a sufficient amount of nutritious and safe food for consumers?

We hope that the evidence-based research cited in this chapter will help policymakers make more pragmatic decisions that help in achieving the above goals. Let us address each one of these in some detail, looking at their challenges and their performance in the recent past, and what promise they hold for 2030 and beyond.

2 India's Food System

2.1 Producing Sufficient Food Efficiently with Environmental Sustainability

India is largely a rural economy, with 66% of the country's population living in rural areas (World Development Indicator 2019) and agriculture being the mainstay of this section of the population. The sector employs the largest share of India's

working population – about 42% (National Statistical Office 2020) - and contributes 16.5% to the country's gross domestic product (GDP). However, of the total geographical area (of 328.7 million hectares (mha)), nearly half is arable (159.7 mha) and only 42.6% (about 140 mha) is actually cultivated, a number that has remained static over decades, thereby reflecting no scope for horizontal expansion. Hence, in order to feed India's growing population from limited resources, an increase in crop productivity is imperative! This requires investments in agri-R&D and extension (both by the public and the private sectors) and an enabling policy ecosystem. India needs to invest at least 1% of its agri-GDP in agri-R&D against the current level of 0.39% (NIAP 2017). In fact, India's agri-food policy of late has been highly skewed towards subsidies instead of investments (Gulati et al. 2018). In FY 2020–21, as per the Union budget, India's expenditure on agri-R&D (ICAR budget) was a meagre INR 7762 crore (about USD 1.1 billion) (Government of India 2021a). Thus, there lies a huge scope for achieving higher growth momentum, as the marginal returns from expenditures on agricultural research are almost 5 to 10 times higher than through subsidies (Fan et al. 2007). If agricultural growth is to provide food security at a national level, then the expenditure on agri-R&D needs at least to be doubled immediately (Paroda 2019).

To better understand the role of investments and enabling policies in our agri-food system, let us peep into the past and see how India transformed from being largely a food deficit nation to a food surplus one, particularly in the case of staples (wheat and rice), milk, poultry, fish, and, lately, cotton. Lessons from the past will certainly help in defining a clear roadmap towards 2030 and beyond.

2.1.1 Lessons from the Past

Who could have imagined that India, after the Bengal Famine of 1943 that claimed around 3.0 million deaths, not from disease, but starvation (Maitra 1991), and having lived in a situation of 'ship to mouth' during the mid-1960s, with heavy dependence on wheat imports under PL 480 food aid (USA), could one day emerge to be the largest exporter of rice? It also had food grain stocks of 97 million metric tonnes (MMT) in June 2020, almost 2.5 times the buffer stock norms of the country. All of this happened through an infusion of new technology (wheat and rice varieties that are high yielding, dwarf, photo-insensitive and responsive to high inputs) in partnership with CIMMYT and IRRI during the mid-1960s, technology that was then further improved and expanded over time through a domestic network of research and extension under the Indian Council of Agricultural Research (ICAR) and State Agricultural Universities (SAUS) (Dalrymple 1975; ICAR 2017). Along with said new technology (such as high yielding variety (HYV) seeds), irrigation, fertilisers, and positive price policy played critical roles in ushering in the green revolution in India. This is a lesson for many developing countries in Africa and Asia that have small holdings and are still aiming to have a green revolution.

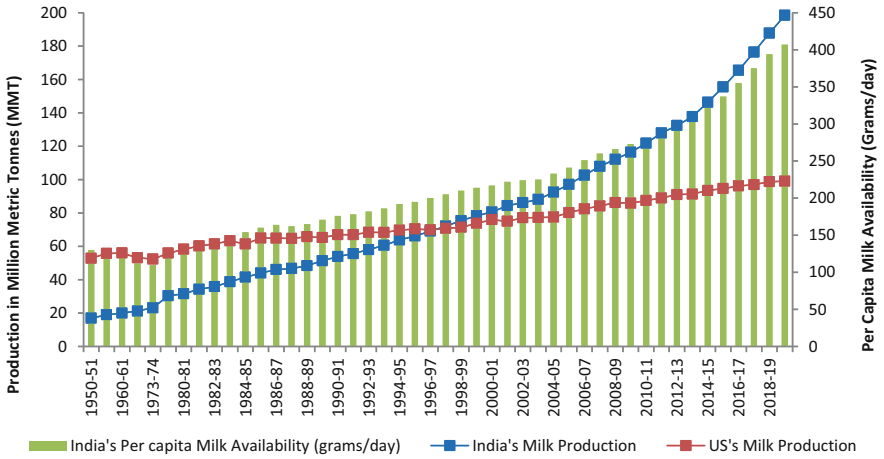

Fig. 1 Milk production in India and the US, and per capita availability in India from 1950–51 to 2019–20. (Source: FAOSTAT 2019 and DoAHD&F 2019)

