

Technical Bulletin

COVID 19 and National Lock Down: Impacts and Future Strategies in Agriculture and Environment

Aug 2020

Dedicated to

Prof. Yash Pal Abrol

Founding President



**Society for
Conservation of
Nature**

NASC Complex, Pusa, New Delhi 110 012

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Preface

As if the gloom of the pandemic was not enough, the Society for Conservation has to bear with the loss of its founder, Prof. Yash Pal Abrol. Yet, the virtual meeting of the Society on COVID-19 was significant for at least 2 reasons. Firstly, this was the last meeting of the Society Prof. Abrol attended on 20th July, less than a week before he was hospitalized and eventually passed away on 28th July. Secondly, he, like many of us, viewed the success of this meeting as heralding a new phase in the growth of the Society that he founded and nurtured throughout. Earlier this month, we heard the good news of the United Nations Environment Programme (UNEP) accreditation of Sustainable India Trust, the other NGO he founded in 2014. He went away with the great satisfaction that both the organizations he founded are doing very well and have a bright future ahead of them. It is now our task to carry forward his legacy of excellence.

The Society has been a launch pad of many pioneering initiatives, especially in the last 15 years. They include the establishment of Indian Nitrogen Group and South Asian Nitrogen Centre for the International Nitrogen Initiative, joining UNEP-Global Partnership on Nutrient Management, assessing Indian Nitrogen and Phosphorus scenarios for informed policies and establishing the Sustainable India Trust. All these initiatives have acquired a life of their own, even though the Society continues to be actively involved with them. Indeed, much of the success of the Society can be attributed to its ability to identify and address the unaddressed gaps in the interface of science, society and public policy. It made new niches for itself in the process.

The COVID-19 pandemic changed our lives like never before. It poses many new challenges in all walks of life, including agriculture, economy and environment. The Society's meeting on this theme was a timely response to this challenge. It was titled 'COVID 19 and National Lock Down: Impacts and Future Strategies in Agriculture and Environment'. It was very well attended and addressed diverse issues including agriculture and extension, air water and soil pollution, biodiversity, climate change and impact on economy. This technical bulletin is an outcome of the felt need of all the participants for documenting the ideas presented and deliberated in the meeting. They will be very useful as we cope with the effects of this pandemic and learn our lessons from it. We take this opportunity to thank all those who organized things and participated in this meeting as well as for writing articles for this bulletin. We also hope that they will inspire the future initiatives of the Society for Conservation of Nature.

Editors

OUR BELOVED MENTOR



*Prof. Yash Pal
Abrol*

1935-2020

May the Eternal Father give rest & peace to the departed soul



Homage to Prof. Yash Pal Abrol

(23-12-1935 to 28-07-2020)



Prof. Yash Pal Abrol, a renounced Plant Physiologist and the doyen of Indian nitrogen research and nature conservation is no more. He passed away peacefully at the age of 84 on the morning of 28 July 2020, which is incidentally the World Nature Conservation Day. His professional legacy lives on in the Society for Conservation of Nature and the Sustainable India Trust, which he established and nurtured throughout, till the last day. A pioneer in crop physiology and biochemistry, he retired in 1995 as Head of Plant Physiology, ICAR-Indian Agricultural Research Institute (IARI), New Delhi. He later served as CSIR Emeritus Scientist (1996-2000), INSA Senior Scientist (2001-2005) and INSA Honorary Scientist (2006-2020). Born in Lahore (now in Pakistan) on 23 December 1935, he did his B.Sc. from Punjab University; M.Sc. from Banaras Hindu University and Ph.D. from University of Chicago in 1963 and worked as Post-Doctoral Fellow in University of California, USA, before returning to India. He was also a Visiting Scientist at McMaster University, Hamilton, Canada (1983-1985) and Consultant to FAO (1971-1993).

He mentored many young scientists and published over 150 research papers and over 15 books. His students went on to become team leaders, directors of state and national institutions, apart from excelling in other government and industry agencies. He is best known for his pioneering work on cyanogenic glycosides, screening of wheat varieties for roti and chapati during green revolution years and his N balance sheet for wheat and barley, which formed the basis for optimal N fertilizer recommendations for farmers in India. He also worked later on nitrate assimilation in rice and vegetables.

