Policy Brief No. 8

National Academy of Agricultural Sciences

Covid-19 Pandemic: Impact and New Normal in Agriculture

New Delhi
September 2020

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Printed : 21 September, 2020

Citation : NAAS 2020. *Covid-19 Pandemic: Impact and New Normal in Agriculture, Policy Brief No. 8*, National Academy of Agricultural Sciences, New Delhi, pp 11

Preface

The Covid-19 pandemic has devastated the socio-economic and political fabric of the world. To contain the pandemic, Governments imposed lockdowns throughout the world that disrupted functioning of the economic systems, labour markets, and supply chains. India imposed a lockdown from March 25, 2020 that lasted 68 days affecting the livelihoods of millions of workers. However, agriculture and rural development activities were not affected much by the lockdown compared to other economic activities.

The lockdown did not have any negative impact on agricultural production but it exposed the weaknesses of labour markets and agri-food supply chains that may hold the promise of evolving into new vistas for farming and farmers *ex-post* the Covid-19 pandemic. Proactively, the Government of India announced the much-awaited market reforms, accompanied by significant investments in supply chain infrastructure and rural industrialization to take agriculture to newer heights.

The National Academy of Agricultural Sciences (NAAS) traditionally celebrates its Foundation Day on June 5 every year. This could not materialize this year due to severe restrictions in place on movement, assembly etc. due to the lockdown. The Academy, therefore, organized a panel discussion on June 5, 2020, in virtual mode, to deliberate on the impact and implications of Covid-19 pandemic on agriculture and agriculture-based livelihoods. The discussion was attended by 135 participants, including agricultural scientists and experts from India and abroad cutting across disciplinary boundaries. The deliberations that took place have been brought out as a Policy document by the Academy.

On behalf of the Academy, I wish to express my appreciation to Drs P. K. Joshi and P. S. Birthal for organizing this panel discussion, as well as synthesising the views and ideas of the eminent panellists and participants. I am grateful to all the panellists from India and abroad for their inputs on this topic. I am grateful to Dr Mangala Rai, Former President, NAAS and Former Secretary, DARE & DG, ICAR for Co-Chairing and steering the Panel Discussion as well as all the panellists from India and abroad for their inputs on this topic. My sincere thanks are due to Drs Kusumakar Sharma and P.S. Birthal for their editorial support in bringing out this document in its present shape.

Trilochan Mohapatra
President

Panel Discussion on Covid-19 Pandemic: Impact and New Normal in Agriculture

Co-Chairs: Dr Mangala Rai, Former President, NAAS
Dr T. Mohapatra, President, NAAS

Convener: Dr P. K. Joshi

Co-Convener: Dr Pratap S. Birthal

List of Panelists

1. Dr Pratap S. Birthal, ICAR-National Professor, National Institute of Agricultural economics Research, New Delhi
2. Dr Ashok Dalwai, Chief Executive Officer, National Rainfed Area Authority, Ministry of Agriculture and Farmers' Welfare, New Delhi
3. Dr P. K. Joshi, Secretary, National Academy of Agricultural Sciences, NASC, New Delhi
4. Dr Uma Lele, Independent Scholar and IAAE President, 700 New Hampshire Avenue, Washington DC, USA
5. Dr S.K. Malhotra, Agricultural Production Commissioner, Ministry of Agriculture and Farmers' Welfare, New Delhi
6. Dr Sudha Narayanan, Associate Professor, Indira Gandhi Institute of Development Research, Mumbai, Maharashtra
7. Dr Prabhu Pingali, Professor of Applied Economics and Director, Tata-Cornell Institute, College of Agriculture & Life Sciences, Cornell University, USAxc
8. Dr C. Ramasamy, Former Vice Chancellor, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu
9. Dr T. R. Sharma, Deputy Director General (Crop Sciences), Indian Council of Agricultural Research, New Delhi
10. Dr Ashok K. Singh, Deputy Director General (Agricultural Extension), Indian Council of Agricultural Research, New Delhi
11. Dr Anil K. Singh, Secretary, National Academy of Agricultural Sciences, NASC, New Delhi
12. Dr M. P. Yadav, Former Director, Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh

Covid-19 Pandemic: Impact and New Normal in Agriculture

1. Background

The novel coronavirus (Covid-19) pandemic which was first reported in China on December 12, 2019, has severely affected the lives and livelihoods of millions of people and now spread across the world. As on June 4, 2020, there were 226 thousand infections in India with a death toll of 6338. Nonetheless, the spread of Covid-19 has remained unabated causing 3.23 million infections and 59449 deaths on August 27, 2020.

