



## Agriculture in India – A Retrospect and Future Prospects

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There are many lessons to be learnt from India's past successes in ensuring food security. The role of improved technology, patterns of production, and public procurement and distribution system have been crucial towards achieving food security. Nutritional security is now the next frontier that we need to conquer.

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**I**ndia has come a long way from once being a food deficit nation to a food surplus one. In the years since Independence, food shortages and deficits were common. Productivity was a problem that India was grappling with. With most of the cropped area rainfed, the monsoon was a crucial determinant of production and hence, the hunger levels of the country. Fertiliser application was miniscule. The lack of assured irrigation and unavailability of fertilisers and pesticides held back India's productivity.

Technology was the way out for India to achieve food security. New varieties of wheat and rice, investments in irrigation, increasing availability of fertilisers and pesticides resulted in a huge increase in productivity and availability of foodgrains. However, today, India stands at

cross-roads once again. Whilst India has achieved food security, nutritional security remains elusive. Environmental considerations have come to the fore; requiring urgent interventions to ensure the hard fought gains in achieving food security are not diminished.

### The Turning of the Tide: Achieving Food Security

India has even witnessed famines in 1964-65 and 1965-66. One of India's greatest achievements since Independence has been the non-existence of large scale famines. However, it was only until the 1960s where India made significant efforts to combat food shortages. Research was already underway in the 1950s and 60s on the development of high yielding varieties (HYVs), the application of fertilisers and pesticides. However, these initiatives

were yet to achieve scale, till the mid-1960s, when the Green Revolution was well and truly underway in the country.

The results were there for all to see. In 1951, the yields of wheat stood at 663 kg/ha, and that of rice at 668 kg/ha. Wheat yields saw a marginal improvement to 730 kg/ha by 1964. By 1972, the yields had improved to 1,380 kg/ha in the case of wheat and 1,141 kg/ha in the case of rice. In 2019, the yields of rice had further increased to 2,659 kg/ha and that of wheat to 3,507 kg/ha. Owing to this rise in productivity, per-capita net availability of foodgrains has seen a significant improvement. In 1951, the availability stood at 394.9 grams/day. By 2020, this number has increased to 512.6 grams/day. This is an impressive achievement, given that our population has nearly quadrupled since Independence. Provision of formal credit played an important role in enabling an increase in productivity. The availability of credit allowed farmers to procure the necessary inputs to enhance their productivity.

A similar achievement was made in the production of milk, through Operation Flood, launched in 1970 through the National Dairy Development Board (NDDB). Milk production, which stood at 17 million tonnes in 1951, increased marginally to 21.2 million tonnes by 1969. With the launch of Operation Flood, milk production grew at an increasing pace. By 1980, milk production expanded to 30.4 million tonnes. By 1997, India was the largest producer of milk in the world. In 2019, India recorded production of 187.7 million tonnes, maintaining its record of being the largest producer in the world. Together with the Green Revolution, we also saw a White Revolution in India at the same time.

The availability of advanced technologies was not just the only intervention from a policy perspective. Major initiatives were taken in the domain of agriculture marketing and public procurement and distribution. More regulated markets were needed where farmers could bring their produce to be sold through a transparent price discovery mechanism. Being a state subject, state governments enacted Agriculture Produce Market Regulations (APMR) Acts during the 60s and 70s. The legal framework through these regulations meant that agriculture produce could only be

bought by licensed and registered traders in these markets. These regulations also meant that anyone who was not a licensed and registered trader could not procure from farmers and all transactions would take place in the designated market yards. The objective behind these regulations was to ensure that agriculture trade was carried out in a transparent, unhindered, and fair manner, with adequate remuneration to farmers as the key outcome of these regulations.