Along with the green revolution, the country witnessed significant transformation in the dairy sector during the 1970s through the mid-1990s. Verghese Kurien spearheaded `Operation Flood,' which transformed the system of milk collection from smallholders under a co-operative structure, homogenising, pasteurising and distributing it to mega-cities as far as 1800 kilometres away in bulk coolers designed to keep the temperature controlled at 3.9 degrees Celsius, through an organised retail network. Subsequently, de-licensing of the dairy sector, in 2002, encouraged private enterprises in a big way, leading to accelerated growth in production and processing. As a result, India emerged as the world's largest milk producer, with 208.0 MMT in 2020/21, up from 17.0 MMT in 1950–51 (Fig. 1), leaving the United States of America (99 MMT) and China (45 MMT) way behind. And all of this was achieved through smallholders with 3–4 cows or buffalo. India's per capita milk availability also increased from 110 grams/day in 1973–74 to 407 grams/day in 2019–20 (DoAHD&F 2019), and an estimated 428 grams/day in 2020–21. However, India's productivity of dairy animals is still far below the global standard of 20 litres plus per day (indigenous cows 2.8 litres per day, crossbreeds 7.5 litres, and buffalo 5.2 litres). Improving milk productivity through genetic enhancement and better fodder and feed availability are the ways forward! This is another major lesson for smallholder-dominated agricultural economies as to what smallholders can do with the right institutional innovations, including needed policy support and building value chains from farm to fork.

Besides dairy, India's poultry sector also witnessed revolutionary transformation from backyard poultry farming to an organised commercial poultry industry, largely driven by the private sector. What was particularly successful was the indigenous pure-line breeding that used germplasm of a foreign strain, leading to genetic improvement and the spread of vertical integration and contract farming practices among the small and marginal holders. As a result, the sector experienced the fastest

average annual growth, reaching 9.2% between 2000/01 and 2018/19, and emerged as the third largest producer of eggs (103.3 billion) and the fifth largest producer of broiler meat (4 MMT) in the world (2018/19).

In 2002, the introduction and commercialisation of Bt (Bacillus thuringiensis) cotton (the only genetically modified crop in India so far), along with huge investments in R&D by private seed companies, ushered in the famous Gene Revolution in the agricultural sector. This led to a breakthrough in cotton production, rising from 13.6 million bales in 2002/03 to 37.5 million bales in 2019/20 (Directorate of Economics and Statistics 2020), with India surpassing China (in 2014/15) to become the largest cotton-producer in the world. The effect of fertilisers, Bt technology and insecticides contributed to 60, 23 and 17 percent of cotton yield, respectively, in India (Paroda and Joshi 2017). The benefit of Bt technology for cotton is estimated to be USD 84.7 billion (cumulatively between 2002–03 to 2018–19) through savings in imports of cotton, as well as extra exports of raw cotton and yarn compared to the business-as-usual scenario.

Over the last five decades, India has experienced an impressive growth trajectory from a food scarce country to a food sufficient one, and then to a food surplus one. All of these revolutions in agricultural production were triggered due to a scaling of innovations, well supported by the right incentives and institutions. Today, India is a net exporter of agricultural produce. As a result, agricultural exports, in nominal US dollar terms, have increased significantly from USD 6.1 billion in 2001/02 to USD 43.6 billion in 2013/14. Imports also increased during this time, and stood at USD 18.9 billion in 2013–14. Thus, there was a net surplus in agri-trade accounting to the tune of USD 24.7 billion in 2013–14, indicating that Indian agriculture has become globally competitive. But after 2013–14, exports slipped down a bit as global prices took a downward turn while imports kept increasing. As a result, the net surplus on the agri-trade front was down to about USD 16 billion in 2018–19. Overall, agricultural trade (exports plus imports) as a percentage of agricultural GDP showed an increase from 4.7% in 1990/91 to 20.9% in 2012/13, and thereafter, it slipped from this peak to 15.1% in 2018/19.