In the absence of any proven curative medical solution, the entire world has been battling to contain the human-to-human spread of coronavirus through preventive means such as sanitization of the self, contaminated objects and surfaces, putting on face-masks, and maintaining proper social-distance. To slow down the speed of its spread, most countries imposed lockdowns of different durations, putting severe restrictions on the mobility of people, goods and services, except for the essential ones. This led to almost a complete cessation of the economic and social activities. There is no denying the fact that the lockdowns saved millions of lives, but the stoppage of economic activities adversely affected the livelihoods of millions, especially in the developing countries which are home to most of the world's poor.

India imposed lockdown on March 25, 2020, initially for a period of three weeks, which was extended thrice consecutively up to May 31, 2020. The lockdown continued afterwards, but in a milder form, allowing the resumption of select economic activities especially in the regions less-affected by the coronavirus. Although there are no official estimates[1] of the economic and social impacts of lockdown, some independent studies suggested a loss of 3% to 10% in the Gross Domestic Product (GDP). Maitra et al. (2020) estimated a loss of 10% in the real gross domestic product and per capita income in 2020-21[2]. Recent estimates from international organizations and agencies, such as the Asian Development Bank[3], the International Monetary Fund, the World Bank, and the S&P Global[4] have put the loss between 3% to 5%. A 5% contraction in the GDP, the most likely scenario, may push back 35 million people into extreme poverty, raising the head-count poverty ratio from its current 13.3% to 16%.

The predicted impacts of lockdown, however, are different for different economic sectors or activities. Manufacturing and construction activities have been hit hard by the lockdown, but agriculture and allied activities have provided a saving grace(Maitra et al. 2020). India's first phase of lockdown (March

[1]On Septmber 1, 2020, the Government of India released GDP estimates for the first quarter (April-June) of the financial year 2020-21, that showed a contraction of 24% over the same period of the previous year.

[2]Maitra, B., Kuruvilla, T., Rajeswaran, A., and Singh, A. 2020. India: Surmounting the economic challenges of Covid-19. Arthur D Little, Luxembourg S.A. (https://www.adlittle.com/en/india-surmounting-economic-challenges-covid-19).

[3]ADB.2020. Asia development outlook supplement 2020: Lockdown, loosening, and Asia's growth prospects. Asian Development Bank, Manilla: https://www.adb.org/sites/default/files/publication/612261/ado-supplement-june-2020.pdf;

[4]Economic Times, June 25, 2020.

24 - April 13) coincided with the harvesting period of *rabi* (winter) crops. In view of this coupled with the lower coronavirus infections in rural areas, the Government of India quickly exempted agriculture related activities from the lockdown. As a result, agricultural production did not experience any negative impact of the lockdown — the country harvested 107.2 million tons of wheat, and procured 38.9 million tons of it for the Public Distribution System (PDS) and buffer-stock.

The agricultural sector grew at its historical rate of growth, i.e., about 3%, in 2019-20. In fact, during January-March 2020, it recorded a substantially higher growth of 5.87% as compared to the overall economic growth of 3.04%. In 2020-21, the agricultural sector is predicted to grow at similar rate as in 2019-20. The predictions of a normal monsoon have further infused confidence among policy makers and hopes of achieving the growth target of 3%. These trends suggest that agriculture is resilient to transient shocks, as of lockdown, and has the potential to revive the overall economic growth *via* its strong backward and forward as well as inter-sectoral linkages. Sustained growth in agriculture and allied activities is essential to boost the demand for manufactured and industrial goods, including agricultural inputs (i.e., seeds, feeds and fodders, fertilizers, pesticides, equipment and machines), and processed food products.

In May 2020, the Government of India announced an economic package to tackle the social and economic fallouts of the prolonged lockdown. This package aims at revitalizing economic growth, enhancing employment and income opportunities for poor, and strengthening supply chain infrastructure and social safety-nets.

On the occasion of its Foundation Day on June 5, 2020, the National Academy of Agricultural Sciences (NAAS) organized a virtual panel discussion to deliberate on the agricultural consequences of Covid-19 pandemic and to find out ways and means for efficient, sustainable and inclusive growth of agriculture and rural development in the post-pandemic period. The discussions focused on the following issues:

- How has the Covid-19 pandemic affected agriculture and allied activities, including production, processing, and supply chains?
- Can the economic package and market reforms announced by the Government of India be a gamechanger for Indian agriculture?
- What is the *new normal* expected in agriculture *ex-post* the Covid-19 pandemic?
- How should agri-food policy, in general, and agricultural science policy, in particular, be aligned to the emerging new normal?

