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FOOD SYSTEM IN INDIA CHALLENGES, PERFORMANCE AND PROMISE

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SUMMARY

India's transformation of its food system from a highly deficit one in mid 1960s to self-reliant and marginally surplus now is a story of success and holds lessons for many small holder economies of Africa and south and south-east Asia. Having lived a situation of 'ship to mouth', India has emerged as the largest producer of milk, spices, cotton, and pulses; second largest producer of wheat, rice, fruits and vegetables; third largest producer of eggs; and the fifth largest producer of poultry meat. It is also largest exporter of rice, spices, and bovine meat. All this became possible with infusion of new technologies, innovative institutional engineering, and right incentives.

However, as India looks towards 2030 and beyond, its food system faces many challenges ranging from increasing pressure on natural resources (soils, water, air, forests) to climate change to fragmenting land holdings, increasing urbanisation, and high rates of malnutrition amongst children. Meeting these challenges successfully, India needs a right mix of policies—from subsidy driven to investment driven, and from price policy to income policy approach, promoting agricultural diversification towards more nutritious

food. It also needs to incentivise its private sector to build efficient and inclusive value chains, giving due importance to environmental sustainability. More innovative technologies from green to gene, increasing digitalization, Internet of Things, Artificial Intelligence, would be needed to 'produce more from less' with a goal to feed the most populous nation on this planet by 2030 in a sustainable manner.

1. INTRODUCTION

Looking into the future towards 2030 and beyond, the challenge to feed 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 per cent 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 would require a continuous supply of safe and healthy food from hinterlands. This challenge is further compounded by limited availability and 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).

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 need to examine the interactions between 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 per cent of holdings are less than 2 hectares (ha) that account for 47.3 per cent 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 ensures good nutrition, and is environmentally sustainable and globally competitive? Achieving all 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 many challenges and one needs to continuously innovate with new technologies, institutions, and policies for better outcomes. This paper attempts to do precisely this: it dwells 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 chain, from farm to fork?
- (iii) Is India producing sufficient nutritious and safe food for consumers?

We hope that the evidence based research cited in this paper will help policymakers take more pragmatic decisions that help to achieve above goals. Let us address each one of these in some detail, see the challenges and its performance in the recent past, and what promise it holds for 2030 and beyond.

2. INDIA'S FOOD SYSTEM

Producing sufficient food efficiently with environmental sustainability

India is largely a rural economy with 66 per cent of the country's population living in rural areas (World Development Indicator, 2019) and agriculture being the mainstay of this section of population. The sector employs the largest share of India's working population – about 42 per cent (National Statistical Office, 2020) and contributes 16.5 per cent 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 per cent (about 140 mha) is actually cultivated which has remained static for over decades reflecting thereby 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 sector) and an enabling policy ecosystem. India needs to invest at least one per cent of its agri-GDP in agricultural research and extension as against current level of 0.39 per cent (NIAP, 2017). In fact, India's agri-food policy of late has been highly skewed towards subsidies instead of investments (Gulati, Ferroni, & Zhou, 2018). In FY 2020-21, India's expenditure on agri-R&D was a meagre INR 7,762 crore (about USD 1.1 billion) (Government of India, 2021a). This is not even half of what a private global company like Bayer spends on agri-R&D – about 2.3 billion Euros (almost INR 20,000 crore/year). Thus, there lies a huge scope of achieving higher growth momentum as the marginal returns from expenditures on agricultural research are almost 5 to 10 times higher than through subsidies (Fan, Gulati, & Thorat, 2007). If agricultural growth has to provide food security at a national level, then the expenditure on agri-R&D needs to be at least double 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 case of staples (wheat and rice), milk, poultry, fish, and lately cotton. Lessons from the past will certainly help in defining clear roadmap towards 2030 and beyond.