2.1.2 Using Lessons of the Past to Create Opportunities for the Future

The lessons from the past always hold promise for what can be done in the future. HYVs and hybrid seed technologies, along with accelerated breeding programmes and vibrant R&D efforts by research institutions and companies both in India and globally, have improved crop yields in corn, vegetables, rice, pearl millet and other crops. However, increased crop productivity is no longer the only end objective today. India's agri-food system is progressing towards an ecosystem-based food system, focusing on end-to-end solutions from agri-inputs to agronomic advisory to market linkages and easy access to finance, credit, etc. Simply increasing crop productivity won't work if farmers don't get the right remunerative prices for their produce (Narain 2020). Therefore, outcome-based value chains such as 'Better Life

Farming' are also providing additional income opportunities through rural agri-entrepreneurship (Better Life Farming 2020).

The Bt cotton Gene Revolution was a game-changer for Indian cotton. Now, we need to expand it to other crops such as corn and oilseeds (soybean and canola) and reduce India's dependence on edible oil imports (TAAS 2014; Paroda and Joshi 2017). This requires the right agri-infrastructure, accelerated market reforms and an enabling policy framework that is focused on empowering farmers and protecting intellectual property rights (IPRs).

Another area where both the government and the private sector are making significant inroads is digital farming using artificial intelligence, drones, the Internet of Things (IoT), remote sensing, etc. Very recently, the Indian Government used e-locust tab and e-locust M to control a locust attack in desert areas of Rajasthan. The technology provided a precise location (GPS), as well as recording the data, which was useful for forecasting, forewarning and taking control measures. Public and private sector are investing in capacity-building to encourage wider adoption of new and existing technologies among smallholder farmers, such as water-efficient rice through hybrid seeds and direct seeded rice (DSR) (NITI 2019). Similarly, ITC Limited has expanded its extensive e-Choupal network, which is working with four million farmers to launch a 'phygital' system, with a crop-agnostic integrated solution framework that will synergistically aggregate digital technologies to empower farmers.

Sustainable and protected agricultural practices like soilless farming systems (hydroponics, aeroponics, and aquaponics) and polyhouse farming systems are also making headway. The government is aiming to increase the area (~2,00,000 ha) under protected cultivation by a factor of 4 in the next 4–5 years, another option for vertical farming and enhanced income to attract youths (including women) to agriculture (Paroda 2018, 2019).

2.2 Increasing Pressure on the Environment and Climate Change

Though India has largely been able to achieve much-needed food, feed and fibre security, which can inspire many developing countries, it has come at the cost of environmental degradation, especially in regard to water and land, in some states of India. The government is realising that longstanding policies of subsidies for agriculture inputs (e.g., power and fertilisers) and price support (MSP) with open-ended procurement of rice and wheat are inflicting significant damage on the environment. For instance, fertiliser subsidies (nitrogenous fertilisers are subsidised for almost 75% of their cost) have resulted in massive overuse of nitrogenous fertilisers, leading to an imbalanced use of nutrients and a decline in soil fertility, as well as the pollution of local water bodies. Moreover, widespread deficiency of secondary and

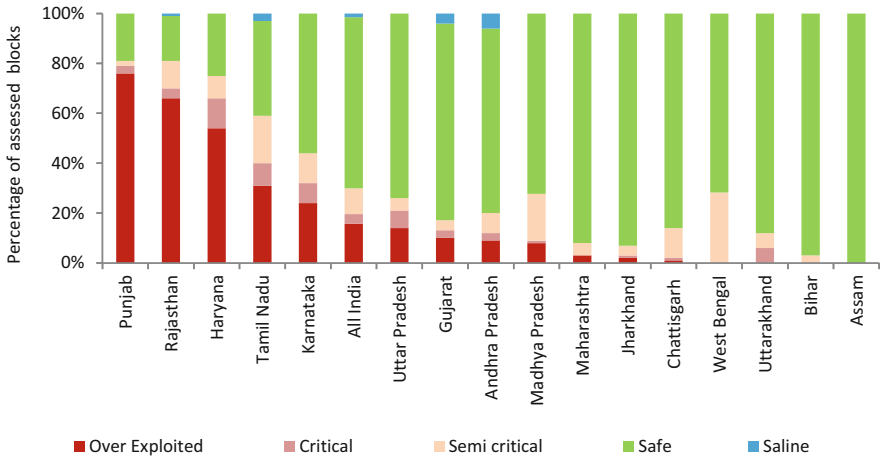

Fig. 2 Status of groundwater level in India, 2017. (Source: CGWB 2017)

micro-nutrients such as sulphur, zinc, iron and manganese has affected soil productivity adversely (Government of India 2016). On the other hand, power subsidies have resulted in an alarming overuse of scarce groundwater, especially in north-west India. This issue is poised to become one of country's big challenges in the years to come, unless jointly prioritised through good policies and corrective measures by the central and state governments.