About 135 professionals, including agricultural scientists and experts from India and abroad, cutting across disciplinary boundaries, participated in the virtual panel discussion. The proceedings of the discussion are summarized in this document.

2. Impact of Covid-19 Crisis on Agri-food Systems

The Covid-19 induced lockdown may have affected the agri-food system through several channels, as shown in Figure 1. The farmers may have faced challenges of (i) accessing inputs, such as seeds,

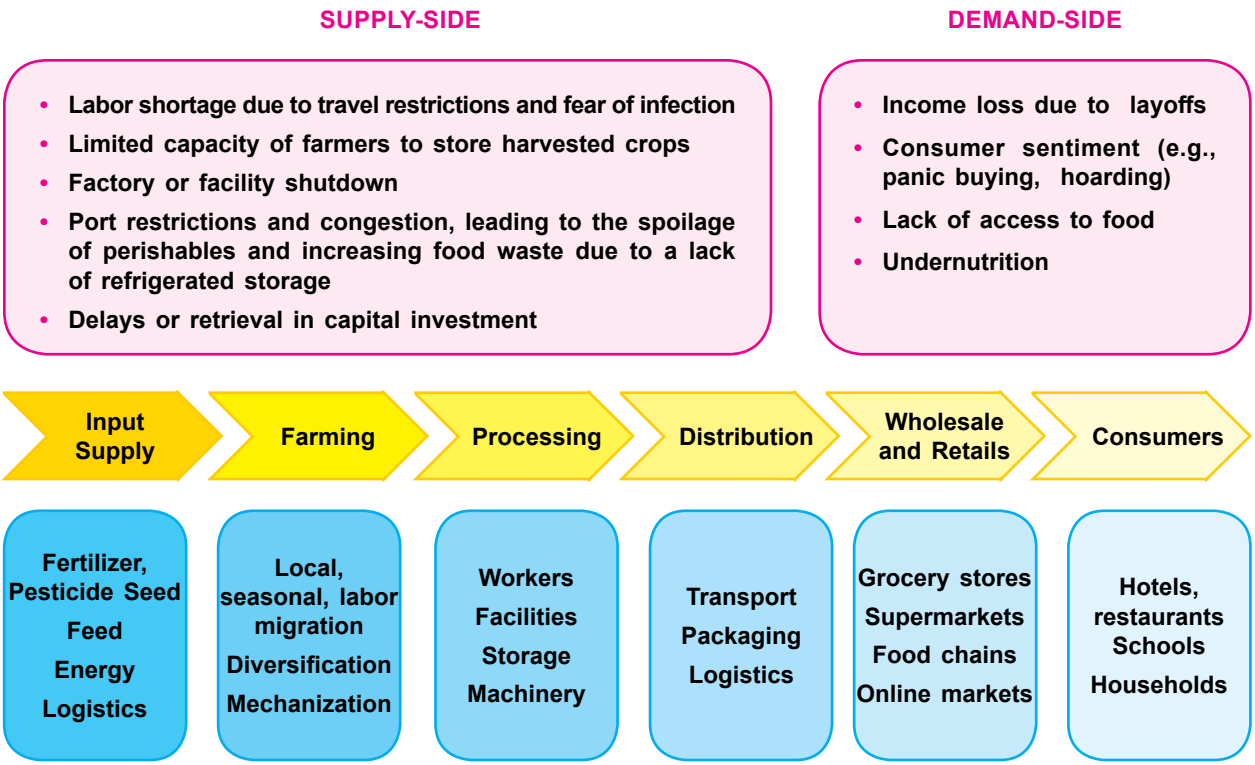

Figure 1. Possible channels and impacts of lockdown

Source: ADB (2020)

fertilizers, pesticides, diesel, electric power, feeds and extension and support services (ii) labour shortages on account of *stay-at-home* and travel restrictions, resulting in delay in farming operations, including sowing, insect-pest management and harvesting, (iii) poor access to output markets and higher post-harvest losses, (iv) higher trade costs due to disruptions in the transport networks, and (v) poor price realization on account of contraction in food demand.

The first phase of India's lockdown (March 24-April 13) coincided with the harvest and sale of *rabi* crops. The Government of India was proactive in exempting agricultural production and marketing operations from the lockdown. Since there was no significant reverse migration of workers during this phase, the farmers had little difficulty in harvest of *rabi* crops. Hence, the production of most *rabi* season crops was unaffected by the lockdown shocks. For example, the country harvested 107.2 million tons of wheat, almost 3.8 million tons more than the previous year. The wheat supply chain too was not affected much as the Government of India procured 38.9 million tons of wheat for the Public Distribution System (PDS) and buffer stock.