Learnings from the past

Who could imagine that India, after the Bengal Famine of 1943 that claimed around 3.0 million deaths not due to 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

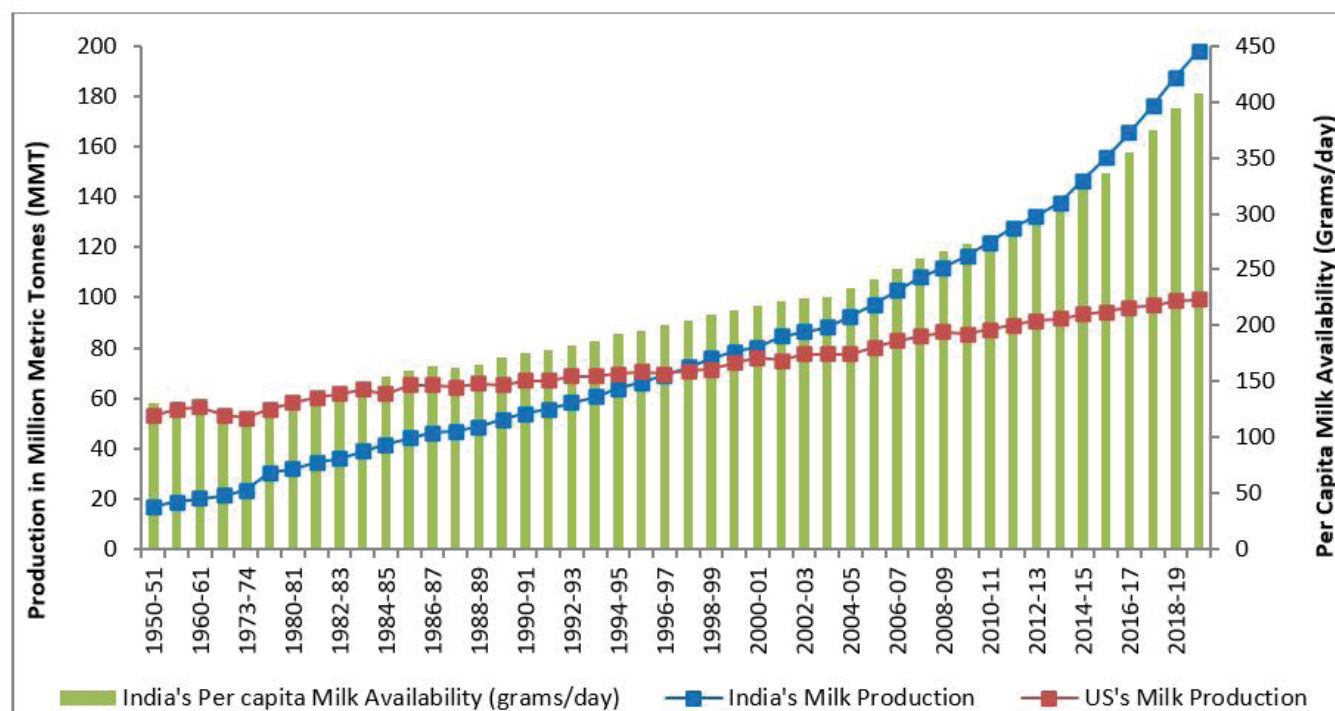
to be the largest exporter of rice? It also had food grain stocks of 97 million metric tonnes (MMT) in June 2020, almost 2.5 times the buffer stock norms of the country. All this happened through infusion of new technology (high yielding, dwarf, photo-insensitive and responsive to high inputs wheat and rice varieties) in partnership with CIMMYT and IRRI during the mid-1960s, and 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) and (ICAR, 2017). Along with new technology (HYV seeds), irrigation, fertilizers, and positive price policy played critical roles in ushering the green revolution in India. This is a lesson for many developing countries of Africa and Asia that have small holdings and are still aiming to have a green revolution.

Along with green revolution, the country witnessed significant transformation in the dairy sector during 1970s through the mid-1990s. Verghese Kurien spearheaded 'Operation Flood', transformed the system of milk collection from smallholders under a co-operative structure, homogenising, pasteurising, and distributing it to mega cities as far as 1,800 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 (Figure 1), leaving the United States of America (99 MMT) and China (45 MMT) way behind. And all this was achieved through small holders with 3-4 cows or buffaloes. 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 estimated 428 grams/day in 2020-21. However, India's productivity of milch animals is still far below (indigenous cows 2.8 litres, crossbreds 7.5 litres, and buffaloes 5.2 litres per day) the global standards of 20 litres plus/day. Improving milk productivity through genetic improvement and better fodder and feed availability are the ways forward! This is another major lesson to smallholder dominated agricultural economies as to what smallholders can do with 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 using germplasm of foreign strain that led 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 of 9.2 per cent