Figure 2 presents an assessment of the groundwater table in 6584 units (blocks) across states in India by the Central Ground Water Board (CGWB) in 2017. It revealed that, overall, 1034 units are 'over-exploited,' 253 are 'critical' and 681 are 'semi-critical' (CGWB 2017). The over-exploited areas are mostly in three parts of the country, namely, north-western India (Punjab, Haryana, and western Uttar Pradesh), western India (Rajasthan and Gujarat) and southern peninsular India (Tamil Nadu, Karnataka, Andhra Pradesh and Telangana). Hence, these regions would need corrective water use approaches like micro-irrigation and enabling policies around cropping systems and water use efficiency (WUE).

In addition to the undesirable consequences of agricultural intensification, climate change is another daunting challenge for achieving overall food-feed-fibre security. As per the predictions of the IPCC, India will face greater frequency and intensity of droughts in the Deccan plateau states of the west and southern peninsula, and floods in the Himalayan foothills from melting glaciers in the Himalayas. With temperatures rising by one degree Celsius, estimates are that wheat production will drop by at least 5 MMT, and, if temperatures rise further beyond 2 °C, the losses will increase rapidly (IPCC 2018).

Several efforts are on to address the issue of sustainable and climate-resilient agriculture. The government and the private sector are joining hands to create climate-resilient villages, saving water in agriculture use through better demand

side efficiency, and augmenting water resources through water harvesting to recharge groundwater. ITC, e.g., has built more than 20,000 water harvesting structures through 44 partnerships (PPP mode) covering 1.2 million acres. It has also extended its focused 'climate smart villages' initiative to more than 600 villages, which have increased yields by about 15%, incomes by about 30% and cut down greenhouse gas (GHG) emissions by more than 30% (SustainCERT 2020). It is being argued that, to protect India's agri-resource endowment, there is a need to switch from highly subsidised input price policy (power, water, fertilisers), as well as MSP/FRP policy for paddy, wheat and sugarcane, to more direct income support policies linked to the saving of soil, water, nutrients and the improvement of air quality. Such shifts will reduce the inefficient use of fertilisers and ensure sustainable use of scarce water supplies, and therefore will be more equitable and environmentally sustainable (OECD-ICRIER 2018).

For agriculture to be sustainable in the long term, it needs to go hand in hand with farm incomes and farmer prosperity. Otherwise, farmers will not take sustainability issues seriously. Globally, several players are working on sustainable agriculture models that also support income generation for farmers. The opportunities to adopt Carbon capture models to reduce carbon emissions and create additional income streams for farmers is currently being introduced by several companies, including Bayer, in the US and South America. This could be a great opportunity for smallholder farmers in India and other smallholder countries in Asia and Africa, too (Bayer 2020; World Bank 2012).

As far as the challenge of climate change is concerned, the government is putting greater emphasis on adaptation through the development of climate-resilient seeds. The ICAR has identified 400 climate-resilient germplasm lines and 58 genotypes with high water and nutrient use efficiency. It is also developing and demonstrating climate-resilient technologies under "National Innovations on Climate Resilient Agriculture (NICRA)."[1] Further, it is increasing the area under micro-irrigation technologies for water preservation, and promoting innovative rice cultivation and irrigation practices like 'Alternate Wetting Drying (AWD)' and 'Direct Seeded Rice (DSR),' which can save about 25–30% of water requirements in rice cultivation. Greater emphasis on laser levelling is also helping by raising WUE up to 30%. Shifting from cereal-cereal to cereal-legume cropping systems will result in sustainable intensification.