His most recent contribution was the Indian Nitrogen Assessment (Abrol et al., 2017), which led India to pilot the first ever UN resolution on Sustainable Nitrogen Management. This unusual feat was achieved in citizen science mode without any government-funded or privately-funded project. His intellectual reputation and gentle personality drew many to deliberate on N-scenario of the country since late '90s and prepare critical input on the need for interdisciplinary coordination on understanding the nitrogen cycle. This led to the formation of the Indian Nitrogen Group in 2006, under the aegis of the Society for Conservation of Nature, a registered non-governmental organization that he founded in 1998 in New Delhi. A couple of workshops led to a book on Agricultural N use (Abrol et al., 2007), followed by a wider collection of review articles for a special issue of Current Science in its platinum Jubilee year (Abrol et al., 2008). During the fifth triennial International Nitrogen Conference a series of 20 technical bulletins on reactive nitrogen in different sectors were published under his leadership. This set the stage for the first ever comprehensive Indian Nitrogen Assessment (Abrol et al., 2017), only second in the world after the European Nitrogen Assessment.

Prof. Abrol founded the Sustainable India Trust in 2014 to highlight sustainable nutrient management, as a part of which another special section of Current Science was brought out on Sustainable Phosphorus management. This Trust also highlighted the Indian Nitrogen Assessment during the World Environment Day (2018) hosted by the Indian government in New Delhi. It was followed by the Trust's advocacy and facilitation of India

piloting the N-resolution successfully during the 4th UN Environment Assembly in 2019. As a result, the Sustainable India Trust has recently been accredited with UN Environment Programme (UNEP) as a NGO under the category of Science and Technology Community.

Prof. Yash Abrol was a Fellow of all the four major Indian Science Academies - National Academy of Sciences, India (1984); Indian National Science Academy (1986), Indian Academy of Sciences (1986) and the National Academy of Agricultural Science (1991), apart from being Full Member of Sigma Xi, USA, and the Indian Society for Plant Physiology. He served as INSA Honorary Scientist (2006-15), Adjunct Professor at the Hamdard University, Chairman, Research Council, Institute of Himalayan Bioresource Technology (1991-1993), and Member, Academic Council, Guru Gobind Singh Indraprastha University, New Delhi (2006-2008). His awards/honours include: Dhiru Morarji Memorial Award (Fertilizer Association of India, 1977); ICAR R.D. Asana Endowment Fund Prize (1974-77); National Fellow, ICAR (1978-84); IARI Sukumar Basu Award, (1980); FICCI Award (1990); Vasvik Award (1993); Platinum Jubilee Lecture Awardee, Indian Science Congress (1995); T.M. Das Memorial Lecture Award (2002) and Birbal Sahni Medal (Indian Botanical Society, 2008).

Prof. Yash Abrol is one of those rare persons of eminence in Indian science who not only did world class science in his professional career, but went on to bring science to the service of the society, government and intergovernmental bodies through his post-retirement work in the civil society. He is survived by his wife, Dr. Mridula Abrol (Nee) Suri and his two sons, Amar and Manav. The Indian Nitrogen community pays sincere homage to this great personality.

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COVID 19 and National Lock Down: Impacts and Future Strategies in Agriculture and Environment

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The recent outbreak of Corona Virus Disease 2019 (COVID 19) has threatened the world with no precedence in modern history. The World Health Organization (WHO) has declared it as a global pandemic. It has already affected more than 20 million, killing more than 0.7 million people worldwide (till August 12, 2020). The number of affected people in 213 countries is increasing exponentially.

India is also very severely hit by the outbreak of COVID 19. Govt. of India resorted to an unprecedented national lockdown i.e., a state of isolation and restricted access instituted as a security measure of the entire country. This is an essential step to fight against the disease but has distressed agriculture and other sectors of the economy. Shut down of the activities has endangered food, health and livelihood security of millions. Farmers and agricultural labourers are those among people who are already poor, marginalized and vulnerable and facing the brunt of lockdown more seriously. Migration of people, farm labourers and other workers, became a very serious issue with lots of hardship or even losing life on the path of migration. The pandemic raised the pertinent question of ‘life or livelihood’ or ‘life and livelihood’.