Figure 1: Milk Production in India and U.S. and per capita availability in India from 1950-51 to 2019-20



Source: FAOSTAT, 2019 and DoAHD&F, 2019

between 2000/01 and 2018/19 and emerged as the third largest producer of eggs (103.3 billion) and 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), surpassing China (in 2014/15) to become the largest cotton-producer in the world. The effect of fertilizers, Bt technology and insecticides contributed to 60, 23 and 17 percent of cotton yield, respectively in India (Paroda & Joshi, 2017). The benefit of Bt technology in 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 and to a food surplus one. All these revolutions in agricultural production were triggered due to scaling of innovations, supported well by 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 on agri-trade account 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 agri-trade front was down to about USD 16 billion. Overall, agricultural trade (exports plus imports) as a percentage of agricultural GDP showed an increase from 4.7 per cent in 1990/91 to 20.9 per cent in 2012/13, and thereafter, it slipped from this peak to 15.1 per cent in 2018/19.

Using lessons of the past to create opportunities for future

The lessons from the past always hold promise for what can be done in the future. High yielding varieties (HYVs) and hybrid seed technologies, along with accelerated breeding programs and vibrant R&D efforts by both Indian and global research institutions and companies 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 systems focusing on end-to-end solutions from agri-inputs to agronomic advisory to market linkages and an easy access to finance, credit etc. Just 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' is 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) and (Paroda & 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, 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 precise location (GPS) besides recording the data, which was useful for forecasting, forewarning and taking control measures. Private sector global company, Bayer, is also investing in digital farming solutions such as predictive modelling for effective disease and pest management. The company is also 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) (Niiti, 2019). Similarly, ITC Limited has expanded its extensive e-Choupal network that works with 4 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. Government is targeting to increase 4 times the area (~2,00,000 ha) under protected cultivation in the next 4-5 years, another option for vertical farming and enhanced income to attract youth (including women) in agriculture (Paroda, 2018b) and (Paroda, 2019).

Increasing pressure on 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, but it has come at the cost of environmental degradation, especially water and

land, in some states of India. Government is realising that longstanding policies of subsidies for agriculture inputs (power and fertilizers, e.g.) and price support (MSP) with open ended procurement of rice and wheat are inflicting significant damage on the environment. For instance, fertilizer subsidy (nitrogenous fertilizers are subsidized by almost 75 percent of the cost) has resulted in massive overuse of nitrogenous fertilizers, leading to imbalanced use of nutrient and decline in soil fertility as well as pollution of local water bodies. Moreover, widespread deficiency of secondary and micro nutrients such as sulphur, zinc, iron and manganese has affected soil productivity adversely (Government of India, 2016). On the other hand, power subsidy has resulted in 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 addressed on priority through right policies and corrective measures jointly by the central and state governments.