Another example involving climate-resilient seeds is the Water-Efficient Maize for Africa (WEMA) Public Private Partnership Project in Sub-Saharan Africa with AATF, CIMMYT, Gates Foundation, USAID and Bayer. By combining advanced breeding techniques, WEMA has delivered drought-tolerant and insect-resistant maize (corn) seed varieties to smallholder farmers in five African nations.

The Soil Health Card Scheme of the government aims to make sure every farmer has a balanced use of nutrients (N, P and K) on the basis of soil tests. The government is also encouraging the cultivation of nitrogen-efficient crops such as

[1] According to the government sources.

pulses (legumes), which fix nitrogen in the soil and boost crop productivity through Biological Nitrification Fixation (BNF), and investing in precision irrigation technologies through satellite crop-monitoring systems that assess soil moisture, expected rainfall and overall crop conditions to suggest the exact quantity of irrigation required. Use of irrigation sensors that help save water is also being encouraged.

The scaling of innovations helps reduce the inefficient use of scarce natural resources (water and soil), and hopefully makes the food system more efficient, sustainable and climate-resilient.

2.3 Marketing Food with Low Intermediation Costs and Low Food Losses

Value chain development and marketing platforms that link farms to agricultural output markets play a critical role in determining prices and incentives for farmers. However, the agri-marketing structure in India continues to be fragmented, with a large number of intermediaries leading to high transaction costs (between 30% and 50% of the retail consumer price). These costs are exacerbated by high commissions of agents, high *mandi* (market) charges and fees in certain states (like Punjab), low investments in supply chains, poor logistics, information asymmetries and a lack of sufficient storage infrastructure. As a result, high intermediation costs for many agri-commodities blunt their global competitiveness. These investments in supply chains are lacking due to restrictive marketing and trading policies, such as the Essential Commodities Act of 1955, that were designed during the era of scarcity. Similarly, indiscriminate export controls that kick in whenever prices of any essential commodity start going up hamper investments in supply lines. The OECD report on Agricultural Policies in India has clearly showed that Indian agricultural marketing policies have favoured consumers over producers by suppressing farmers' prices. The Producer Support Estimate (PSE) for India was negative 11.2% of the value of farm receipts between 2000–01 to 2019–20, while the Consumer Support Estimate (CSE) was one of the highest in the world (28.8%) (OECD 2021). Figures 3 and 4 give PSE and CSE estimates of several countries, respectively, for a period of the latest three years (2017–18, 2018–19 and 2019–20) (OECD 2021). India's PSE is about −4% vis-à-vis 13% for China and 17% for OECD as a group. Contrastingly, CSE for India is highest at 21%. Thus, the typical consumer bias in India's marketing and trade policies still continues. Correcting this bias remains a tall order.

The government's efforts to reform the agri-marketing system, through the recently passed Farmers Produce Trade and Commerce (Promotion and facilitation) Act, 2020, the Farmers Empowerment and Protection Agreement on Price Assurance and Farm Services Act, 2020, and amendment of the Essential Commodities Act, have run into rough weather, as some leaders in the farming industry, particularly from the Punjab, Haryana and western Uttar Pradesh belt regions, are opposing