The supply chains of other agricultural commodities, especially perishables, were disrupted, which adversely affected farmers' incomes. Despite the markets being functional during the lockdown, the supply or value chain participants encountered several challenges due to frequent closures of markets, disruptions in transport network, and restrictions on inter-state movement of transport vehicles. This led to a significant fall in the volume of sales and wholesale prices, and resulted in higher

transportation costs that adversely affected farm profits. According to an estimate, the volume of market arrival of food commodities and their wholesale prices were 64% and 10% less during the first phase of lockdown (March 24-April 13) over the corresponding period of previous year (Figure 2)[5]. The crop-specific behavior, however, was different. The producers of perishable crops, such as fruits, vegetables and flowers suffered more as compared to the producers of cereals, pulses and oilseeds. Poor off take of perishables from the farm gate implied greater post-harvest losses. It may be noted that agricultural production is not flexible enough to adjust to sudden changes in market conditions. Nevertheless, the arrivals and prices of most commodities started recovering towards end of the first phase of lockdown.

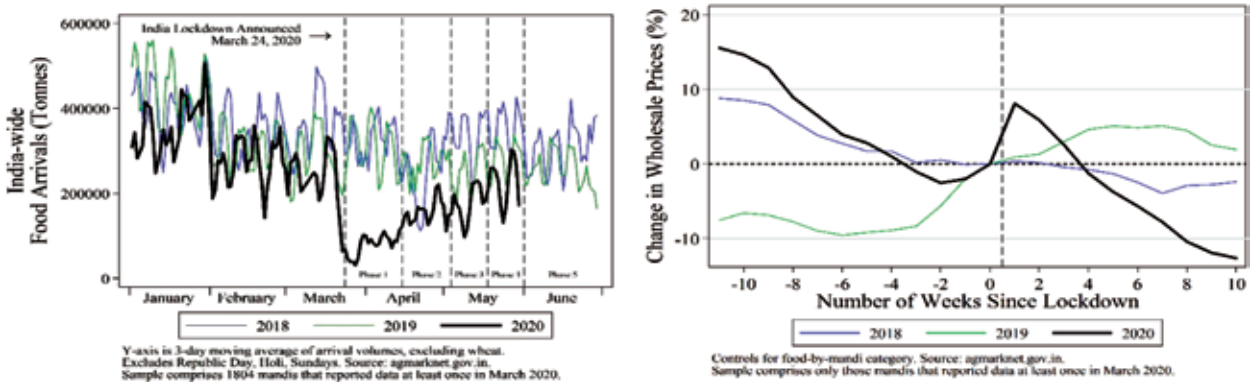

Figure 2. Impact of lockdown on market arrivals and wholesale prices of food commodities

Source: Lowe and Roth (2020)

The dairying, poultry and fisheries suffered more due to lockdown shocks. The production of broilers and eggs dropped significantly, initially due to the misinformation linking spread of coronavirus to the consumption of meat and eggs, and subsequently due to the disruptions in supply chains of inputs (*i.e.*, *day-old chicks and feeds*) as well as of outputs. The rumours of an association between chicken and egg consumption and coronavirus infection led to a significant fall in the demand for these commodities, between 30% to 40%[6]. The poultry producers resorted to distress sales and even culled the birds due to non-availability of feed and other inputs. This severely affected liquidity of several small-scale independent and contract producers and also of small-scale integrators, forcing many of them to exit the industry. Nonetheless, the demand for chicken and eggs has recovered and prices have started rising.

The dairying suffered primarily due to disruption of supply chains. The milk procurement by dairy cooperatives dropped by 15% during the first lockdown[7]. The guesstimates also indicate a decline up to 25% in milk sales as well as prices[8]. The impact was severe for those who had been supplying milk directly to the unorganized segment of market comprising urban households, sweet shops and

[5]Lowe, M., and Roth, B. (2020). India's supply chains unchained. Available at: http://southasia.ifpri.info/2020/06/18/indias-supply-chains-unchained/

[6]Melly Maitreyi, M.L. (2020). Lockdown hits poultry farmers hard, The Hindu, April 11.

[7]Rath, D. (2020). A new White Revolution: How COVID-19 could benefit the dairy industry. Financial Express, April 29.

[8]Business Standard, March 31, 2020.

restaurants. In addition, the disruption of supply chain of manufactured feed and other inputs (*e.g., mineral mixture*) pushed up their prices.