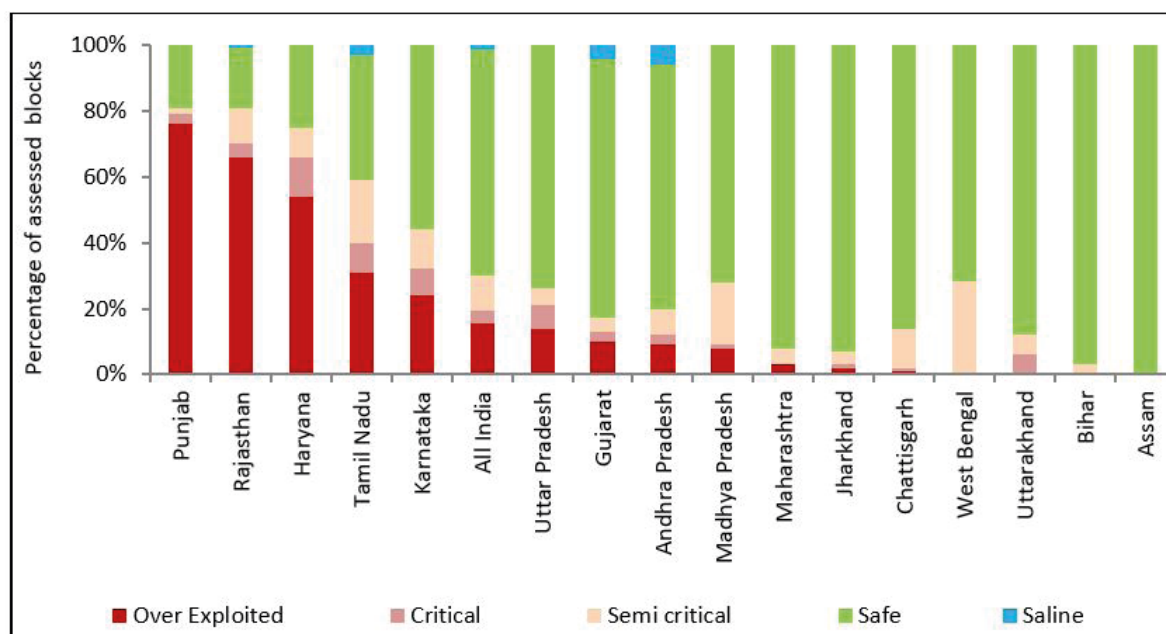
Figure 2 presents an assessment of groundwater table in 6,584 units (blocks), across states in India by the Central Ground Water Board (CGWB) in 2017. It revealed that overall, 1,034 units are ‘over-exploited’, 253 are ‘critical’ and 681 are ‘semi-critical’ (CGWB, 2017). The over-exploited areas are 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 undesirable consequences of agricultural intensification, climate change is another daunting challenge for achieving overall food-feed-fibre security. As per the predictions of IPCC, India will face greater frequency and intensity of—droughts in 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 degrees Celsius, the losses will increase rapidly (IPCC, 2018).

Several efforts are on to address the issue of sustainable and climate resilient agriculture. 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 focused ‘climate smart villages’ initiative to more than 600 villages that have increased yields by about 15 per cent, incomes by about 30 per cent and cut down greenhouse gas (GHG) emissions by more than 30 percent (SustainCERT, 2020). It is being argued that to protect India’s agri-resource endowment, there is a need to switch from highly subsidized input price policy (power, water, fertilizers), and MSP/FRP policy for paddy, wheat, and sugarcane, to more direct income support policies linked

Figure 2: Figure 2: Status of groundwater level in India, 2017



Source: CGWB (2017)

to saving of soil, water, nutrients and improvement in air quality. Such shifts will reduce inefficient use of fertilizers, 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 issue 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 (World Bank, 2012).

As far as the challenge of climate change is concerned, government is laying greater emphasis on adaptation through 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 also develops and demonstrates climate resilient technologies under “National Innovations on Climate Resilient Agriculture (NICRA)” It is also increasing area under micro-irrigation technologies for water saving, promoting innovative rice cultivation and irrigation practices like ‘Alternate Wetting Drying (AWD)’ and ‘Direct Seeded Rice (DSR)’, which can save about 25-30 per cent of water requirements in rice cultivation. Greater emphasis on laser levelling is also helping in water use efficiency up to 30 per cent. Shifting from cereal-cereal to cereal-legume cropping system will result in sustainable intensification.

Another example of climate resilient seeds is 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.

Soil Health Card Scheme of the government targets every farmer to have balanced use of nutrients (N, P and K) on soil test basis. Government is also encouraging cultivation of nitrogen-efficient crops such as pulses (legumes) which fix nitrogen in the soil and boost crop productivity through Biological Nitrification Fixation (BNF); 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.

Scaling of innovations that help reduce inefficient use of scarce natural resources (water and soil), and hopefully make the food system more efficient, sustainable and climate resilient.

Marketing food with low intermediation costs and low food losses

Value chain development and marketing platforms that link farms to agricultural output markets play critical role in determining prices and incentives for the farmers. However, agri-marketing structure in India continues to be fragmented with a large number of intermediaries leading to high transaction costs (between 30 to 50 per cent of the retail consumer price). These costs exacerbate with high commissions of commission agents, high *mandi* (market) charges and cess in certain states (like Punjab), low investments in supply chains, poor logistics, information asymmetries and lack of sufficient storage infrastructure. As a result, high intermediation costs for many agri-commodities blunt their global competitiveness. These investments in supply chains lack due to restrictive marketing and trading policies, such as Essential Commodities Act of 1955, which were designed during scarcity era. Similarly, indiscriminate export controls 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 per cent of the value of farm receipts between 2000-01 to 2019-20, while Consumer Support Estimate (CSE) was one of the highest in the world (28.8 per cent) (OECD, 2021). Figure 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 per cent vis-à-vis 13 per cent for China and 17 per cent for OECD as a group. On the contrary, CSE for India is highest at 21 per cent. Thus, the typical consumer bias in India’s marketing and trade policies still continues. Correcting this bias still remains a tall challenge.