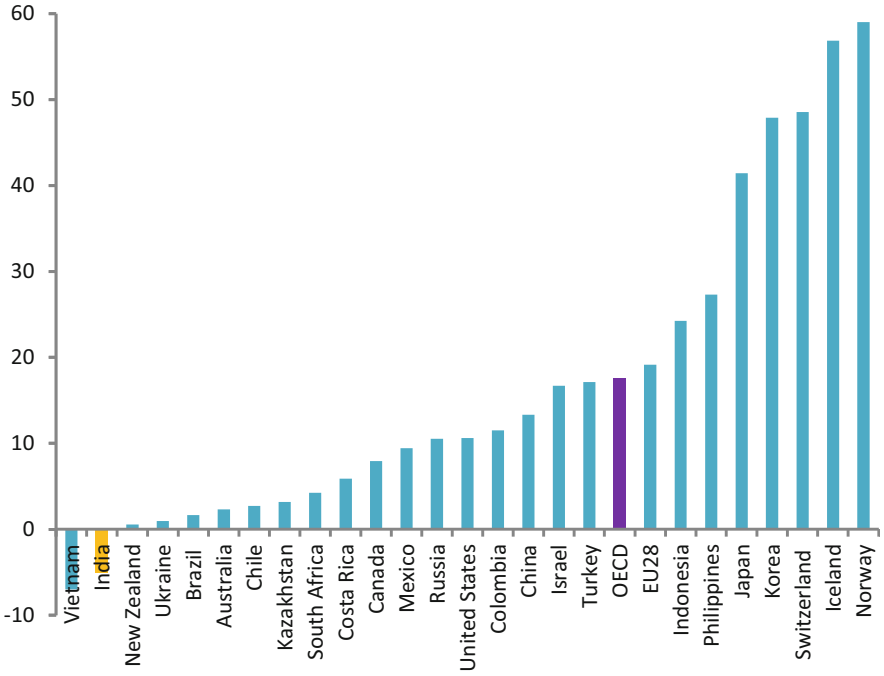

Fig. 3 Producer Support Estimate, 2017–19 (as a percentage of gross farm receipts). (Source: Author's compilation from the OECD database, 2021)

these marketing reforms and want assured procurement of all 23 commodities to be bought under the ambit of the MSP program. In the wake of this opposition, these three farm laws have now been withdrawn.

Nevertheless, emergence of digital marketing platforms such as electronic unified agricultural markets (e-NAM), negotiable warehousing and commodity futures, as well as recent government initiatives like the Agriculture Infrastructure Fund (AIF), *Atmanirbhar Bharat* (self-reliant India), and Farmers Producer Organisations (FPOs), are steps in the right direction, but are not free from implementation gaps, which need to be filled with timely incentives, investments and monitoring.

Other policy interventions to bring about efficiency in agri-marketing, lower transaction costs and reduce food losses include freeing up agricultural markets to greater competition, giving farmers the freedom to sell what they want, where they want, when they want, without any restrictions on sale, stocking, movement, or the export of farm produce, and providing an enabling ecosystem in which private enterprises can invest freely in agriculture value chain development, as it will gradually boost investment in building efficient and sustainable supply chains while ensuring a better share for farmers of consumers' rupees. For future food and nutritional security, linking farmers to markets will be a critical need.

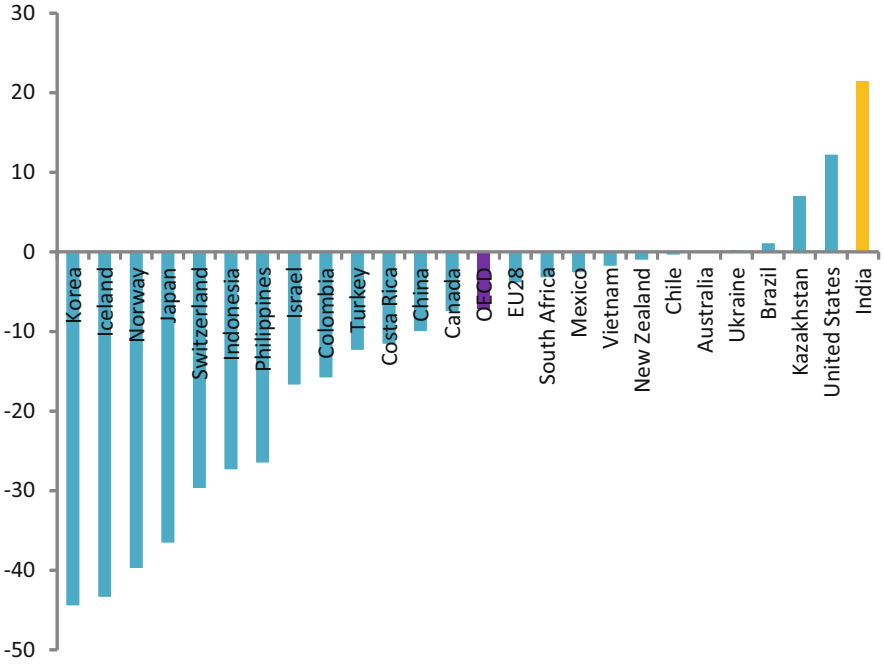

Fig. 4 Consumer Support Estimate, 2017–19 (as a percentage of consumption expenditure at the farm gate. (Source: Author's compilation from the OECD database, 2021)

Private companies like ITC are in the forefront of building such efficient value chains. For example, ITC's e-choupal sources over three million tonnes of agri-products from 225 districts in 22 States of India. Its competitive and inclusive agri-value chains, anchored by ITC's world-class FMCG brands, provide consumers with high quality products while generating substantial livelihoods. ITC's fork-to-farm value chains enable the company to manufacture world-class food brands by sourcing differentiated, value-added, identity-preserved, traceable raw materials, and simultaneously empowering farmers with best practices and technology, resulting in enhanced farmer incomes. The multi-stakeholder partnerships that build end-to-end demand-responsive value chains lead to efficiencies and the enlarging of value for farmers.