These changes in market dynamics due to lockdown can be attributed to the contraction in institutional and household demand for food commodities. The institutional demand (i.e., demand from restaurants, hotels, religious places, banquet halls, etc.) comprises about 5% of total food demand[9]. The closure of eateries, thus, had a significant negative impact on food supplies and farm profits.

International trade was also severely hit by the Covid-19 crisis. India's exports of horticultural products fell by about 70%, while the freight charges almost doubled. The exports of marine products dipped sharply. According to an estimate by the Central Institute of Fisheries Technology (CIFT), India's fishery sector incurred a loss of Rs. 224 crores a day due to a sharp fall in the export demand. Agricultural imports too were severely affected, for example, the import of palm oil in March 2020 was 58% less than in March 2019, due to lower demand, logistics challenges and higher import duties.

Nonetheless, the retail prices of food commodities, especially perishables, increased during the first phase of lockdown[10], leading to a widening of the price spread between producers and consumers that benefitted neither of them.

Finally, the lockdown triggered large-scale reverse migration labour from urban as well as rural areas. An estimated 10 million workers moved back to their villages; and they are unlikely return to their workplaces in the short-run due to the fears of prolonged pandemic and uncertain employment opportunities. This led to an imbalance in the regional urban as well as rural labour markets. The regions that have comparatively a higher land-man ratio (e.g., *Punjab and Haryana*) may face acute scarcity of labour. The growing labour scarcity in urban markers also triggered a migration of local rural workers to high-wage non-farm sectors in urban areas, which resulted in an increase in agricultural wages. On the other hand, states like Bihar, Jharkhand, Madhya Pradesh, Odisha and eastern Uttar Pradesh, which are home to bulk of the reverse migrants, may face an excessive employment pressure on agriculture, leading to a fall in agricultural wages. The reverse migration, in absence of employment opportunities outside agriculture, poses a challenge to the Governments' efforts towards distressing agriculture from excessive employment pressure in these states.

3. Economic Package and Market Reforms

To cope with the economic and social fallouts of the lockdown, the Government of India announced an economic package of Rs. 20 lakh crores on May 12, 2020, of which Rs.1.5 lakh crores were allocated for agriculture and allied activities. Within the agriculture sector, a sum of Rs. 1.0 lakh crore is for meant for strengthening post-harvest infrastructure and supply chains, Rs. 10,000

[9]Kumar, P., and Joshi, P.K., 2017. Food demand and supply projections to 2030: India. In: Brouwer, F., Joshi, P.K. (Eds.), International Trade and Food Security: The Future of Indian Agriculture. CABI, Wallingford.

[10]Narayanan, S., and Saha, S. (2020). The great Indian lockdown: Operational challenges and price increases in urban markets. Available at: http://southasia.ifpri.info/2020/05/27/the-great-indian-lockdown-operational-challenges-and-price-increase-in-urban-food-markets/.

crores for promotion of micro-food enterprises, Rs. 20,000 crores for development of fisheries, Rs.15,000 crores for strengthening animal husbandry infrastructure, Rs. 4,000 crores for cultivation of herbal or medicinal plants, and Rs. 500 crores for beekeeping. The Government of India had already made a provision for the direct benefit transfer of Rs. 6000 per farm household per annum in three equal instalments under *PM-Kisan Samman Nidhi*. One instalment of Rs. 2000 was released during the lockdown so as to ease liquidity constraint on purchase of inputs for the forthcoming *kharif* season.

The Government of India also allocated an amount of Rs. 40,000 crores for creating more jobs under the *Mahatma Gandhi National Rural Employment Guarantee Act* (MGNREGA) over and above its budgeted allocation of Rs. 61,000 crores. Recently, a new rural employment scheme *Garib Kalyan Rojgar Abhiyan* (GKRA) has been launched with a provision of Rs. 50000 crores. The aim of this scheme is to create employment opportunities for the jobless migrants in 116 districts encompassing the states of Bihar, Jharkhand, Madhya Pradesh, Odisha, Rajasthan and Uttar Pradesh. It is expected that this scheme will absorb about two-thirds of the migrant workers who returned back to their villages. The agriculture and rural development together share about 15% of the total allocation for economic revival.

The economic package for agriculture and rural development intends to take care of both the supply and demand side effects of lockdown. The MGNREGA and GKRA are expected to put more money in the hands of poor workers to enable them to achieve their pre-lockdown income and consumption levels. On the supply side, most activities under these schemes aim at building community assets and infrastructure, and enhancing environmental services that contribute to improving efficiency and sustainability of agricultural production systems.