Figure 3: Producer Support Estimate, 2017-19
(as percentage of gross farm receipts)

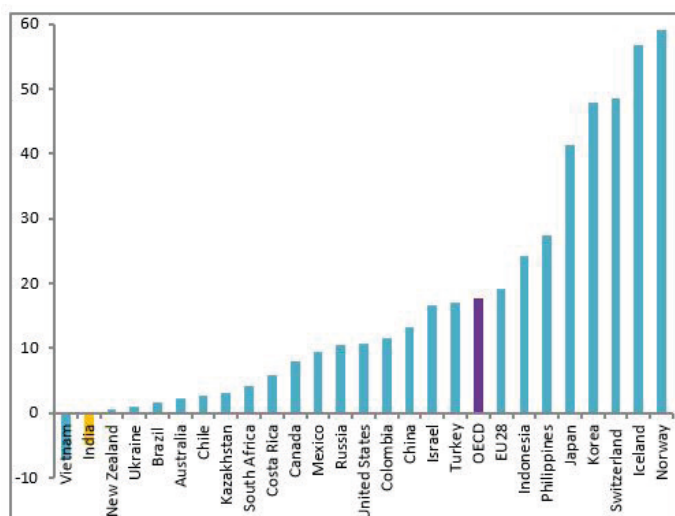
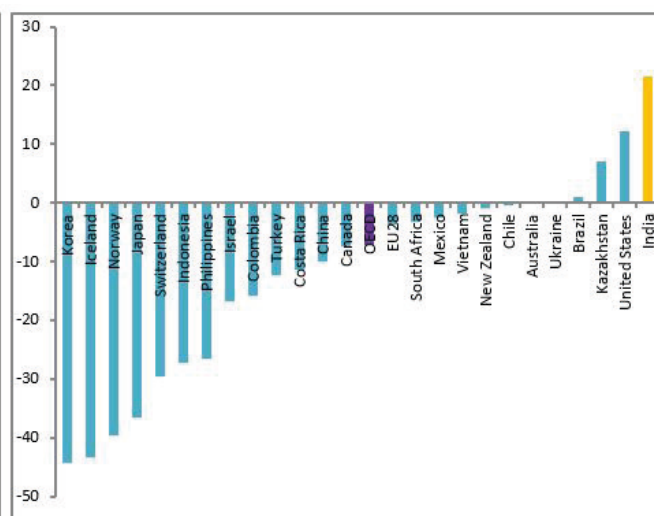


Figure 4: Consumer Support Estimate, 2017-19
(as percentage of consumption expenditure at the farm gate)



Source: Author's compilation from the OECD database, 2021

Government's efforts to reform agri-marketing system (through recently passed Farmers Produce Trade and Commerce (Promotion and facilitation) Act, 2020, Farmers Empowerment and Protection Agreement on Price Assurance and Farm Services Act, 2020, and amendment of Essential Commodities Act has run into rough weather as some farmer leaders, particularly from the Punjab, Haryana and western Uttar Pradesh belt, are opposing these marketing reforms and want assured procurement of all 23 commodities to be bought under the ambit of MSP program.

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 Agriculture Infrastructure Fund (AIF), *Atmanirbhar Bharat* (self-reliant India), Farmers Producer Organisations (FPOs) are the steps in the right direction but are not free from implementation gaps, which needs to be plugged in with timely incentives, investments and monitoring.

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

Private companies like ITC are in the forefront of building such efficient value chains. For example, ITC's e-choupal sources over 3 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 to build end-to-end demand-responsive value chains lead to efficiencies and enlarging of value for farmers.

Marketing reforms also need promotion and finance for creation of assaying, sorting, and grading infrastructure 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, Kapur, & Bouton, 2019). Digitalization 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 the farmers as well as consumers. Entrepreneurship for low cost rural based value chain involving youth is now being emphasised.