Marketing reforms also need promotion and finance for the creation of assaying, sorting and grading infrastructures at the *mandis*. This will reduce variance in the quality of produce from *mandi* to *mandi* and encourage retailers and processors to procure through e-NAM (Gulati et al. 2019). Digitalisation of value chains, bringing the physical characteristics to digital platforms, will open up further opportunities for efficient marketing channels with low market risks, benefitting both farmers and consumers. Entrepreneurship for low-cost, rural-based value chains involving youths is now being emphasised.

With solar energy costs coming down drastically, investment in solar-powered cold storage will reduce the costs, as well as losses, of agricultural produce, particularly perishables, and improve storage quality. In the case of onions, losses have been 30–35% in the absence of proper cold storage structures; further, promoting contract farming and other forms of Public Private Partnerships to drive local innovations in the supply chain will also help reduce market risk for farmers and improve their price realisation. Investing in food processing and value addition, as well as linking processing with organised retailing, will go a long way towards building efficient value chains from farm to fork. As the processing industry adds value and absorbs surpluses at the time of harvest, it is believed that, on average, about one-fourth of produce must be processed at this stage of development, as is the case in several south-east Asian economies. But India is way behind on this graph, with less than 10% of agri-produce being processed.

Finally, it should be emphasised that only by developing the forward and backward linkages can the government ease large price fluctuations, ensure a remunerative price for farmers, and provide lower prices for consumers: a win-win situation for all. The current set of Farm Laws had sought to achieve precisely this, but now have been withdrawn due to opposition from some farmers groups (most notably from Punjab, Haryana and western UP) and from opposition parties in the Parliament.

2.4 Making Food More Nutritious and Safer for Consumers While Ensuring Remunerative Prices for Farmers

India's agriculture food system is backed by a unique National Food Security Act (NFSA, 2013) that ensures the availability and affordability of a sufficient supply of food for its population. India's Public Distribution System (PDS), which is the world's largest, covering more than 800 million people, is an important channel through which the government provisions food to the identified poor under various welfare programmes. Social welfare schemes aimed at improving nutrition also focus on ensuring calorie sufficiency, neglecting the quality and diversity of diets and behavioural change towards better nutrition. On behalf of the government, the Food Corporation of India (FCI) procures and stocks food grains from the state agencies to maintain food security and price stability. There is little doubt that ample food availability has been ensured for the country, but its economic access to nutritious diets remains a challenge, as indicated by the high rates of stunting amongst children. The head count ratio of people under extreme poverty measured as a per day per capita income of USD1.9 (at PPP of 2011–12 prices) has declined from 45.9% in 1993 to 38.2% in 2004, and to 13.4% in 2015 (World Development Indicators 2019). A recent Policy Research Working Paper no. 9994 (April 2022) from the World Bank by Sutirtha Sinha Roy and Roy van der Weide, gives the head count ratio of extreme poverty at 10.2 percent in 2019. The World Poverty Clock

estimates that India's poverty ratio in 2021, even after accounting for the impact of Covid-19, would be about 6% (World Poverty Clock 2021).

Given the gradual decline in extreme poverty, there is a need to re-visit the NFSA, which covers 67% of population and basically distributes rice and wheat. The FCI operations for the procurement, stocking and distribution of wheat and rice to identified beneficiaries are expensive and riddled with inefficiencies, as they add almost 40% on top of the MSP to farmers. The market prices of rice and wheat often remain way below the economic cost of FCI, especially in rural areas where poverty is concentrated. The overall cost of the food subsidy was INR 4.22 lakh crore (USD 57 billion) in 2020–21, and is provisioned to be INR 2.42 lakh crore (USD 37 billion) in 2021–22. This is huge in relation to the total tax revenue of the Union Government. This calls for a re-examination of the extent of coverage and suggests reducing it from 67% of the population to ~30%, as was suggested by the Economic Survey of 2019–20 (Government of India 2021b), as well as recommending an option of direct cash transfers to identified beneficiaries equivalent to MSP plus 25%. This will lead to demand for more nutritious and diversified food in line with changing consumption patterns.