A significant drop in the market arrivals and wholesale prices of food commodities, and consequently, an increase in the post-harvest losses at farm level, especially in the perishable commodities during the first lockdown, have exposed weaknesses and inefficiencies of the agri-food supply chains. The agricultural package lays a greater emphasis on strengthening supply chain infrastructure, i.e., storage, warehousing, refrigerated transport, etc. The package also provides incentives for diversification of agriculture towards medicinal plants and apiculture, the demand for their products is likely to grow at an accelerated rate in the future.

The allocation to micro-food enterprises although small, is a significant step towards promoting the agriculture-based rural industrialization. This will strengthen (i) start-ups, (ii) processing, and (iii) packaging and branding that will generate income and employment opportunities in rural areas, discouraging migration of workers from rural to urban areas.

More importantly, the economic package has been accompanied by three long-awaited major reforms in agricultural marketing system. One, the Government of India has significantly amended the Essential Commodities Act (ECA) 1955 and removed stock limits on agricultural commodities. The ECA, however, can be invoked during extra-ordinary circumstances, such as natural calamities, war and excessive price rise. This is likely to incentivize private investment in storage and warehousing and make agricultural markets more competitive. Two, the Government has brought an ordinance -

The Farmer's Produce Trade and Commerce (Promotion and Facilitation) Ordinance 2020, to provide multiple market channels to farmers beyond APMC markets. This is expected to accelerate the speed of implementation of the concept of e-NAM — *electronic National Agricultural Market*, leading to an increased integration of the agri-food markets. The gamechanger here is that the states cannot charge market fee on the commodities being traded outside the APMC markets. Three, the Government has also brought out another ordinance - *The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farmers Services Ordinance 2020* that aims at promoting contract farming, reducing price risk and enhancing farmers' access to support services. It provides for pre-agreed price contracts with provision of sharing of benefits of the higher market prices, and also accords legal status to contract farming. These reforms are expected to evolve a new market architecture for agricultural commodities.

4. New Normal in Agriculture

The prolonged lockdown has brought out several behavioral and institutional changes in urban as well as rural areas that are likely to influence agri-food value chain activities, from production to end-consumption. *Ex-post* the Covid-19 pandemic, the agriculture and agri-based business activities are likely to confront new norms related to technologies, support services, marketing, trade, finance, governance, consumer preferences, etc.

The reverse migration has distorted the geography of labour markets, and these distortions are likely to persist in the near future. The regional food systems are also going to respond differently to such distortions. An important change that we expect in the food systems is the diversification of agriculture. Depending on the endowments of natural resources, labour and capital, the regional production systems are expected to diversify but differently. In the states like Punjab and Haryana, which have a higher land-man ratio, the scarcity of labour would induce farmers to re-allocate a part of their land to crops that are less-labour intensive (*e.g., maize, cotton, pearl-millet, sunflower and soybean*) or even to perennial fruit crops (*e.g. kinoo, guava*) away from the labour-, energy- and water-intensive crops like the paddy and sugarcane. Such a change in the cropping pattern will arrest depletion of groundwater, and reduce burden of power and irrigation subsidies. Additionally, diversification will lead to improvements in soil health and reduction in greenhouse gas emissions (GHGs) and air pollution. If the potential substitutes of paddy are not competitive, the rising wages will induce farmers to adopt new innovations that are less labour-intensive. Such innovations include agricultural practices such as direct seeding of rice, conservation agriculture, and mechanization.

On the other hand, the reverse migration of workers in the land-scarce, water-abundant states like Bihar, Odisha and West Bengal, may induce a shift in cropping patterns in favour of labour-intensive high-value wellness crops such as vegetables and medicinal plants. These crops have small gestation periods and generate higher returns compared to the widely-grown staple crops. Dairying, poultry and fisheries, known for their contribution to nutrition and human health, are also options for improving agriculture and agriculture-based livelihoods. These commodities provide significant nutraceutical and therapeutic benefits, and *ex-post* the pandemic their demand is expected to increase, providing a big

push to *vegan food* and *pharmaceutical* industries. However, this will depend on *how the government policies, institutions and infrastructure facilitate this transition*.

The post-pandemic agriculture will be more knowledge-, information- and skill-intensive. Producers will require more, accurate and timely information on several aspects of agriculture — on seeds, plant nutrients, soil and water health, insect pests and diseases, consumer preferences, wellness crops, food safety, storage, markets, prices, weather, climate-resilient technologies and practices, and animal health, nutrition and breeding. Therefore, agriculture will leap-frog to a new era, compelling public extension systems to shift towards digitized approaches for quick diffusion of information and innovations.