At the same time, an extensive public procurement and distribution system was setup. The Food Corporation of India (FCI) was setup in 1965, to undertake price support operations, to distribute foodgrains under the public distribution system (PDS) and to maintain buffer stocks of foodgrains. Minimum support prices (MSPs) were determined through the Agriculture Prices Commission, which was then renamed as the Commission on Agriculture Costs and Prices (CACPC) in the 1980s. Procurement of key foodgrains took place at MSPs to be distributed in the PDS. The procurement at MSP of these crops further incentivised their cultivation, further increasing the availability of foodgrains in the country. Whilst the PDS system has undergone several changes since then, the goal remains the same, to ensure the distribution of food and non-food items at subsidised rates to India's poor. The net was significantly expanded with the National Food Security Act, 2013. In terms of milk production, the cooperative model worked wonders. The model evolved and perfected in Anand, Gujarat, was replicated in many parts of the country.

### The Need for a New System

As we moved towards achieving food security, there have emerged several issues that are detrimental to the long-term growth of India's agriculture sector. The first major constraint emerged in that of agriculture marketing. Over time, the system designed to protect farmers, was doing the opposite. The number of markets failed to grow, and the fragmentation present in the system created inefficiencies in the movement and trade of agricultural commodities. Whilst the markets were expected to be avenues for transparent price discovery, the opposite started to occur. Due to the requirement of only licensed traders being able to procure from these markets,

the traders with licenses often blocked the entry of new entrants, and acted in a collusive manner, fixing prices, rather than engaging in open auctions, as envisaged. The role of commission agents also started to gain prominence. With markets often far away from villages, commission agents acted as a conduit between farmers and traders. Intermediation costs, owing from fragmentation and presence of intermediaries, occupied a larger and larger chunk of final retail prices, with the share of farmers getting smaller. There was also a lack of investments across the value chain, especially private investment. Post-harvest losses were then estimated to cost the nation Rs. 90,000 crores annually. Linkages to food-processing and export markets remained weak as well. The reforms introduced by the government in the form of the three farm bills were aimed at addressing these inherent inefficiencies in agriculture marketing. At the same time, state governments have also been amending their own APMC Acts towards a more liberal trading environment. To further support infrastructure creation in agriculture, a Rs. 1 lakh crore Agriculture Infrastructure Fund (AIF) has also been created, in which existing APMC market yards are also eligible.

The second constraint or shortcoming has emerged in the area of sustainability. It is no secret that the threat of climate change is upon us, and that crop yields are likely to be impacted. Mitigation and adaption strategies are the need of the hour. Inefficient and unsustainable practices in production have led to many environmental issues. Flood irrigation, lop-sided fertiliser usage, and excessive fertiliser use are just some examples. Agriculture also contributes to air pollution, not just through the emission of greenhouse gases, but also through stubble burning, for instance. Degrading soil health is perhaps the biggest challenge to sustaining our production levels. Soil organic carbon (SOC), cited as an important indicator of soil health, has seen a decline across India. Data available from the Soil Health Card

(SHC) scheme showed that at the time of the launch of the scheme, an average of 9 percent of all samples tested 'very low' for SOC during Cycle I (2015-17) and an average of 33 percent of samples tested 'low' for SOC. This implies that a little less than half of all the samples tested under the first phase of the SHC saw low or very low levels of SOC. Cycle II (2017-19) saw some improvements. From 9 percent, the proportion of samples testing 'very low' for SOC fell to 7.8 percent, whilst the proportion of samples testing 'low' declined to 31.6 percent, a marginal improvement. The link between imbalance in fertiliser use and declining soil health has been examined by many scholars at the National Academy of Agriculture Sciences (NAAS). It has been noted that imbalance in the use of fertilisers has been a contributor to declining soil health. The consumption of nitrogenous fertilisers, over others has been the primary cause. For instance, against a prescribed N:P:K ratio of 4:1.6:1 in Punjab, the actual usage was 33.9:7.9:1, reflecting the imbalance. A similar case arised

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## The New Farm Laws Helping Farmers Get the Right Price

- The New Farm laws provides an ecosystem where the farmers can enjoy the **freedom of choice relating to sale of farmers' produce**
- Facilitate **direct buying from farmers in the trade area** by traders, processors, exporters, FPOs, etc
- Farm laws provide **additional marketing opportunities outside the APMC market yards** : Farmers are free to sell their produce in APMC as earlier
- More investment in marketing & value addition infrastructure near the farm gate **creating more employment opportunities**

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in Haryana, where against a prescribed ratio of 4.0:1.7:1, the actual usage was 22.6:6.2:1.