Besides the issue of life and livelihood, environment at global as well as local levels has witnessed several unprecedented changes due to the lockdown. Global assessment shows that 68% of CO₂ and more than 80% of NOx emissions have reduced leading to a cleaner environment. People could see the Himalayas from Chandigarh and Saharanpur, which was only a dream for the younger generations. Many birds and other animals, unseen for last many decades are now making their appearances. Wild animals have been seen to occupy city spaces during the lockdown. Some other reports, however, suggest that atmospheric CO₂ concentration has not declined as expected; due to burning of forests in some parts of the world. Many also argue that this cleaning of environment is only a short-term event and the world act more vigorously with industrial and other economic activities after the lockdown to make up the lost ground. The environment thus will revert back to as polluted as earlier, if not more.

As few states are mulling for extending lockdown even after 3 months in coping with emerging COVID 19 scenarios, the pressure on rural life is expected to intensify at significant level. By taking cognizance of its global spread, it is still uncertain that COVID 19 active cases may stabilize/ reduce even after few months leading to unprecedented economic hardships to the people and governments. Observing this trend, though states have charted plans to ease norms and bring economy on pre COVID levels, but momentum has still not picked up. Indeed, agriculture and lives of rural populace to an extent is not much affected unlike other sectors, which once again reiterate that '*anything can wait but not agriculture*'. The sector amid disruption is predicted with fairly resilient growth rate of 2.5% in the FY 2020-21. This shows that the green shoots for the economy are coming out from the agriculture. In order to nourish this growth it is pertinent to take stock of overall economic impacts, interventions and policy that invariably needs a fresh stream to boost growth and development in agriculture After Corona (AC) crisis. This will ease the constrained supply chains since the lockdown began and open avenues for structural reforms for ameliorating

supply side constraints in an attempt to bring seamless food system. Several bold measures have been taken to avoid further dip in ailing economy from the past slowdown, especially agri- and allied sectors, which cannot bear heat anymore.

The bulletin discusses the (1) impacts of COVID 19 and national lockdown on agriculture, economy and environment, locally and globally; and (2) strategies in post-COVID situation to improve the environment, economy and agriculture.

Impacts of COVID 19 and Strategies for Improvement in Agriculture

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Coronavirus disease has caused an unprecedented havoc in the well-being of the earth and has adversely affected almost all the sectors of human activity including causing a devastating trail on the human life and well-being. Globally, more than 20 million people have been affected by the disease with a death of more than 0.07 million. India alone has a coronavirus tally of >2 million and a casualty figure of more than 47 thousands (as on 12th August, 2020). Agriculture being an important economic activity of the people with the aim to provide food to growing billions is also affected. Agriculture, being an important economic activity of India with around 14.7% of GDP, is also expected to be adversely affected.

The Food and Agriculture Organization (FAO, 2020) states that COVID-2019 is likely to affect agriculture in two significant aspects: (a) food supply - a network that connects an agricultural system (the farm) with the consumer's table, including processes such as manufacturing, packaging, distribution, and storage and (b) food demand that implies the willingness and ability of consumers to pay money for a particular good or service, during any particular period. These two aspects are directly related to food security, so food security is also at risk. Both supply and demand in the food security system with COVID-19 and without COVID-19 are likely to be affected, although a greater effect on demand, due to the passability restrictions that affect accessibility. At the beginning of 2020, 135 million people around the world were already facing extreme hunger. According to the World Food Program, that figure could rise to a staggering 265 million people by the end of this year. UN World Food Programme projected that in a worst-case scenario, famine in about three dozen countries could be possible. However, both availability and consumption remain almost stable in most of the countries. For example, major rice importing countries of US, EU and Gulf have almost 3 month's stock that is supposed to be sufficient to tide over the present crisis.

India on the other hand being a producing country the scenario is different. Thanks to the efforts of the farmers and scientists alike with favorable support from the policymakers, the overall situation is much better with a huge production and comfortable stock position of food grains. Even in the ensuing *kharif* season planting coverage of crop lands is much higher. However, many sub-sectors of agriculture are affected badly due to the impact of the disease and the associated lockdown. The vulnerabilities in agricultural supply chains and reduced workforces caused by the COVID-19 crisis have adversely affected the output of farms of all sizes in India, especially high-value enterprises. Most affected have been dairy farming, floriculture, fruit production, fisheries, and poultry farms.