With implementation of the market reforms, the agri-food supply chains are expected to become shorter with lesser number of intermediaries between producers and consumers. A new vertically coordinated marketing system driven by institutions is expected to come up, such as contract farming, cooperatives and farmer producer organizations (FPOs). This will reduce transaction costs of trade, and make it easier for small farmers to access inputs, finances, services and technologies. Agribusiness firms would benefit from reduced uncertainty in the procurement of farm produce.

The emphasis on supply chain management and development of micro-food enterprises will bring primary processing facilities (*e.g., grading, processing, storage and branding*) closer to the farm gate, providing a push to the long-awaited transformation of rural economy. It will help producers to access market and market intelligence, and manage value chains, besides generating employment opportunities for local rural youth. Its multiplier effect on farmers' income is expected to be quite large.

E-commerce that directly connects producers to consumers may emerge as a new normal in the post-pandemic period. Agri-based e-commerce platforms in India saw a significant growth in the daily food orders during the lockdown period, and many of these have struggled to meet the online demand. It is likely that with market reforms they may invest more to expand their capabilities. There has been an even more interesting trend - the backend upgradation of traditional retailers like *kirana* stores through tech-driven B2B initiatives in servicing consumers during the lockdown. This may lead to another innovation in marketing of agricultural commodities.

Mobile and internet banking will emerge a new normal for farmers and other participants in the financial and product markets. Although, Indian farmers have a preference for cash transactions, there is a very high probability that mobile or internet will become an essential means of money transfer and payments all along the agri-food supply or value chains.

The concerns for food safety and hygiene have never been so prominent as during the Covid-19 pandemic period. These will reinforce a new normal in the post-pandemic period, compelling the value chain participants, from genetics to end-consumption, to comply with the domestic and international food safety standards. Essentially, this implies integration of the food system with the concept of *One Health* that recognizes the interaction among plants, animals and humans in their shared environment for prevention of zoonotic diseases through the movement of people, and trade in animals and animal products. Given this realization, organic farming may also emerge a new normal ex-post the Covid-19 pandemic.

5. Key Recommendations

Approximately 45% of India's workforce is directly engaged in agriculture. However, over 86% of the farm households have land holdings of size less than or equal two hectares, hence, any disruption in the food system will directly impact farmers' financial position, livelihoods and investment decisions. The social and economic effects of Covid-19 pandemic accompanied by a prolonged lockdown, call for alignment of agri-food policies and production systems to the new normal agriculture. Following are the key recommendations that emerged from the Panel Discussion for adapting to the emerging new normal in the agricultural and rural economy.

(i) Changes in rural labour markets have created an opportunity for diversification of agriculture, that may lead to a quantitative and qualitative improvement in natural resources and environment, reduce farm risks and enhance farm incomes. *There is a need to diversify in favor of* (i) *high-value wellness food crops*; (ii) *water-, and energy-saving crops; and* (iii) *export promotion and import substitution crops*. But, for diversification to take a desired shape, one of the most important requirements is the crop planning at a disaggregated spatial scale taking into considerations the local endowments of natural resources, such as soil types, temperature, rainfall, surface and groundwater and animal resources.

There is a possibility that the crops proposed in the diversification plan do not have a comparative advantage over the existing crops, either because of their relatively low yields or low prices or both. A case in point is that of paddy in Punjab and Haryana, where the policy makers have been struggling to substitute paddy by some other crops but have not succeed because the competitive crops are not as profitable as paddy. The scarcity of labour leads to higher wages, which in turn may reduce net returns from labour-intensive crops as paddy. The policymakers should convert labour crisis into an opportunity for diversification, by providing incentives for the adoption of new crops. For instance, the Government of Haryana has launched a scheme "*Mera Pani Meri Virasat*" (My Water My Heritage) that provides for a compensation of Rs. 7000 per acre to those farmers who diversify from paddy to maize, pearl-millet, pulses and horticultural crops. In addition to that, the scheme provides for (i) purchase of cereal crops at their pre-announced minimum support prices (MSP), (ii) no insurance premium for the proposed crops, (iii) 85% subsidy on micro-irrigation equipment - the farmers have to pay only GST, and (iv) 40% subsidy on pneumatic maize sowing machines. Likewise, the Government of Telangana has taken a bold initiative to regulate cropping patterns befitting the agro-ecological conditions. The Government of Telengana has linked this initiative to the existing "*Rythu Bandhu*" scheme —those who do not follow the specified cropping patterns will be denied monetary support of the scheme.