Water is another area where urgent action is required. Groundwater levels are depleting in several areas as the pace of extraction is exceeding the pace of recharge. Assessed in 2017, by the Central Groundwater Resources Board, close to 17 percent of all groundwater assessment units were overexploited, meaning that the water levels have been declining. Punjab, Rajasthan, Delhi and Haryana were the states with the highest levels of over-exploitation of groundwater resources. Close to 90 percent of all groundwater extracted annually is for agricultural purposes. Nearly 2/3<sup>rd</sup> of the water used for irrigation comes from groundwater. The conventional flood irrigation used by farmers in India, is inefficient, when compared to micro-irrigation systems. The efficiency of micro-irrigation reduces water use which ranges from 30-60 percent, depending on the method of irrigation employed (drip or sprinkler).

Nutritional security is now the next frontier that we need to conquer, having gotten over the first hurdle of food security. According to the National Family Health Survey 4 (2015-16), 35.7 percent of children under 5 were underweight and 38.4 percent were stunted. The Comprehensive National Nutrition Survey (CNNS) 2016-18 found the prevalence of underweight and stunting to be 33.4 percent and 34.7 percent respectively. Recognising this, the government launched first the Poshan Abhiyaan and Mission Poshan 2.0. As per the Tata Cornell Institute (TCI), agriculture and nutrition outcomes are linked. The first mechanism is through household income effect which in turn improves the access of households to more diverse and nutritious foods, better health and sanitation facilities. The second mechanism is that of access to more diverse foods. Low diet diversity, as per the TCI has been linked to both stunting and obesity. Biofortification is another link.

### **The Need for a New Paradigm**

Three key challenges have been identified that Indian agriculture must tackle in the coming years. The first is that of agriculture marketing. The second is the issue of sustainable intensification. The third is centred around achieving nutritional security. All three goals are inter-linked, and policy must be designed taking these interlinkages into

account. Our success story in wheat and rice leaves us many lessons – some to replicate, some perhaps to refine.

### **The Role of Technology:**

Just as India required technological breakthroughs in the 1960s to achieve cereal security, we now stand at a similar crossroads. Frontier technologies such as artificial intelligence (AI), blockchain, Internet of Things (IoT) amongst others are permeating industries like never before. Agri-Tech, or Ag-Tech, has emerged as one of the most attractive investment destinations for start-ups. A recent report by Bain & Company has highlighted the growing importance of ag-tech in India, with India already the 3<sup>rd</sup> largest ag-tech market. The applications range from enhancing productivity to ensuring traceability and access to credit. Many companies are engaging in developing models to predict yields using satellite data, administrative data and weather data through AI-ML models. Several pilots are underway across the country where blockchain platforms are being developed to provide end-to-end traceability of agriculture produce, a key constraint to growing our export base. Handheld gadgets, along with image recognition powered by AI-ML are being developed to assay and grade produce, another key constraint in marketing. Recognising the potential of the digital transformation of the agriculture sector, the Ministry of Agriculture & Farmers' Welfare has been developing the IDEA platform, a database of 10 crore+ farmers, on which the private sector can build solutions that can be scaled across India. The application of technology may also promote sustainable intensification.