The central and state governments have acted quickly to help agriculture navigate this unprecedented crisis. The “*Pradhan Mantri Garib Kalyan Yojana*” contained the following components for immediate succor to the agricultural sector like (1) free additional 5 kg wheat or rice per person, upto November, 2020; (2) 1 kg free pulses per household, upto November, 2020; (3) Free LPG for *Ujjwala beneficiaries* upto November, 2020; (4) Rs. 2000 to 87 million farmers under *PM Kisan Yojana in 10 days*; (5) Increase in MGNREGA wages to Rs.202 from Rs. 182; (6) Rs. 500 per month to 200 million female Jan Dhan account holders for next 3 months

However, more measures are needed to reboot the sector and ensure it exits the crisis more resilient than before. A few actions that the policymakers can consider as they gear up to deal with the economic crisis are listed below:

- Safety of farm population: Farmers, agricultural labourers, workers in supply chains have to be protected from the health shock.
- Supply chains: During the lockdown and beyond, one has to concentrate on smooth operation of post-harvest activities, marketing of production, retail, wholesale, storage and transport.
- Procurement measures: It is important to have continued markets for farmers. Farmers with perishable products need help as they face more problems.
- Milk and poultry industry: Small farmers in poultry and milk activities need more help as they are facing problems due to the pandemic.
- Food security for farm families and agricultural workers
- Avoid export bans: At the macro level, trade in food and agriculture has to be maintained in order to have availability of food.

Global community has witnessed many pandemics since the beginning of civilization. While COVID-19 pandemic might have surpassed many of them, this has also unleashed several opportunities to tighten the belt and start working with more clear policies and zeal. COVID-19 in India has accentuated the need for agricultural market reforms and digital solutions to connect farmers to markets, create safety nets, ensure reasonable working conditions, and decentralize agri-food systems to make them more resilient.

The Pandemic and Dryland Agriculture: Coping Strategies

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Corona viridae is a family of related viruses with a very striking appearance under the microscope, Corona for crown-like. In this group of corona viruses, there exists one particular species, namely SARS-CoV, which has caused two significant epidemics in recent history. Distinctively, the current pandemic is caused by the SARS-CoV-2, a particular strain of the aforementioned species. The virus contains many glycoprotein spikes, which are proteins that attach to the host cell and promote the combination of the viral and cellular membranes. Both of these processes occur in a highly concerted fashion. The receptor-binding region interacts with a specific receptor on human cells, ACE2 (Angiotensin Converting Enzyme 2). ACE2 is expressed primarily by the human airway and the lung cells. Once SARS-CoV-2 enters the alveoli of the body, the body responds by releasing a host of chemicals. This causes inflammation and accumulation of fluid in the lungs, effectively drowning the victim. Apart from majorly affecting the respiratory system, SARS also affects the intestine and kidneys. Research has picked up and valiant efforts to thwart the pandemic are being made around the world. Curiously, how the virus travels and transmits is also understood by analyzing the peplomer. In fact, some research shows that SARS-CoV-2 binds at least 10 times more tightly to ACE2 than SARSCoV, hence the SARSCoV-2 is much more infectious than the latter.

Coping strategies in dryland agriculture during lockdown period

As in the case of several other sectors, the situation of COVID-19 and National lockdown has also affected agriculture on the whole and also rainfed agriculture. The small and marginal farmers and agricultural labourers are amongst people who are already poor and vulnerable. Hence, a focus on coping strategies in dryland agriculture is of paramount importance, a few of which are discussed below.

Spread of information related to COVID-19

As per the communication received from the ICAR-ATARI and different other ministries, GoI, the information related to COVID-19 like, Symptoms, Dos and Don'ts, precautionary measures, use of Arogya sethu App, Follow up of Ayush guidelines for improving immune system with healthy food, etc. was communicated to farmers in KVK adopted villages.

Advisories through ICTs

Agro advisories for need based problems of farmers in different commodity groups communicated through ICTs during the lockdown period. Farmers are advised to post detailed information including images and video clips of diseases, pests, nutritional disorders etc. of field crops, vegetables, flowers, livestock, fodder, farm machinery, soil and water conservation. The contact farmers of KVK were grouped based on commodity and made different groups in Whats App, mKisan, Print media, Radio/TV Talk, Facebook, individual farmer mobile advisories, etc.