(ii) The Indian Council of Agricultural Research has ready-to-use soil maps for each district; groundwater maps are available from the Ministry of Water Resources, and the rainfall maps from the Ministry of Earth Sciences. The policymakers should utilize these and harmonize location-specific cropping patterns with the natural resource endowments. Nonetheless, market forces may distort the cropping patterns. Hence, there is imperative need to evolve an incentive structure that can bring at par the comparative advantage of all the crops. At the same time, it

is also essential that farmers are assured of required supplies of inputs, credit, support services, and market for outputs. *Essentially, the natural resource-based cropping patterns enhance ecosystem services, and therefore, there is a strong case to link economic incentives with ecosystem services*. In 2019-20, India's agricultural subsidy bill stood at Rs. 2.56 lakh crores, a part of which can be repackaged as *payment to farmers for the ecosystem services* they provide to the society at no cost.

(iii) The Government of India has taken a significant step towards much needed market reforms for strengthening the supply chains. The emerging agri-market architecture should be inclusive of smallholder producers, who often face significant challenges in accessing inputs, services, credit and markets. *To enable small-holders benefit from the market reforms, there is a need to promote collective action in the form of Farmer Producer Organizations (FPOs), self-help groups (SHGs) and cooperatives; and link these with agri-entrepreneurs or start-ups*.

(iv) Agricultural research has played a critical role in enhancing agricultural productivity and food supplies and reducing rural poverty. *The emerging new normal suggests that the agricultural research should re-orient itself from increasing production to multiple goals of improving efficiency and sustainability of production systems, food quality and nutrition, and environment.* The ultimate aim of agricultural research should be to make agriculture a lucrative profession without compromising sustainability of the natural resources. Artificial intelligence, agro-robotics, precision farming, nanoscience, cloning, plant and animal genomics, gene editing will be important tools of agricultural research for developing multiple stress-tolerant and biofortified products as well as environmental conservation.

(v) Agricultural research should integrate itself with the concept of 'One Health'. It should emphasize on food safety and quality all along the value chains, as well as on crops and animals that have nutritional and medicinal values and help build immunity against multiple micro-organisms of significance, i.e., viruses, bacteria and fungi. *There should be greater research collaboration among the faculties of crop sciences, animal sciences and ayurvedic/medical sciences for prevention/control of diseases in plants, animals and humans.*

(vi) Public-private partnerships in agricultural research need to be strengthened. The public and private sector research entities are required to develop joint research platforms by pooling and sharing human and financial resources, skills, and knowledge. *There is huge potential for start-ups for scaling-up production of quality planting material and seeds. It can also generate vast employment opportunities for rural youth.*

(vii) The future agricultural extension system should be market-led to facilitate exchange of information on technologies, inputs, market conditions, consumer preferences, weather forecasts, etc. all along the value chains. The private players with an agribusiness orientation should be attracted to provide agricultural extension and support services. *The power of digital technologies should be leveraged for quick delivery of agricultural information and innovations.* More importantly, the focus should be on timely delivery of information and technologies. Some of the communication methodologies that are becoming popular include the call centers, social media (Face book and WhatsApp), mobile apps, community radio and video, web portals, GIS, and GPS.

(viii) To make the social safety-net program more effective, the Government of India has already announced implementation of the 'One-Nation, One-Ration Card' scheme. Approximately 90% of India's workforce in the informal sector is without minimum wages or social security[11]. *Therefore, it is now the right time to consider the proposal of 'Universal Basic Income Scheme' to provide unconditional fixed monetary support to every household, with the exclusion of the well-off households*. This will guarantee secured income to the poor and increase their purchasing power, besides allowing them to buy the food of their choice. The scheme will also reduce the leakages as the income would be directly transferred to the bank account of the beneficiaries.

Indian agriculture was the least affected by the Covid-19 pandemic and the accompanying lockdown. Nonetheless, there was a disruption in the supply chains of perishable commodities, and labour markets. The Government of India has taken several measures to improve the supply chain infrastructure, and ensure food and income security to the migrant workers. One advance installment of PM-KISAN was also released to enable farmers to buy seed and fertilizer for *kharif* crops. Similarly, the scope of MGNERGA was widened to provide employment to landless workers. The Government has also announced long-awaited reforms in agricultural sector to make agriculture more efficient and business friendly. It appears that these timely interventions and reform measures will transform Indian agriculture and take it to newer and higher frontiers.

[11]National database of workers in informal sector in the works. Economic Times, January 19, 2020

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Published by Executive Director on behalf of
NATIONAL ACADEMY OF AGRICULTURAL SCIENCES
NASC, Dev Prakash Shastri Marg, New Delhi - 110 012
Tel: (011) 25846051-52; Fax: (011) 25846054
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