With solar energy costs coming down drastically, investment in solar powered cold storages will reduce the costs as well as losses of agricultural produce, particularly perishables and improve storage quality. In case of onions, losses have been 30-35 per cent in the absence of proper cold storage structures further, promoting

contract farming and other forms of Public Private Partnerships to drive local innovations in supply chain will also help reduce market risk for farmers and improve their price realisation. Investing in food processing and value addition and also linking processing with organized retailing will go a long way to build efficient value chains from farm to fork. As processing industry adds value and absorbs surpluses at the time of harvest, it is believed that, on an average, about one-fourth of the produce must be processed at this stage of development, as is the case with several south-east Asian economies. But India is way behind on this graph with less than 10 per cent of agri-produce being processed.

Finally, it should be emphasized that only by developing the forward and backward linkages, the government can ease large price fluctuations, ensure remunerative price to farmers and, ensure lower prices for consumers: a win-win situation for all. The current set of Farm Laws sought to achieve precisely this, but some recent ones are stuck for lack of understanding by farmers and for political reasons.

Making food more nutritious and safer for consumers while ensuring remunerative prices to farmers

India's agriculture food system is backed by a unique National Food Security Act (NFSA, 2013) for ensuring availability and affordability of enough 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 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 for maintaining food security and price stability. There is little doubt that ample food availability in the country has been ensured, but its economic access to nutritious diets remains a challenge, as is indicated by high rates of stunting amongst children. The head count ratio of people under extreme poverty measured as per day per capita income of USD1.9 (at PPP of 2011-12 prices), has declined from 45.9 per cent in 1993 to 38.2 per cent in 2004 and to 13.4 per cent in 2015 (World Development Indicators, 2019). The World Poverty Clock estimates that India's poverty ratio in 2021, even after accounting for Covid-19 impact, would be about 6 per cent (World Poverty Clock, 2021).

Given the gradual decline in extreme poverty, there is need to re-visit the NFSA which covers 67 per cent of population, and distributes basically rice and wheat. The FCI operations of procurement of wheat and rice, stocking and distributing it to identified beneficiaries,

are expensive and riddled with several inefficiencies as they add almost 40 per cent 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. Overall cost of 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-look at the extent of coverage and reducing it from 67 per cent population to ~ 30 per cent as was suggested by Economic Survey of 2019-20 (Government of India, 2021b), and one should rather give an option of direct cash transfers to identified beneficiaries equivalent to MSP plus 25 per cent. 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 of nutritional security. According to the National Family Health Survey (NHFS-4) 2015-16, 35.8 per cent of children below 5 years of age are underweight, 38.4 are stunted and 21 per cent are wasted (International Institute for Population Sciences, 2017). Therefore, the need is to assign the highest priority to address all forms of malnutrition.

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

- Interventions in food systems can help push-up India's nutritional security status to higher levels. It is often assumed that as country's food production goes up, its nutrition levels also go up 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). But, 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. Government has already renamed the National Food Security Mission as the National Food and Nutritional Security Mission from the year 2021-22 onwards to lay emphasis on nutrition aspects along with food security. One way is to work with schools to promote sustainable kitchen gardens to grow vegetables and use it for providing nutritious midday meals to school students. Use of soybean as food and good source of protein is another option (TAAS, 2014) and (Paroda & Joshi, 2017).

- Bio-fortification of basic staples is a very cost-effective technological innovation for improving the diet 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 Harvest-Plus 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; iron bio-fortified beans in India (HarvestPlus, 2020). 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).
- Prime Minister's recent initiative of "POSHAN Maah" to contribute towards the holistic nourishment of children and a malnutrition free India by 2030 is a step in the right direction. PM has also announced 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 to 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 "One Health" concept.
- Further, there is a need to 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 private sector, NGOs, and civil society partners can be incentivised in a mission mode to develop and market bio-fortified foods.
- Besides this, the Government also needs to address other determinants of malnutrition on par with such as women education through liberal scholarships, separate sanitation facilities for girls in schools, and safe drinking water and nutritious food to 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 paper overall argues that fundamental reforms in agri-food system is the need of the hour, if we have 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 to build healthy India in ways that increase farmers' income and are fiscally and environmentally more sustainable.

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

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