Notwithstanding the foodgrain surpluses and the world's largest PDS distribution system, India faces a complex challenge around nutritional security. According to the National Family Health Survey (NHFS-4) 2015–16, 35.8% of children below 5 years of age are underweight, 38.4 are stunted and 21% are wasted (International Institute for Population Sciences 2017). Therefore, there is a need to assign the highest priority to addressing all forms of malnutrition.

To augment production of more nutritious food, a wide range of interventions can be undertaken, such as:

- Intervene in food systems in order to help push India's nutritional security status to higher levels. It is often assumed that, as a country's food production goes up, its nutrition levels also go up, as seems to be the case in most of the countries in the world, but this is not true for India. Over the last five decades, total production of foodgrains in India has increased *by* six-fold: from 51 million tonnes in 1950–51 to about 296.67 million tonnes in 2019–20 (estimated 303 million tonnes in 2020–21). However, India still faces relatively high levels of malnutrition.
- Leverage agricultural policies and programmes to be more "nutrition-sensitive" and reinforce diet diversification towards a nutrient-rich diet. The government has already renamed the National Food Security Mission as the National Food and Nutritional Security Mission from the year 2021–22 onwards, so as to put emphasis on nutrition aspects along with food security. One way is to work with schools in promoting sustainable kitchen gardens to grow vegetables and use them to provide nutritious midday meals to school students. The use of soybean as a food and a good source of protein is another option (TAAS 2014; Paroda and Joshi 2017).
- Bio-fortify basic staples, as a very cost-effective technological innovation for improving the diets of households and the nutritional status of children. The

HarvestPlus programme of the Consultative Group on International Agricultural Research (CGIAR) is already working towards this in many countries around the world. In India, too, the HarvestPlus programme is working in collaboration with the Indian Council of Agricultural Research (ICAR) to grow new varieties of nutrient-rich staple food crops, such as iron and zinc bio-fortified pearl millet, zinc bio-fortified rice and wheat, and iron bio-fortified beans (HarvestPlus 2020). The Extension Division of ICAR has also launched two special programmes viz. Nutri-sensitive Agricultural Resources and Innovations (NARI) and Value Addition and Technology Incubation Centres in Agriculture (VATICA) for up-scaling the bio-fortified varieties through its Krishi Vigyan Kendras (KVKs).

- Contribute towards the holistic nourishment of children and a malnutrition-free India by 2030 through initiatives such as the Prime Minister's recent "POSHAN Maah," which is a step in the right direction. The PM has also announced an effort to scale up production of 17 bio-fortified varieties of eight crops and some nutri-cereals (water-saving crops) that can be further integrated with government support initiatives, like midday meals for elementary school children, to reach millions of vulnerable population groups. The Government of Bihar has also come forward and announced that it will establish a 'Nutritional Village,' where farming families will cultivate bio-fortified crops. These policy interventions need to be scaled up across the country and emphasis shall now be on local food systems for enhanced food and nutritional security while ensuring the "One Health" concept.
- Improve the nutritional status of the population, particularly for pre-school children and women of reproductive age. A game-changer policy intervention in this direction could be devoting a part of the food subsidy from wheat and rice to nutritious food crops. Even the private sector, NGOs, and civil society partners can be incentivised towards a mission mode that develops and markets bio-fortified foods.
- Have the Government address other determinants of malnutrition on a war footing, such as the enabling of women's education through liberal scholarships, separate sanitation facilities for girls in schools, and safe drinking water and nutritious food for all at affordable prices. *Swachh Bharat Abhiyan* (Clean India Mission) is a commendable step towards eliminating open defecation and bringing about behavioural changes in hygiene and sanitation practices.

Thus, this chapter overall argues that fundamental reforms in the agri-food system are the need of the hour, if we are to increase production to feed the growing Indian population, lower transaction costs to achieve marketing efficiency and provide safe, nutritious and affordable food to consumers in an effort to build a healthy India in ways that increase farmers' income and are more fiscally and environmentally sustainable.

In the final analysis, it is like a symphony orchestra in which our farmers, industry and society are all playing their instruments in perfect synchrony. And success is defined by winning the battle of producing a sufficient amount with efficiency and sustainability, and with an aim towards delivering wellbeing for both the people and the planet by 2050!

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