### **Sustainable Intensification:**

Now that India has made significant productivity gains, sustainable production is a trade-off that India can perhaps afford now. With declining soil health and dropping water tables, urgent interventions are necessary to reverse this trend. Shifting the production base of rice and wheat to areas where the benefits of the Green Revolution have not yet reached, for example in East India, is one avenue. However, this is easier said than done, as incentive mechanisms will have to be designed for farmers who are currently growing wheat-rice in water-stressed areas to switch to different crops.

Agro-climatic regional planning (ACRP) is a concept that has started gaining traction again. Aligning cropping systems with agro-climatic systems may boost biodiversity and enhance India's adaptation and mitigation capabilities in combating climate change.

Agroecological farming is another concept that has been brought back into the limelight, given the sustainability concerns with the present system of production. In 2019, the Food & Agriculture Organisation (FAO) constituted a High Level Panel of Experts (HLPE) on Food Security & Nutrition, which called for a large scale transition to agroecological principles. In India, Natural farming is promoted as Bharatiya Prakritik Krishi Paddhati Program (BPKP) under the Centrally Sponsored Scheme- Paramparagat Krishi Vikas Yojana (PKVY). BPKP is aimed at promoting traditional indigenous practices, based on use of on-farm cow dung-urine formulations with application of recycling, mulching, periodic soil aeration and exclusion of all synthetic chemical inputs. Natural farming practices have now been adopted by more than 20 lakh farmers across 9 states. States such as Andhra Pradesh, Himachal Pradesh and Gujarat are leaders in this movement. There is increasing evidence of beneficial results from these practices, both for farmers' welfare and environment protection. NITI Aayog has been taking the lead in promoting natural farming, through a multidimensional approach, involving scientific evaluation, documentation of best practices and case studies, global and national level consultations, and technological interventions for traceability and certification of produce.

#### **Learning from Past Success to Drive Future Success:**

The lessons from our success in the Green Revolution is not just limited to the application of technology and public investments in irrigation infrastructure, for instance. There are also important lessons to be learnt from the success of the public procurement and distribution system, which had a large role in creating demand and incentivising farmers to grow rice-wheat. Assured procurement and minimum support prices (MSPs) creates incentives for farmers to grow more rice-wheat, in alignment with the government policy. The distribution of these grains through the PDS generates further demand, with a knock-on effect on production.

In the context of nutrition security and sustainability, crops such as millets are clear winners. They are more nutritious and require lesser water to grow. However, due to the relative economics, in terms of productivity and prices received in markets, millets lose out to cereals. Whilst MSPs for millets are declared; procurement and distribution under the PDS is miniscule when compared to rice-wheat. Including millets at a large scale in the PDS may have the effect of aligning incentives between government policies and farmer growing decisions. At the same time, efforts in research and development (R&D) need to be directed towards raising productivity of millets relative to cereals.

The success of the cooperative model was demonstrated in the White Revolution. Recognising the potential of farmer collectives, the Central Government is committed to creating 10,000 Farmer Producer Organisations (FPOs). The recently formed Ministry of Cooperation is a further demonstration of the commitment to strengthen farmer collectives. The benefits of bargaining power, both in input markets and output markets are a key strength of farmer collectives. Given that raising our agriculture exports is a target of ours, standard production practices, as per export requirements, are easier to execute through farmer collectives. By making FPOs eligible to borrow under the AIF, shared post-harvest infrastructure can be created, allowing for greater reach to terminal markets and hence lower wastage.

There are many lessons to be learnt from India's past successes in ensuring food security. The role of improved technology, public procurement and distribution were crucial in ensuring consistent supply and demand of cereals. Farmer collectives saw India become the largest producer of milk in the world, with much of the potential still untapped. Now, nutritional security and sustainability are key challenges to be tackled. Public procurement and distribution can play a major role in ensuring consistent demand and supply of nutrient-rich foods. Agro-ecological practices can be scaled up to ensure sustainable intensification. Frontier technologies can be leveraged to increase productivity and ensure traceability and certification of produce, which is key to tapping export markets.

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