Assessment of crop damage due to Hailstorm

Hailstorm occurred on 6th, 8th and 10th April, 2020 in several villages of Yacharam, Ibrahimpatnam, Maheshwaram, Kandukur, Kottur, Nadigam mandals of Rangareddy dist. Major crops damages are Mango, Vegetables, Papaya, Paddy and flower crops to an extent of 1693 ha. Farmers advised to remedial measures to overcome losses and follow the plant protection measures to contain the spread of pest and diseases.

Developing farmer to consumer linkages during lockdown period

A few problems in marketing of the existing perishable products encountered by farmers include high percent of perishability of fruits & vegetables, delay in harvest and transport, closure of most markets, farmers could not take vegetables & fruits to the markets in town/city. To address these issues, the Krishi Vigyan Kendra promoted marketing of fruit and vegetables through social media (Whatsapp, Facebook, Twitter, Individual traders, large communities in city, etc.). Also tried to link FPOs, FPCs, Farmers groups/Associations with group of consumers, NGOs, and market vendors through ICTs during the lockdown period. Thus, attempts were made to develop farmer to consumer linkages.

Other salient activities and coping strategies included seed production, procurement and processing activities of pulses such as, pigeon pea, green gram and black gram; assessment of soil health and nutrient status in farmers' fields; demonstration of integrated farming systems modules including livestock and poultry; and demonstration of efficient micro irrigation systems such as, sprinklers in KVK adopted villages during the lockdown period. Also, women groups in these villages were motivated to prepare masks and trained them in using the masks, sanitizers as well as maintaining physical distancing.

Way Forward

Capacity building and reducing migration of small and marginal farmers from villages needs to be focused. In this context, strengthening seed system for food and nutrition security assumes greater importance. Effective integration of livestock and poultry in farming system modules and strengthening farm-based activities for productive outcomes and linking markets are key to improve livelihoods of rainfed farmers. Further, quantification of contributions to natural resources as well as nurture and conservation of precious natural resources of soil, water and biodiversity are most critical for effective management of this fragile agro-ecology.

Impacts of COVID-19 on Air Pollution and Strategies for Improvement

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1. Introduction

The air pollution data analysis show that in general, the levels of air pollutants have drastically decreased during the COVID-19 lockdown period resulting in an improved air quality worldwide. Emissions of carbon, nitrogen and sulphur are reduced remarkably which had resulted in a significant reduction in PM_{2.5}, PM₁₀, NOx, BC and OC etc. The lockdown period witnessed lesser road congestion, lesser domestic wastes, noise free atmosphere, lesser road dust, lesser construction dust, haze free air and clear visibility etc. The visibility was so clear that the Himalayan ranges could be seen from Jalandhar, which is almost 200 km far from the Himalayan foothills (CNN, 2020). Even the stratospheric air had rejuvenated because of no aircraft flying, which had reduced huge atmospheric burden. In a way we can say that the lockdown has been an opportunity of rejuvenation of the Earth system.

2. CO₂ at Mauna Loa

During COVID-19 lockdown, major anthropogenic activities such as aircrafts, road transport and industries were shut reducing the consumption of fossil fuel. This resulted in a significant reduction of C, N and S emissions. According to reports, the CO₂ concentration at the Mauna Loa had shown a lowering trend during March 2020 as compared to March 2019 (Fig. 1). Hence, the lockdown was a positive change for atmospheric healing. On the other hand the cleansing of atmosphere has indicated that the major cause of air pollution is the anthropogenic activities. This also confirms the IPCC findings that the major cause of present climate change are anthropogenic activities.



Fig. 1. Comparison of CO₂ levels at Mauna Loa during March 2019 and March 2020.

Source: NOAA (2020)

At local level for example in New Delhi, almost all the criteria pollutants which had their levels very high or above the prescribed limits are showing satisfactory levels which is a good indication for public health.

3. Air Quality in India

As shown in the Fig. 2, all the sites of NCR Delhi showed a positive change in the air quality index (AQI) during March 2020 as compared to the March 2019. The AQI improvement ranged from 52% at Gaziabad to 81% at Bhiwandi. The reason for a significant reduction but

lesser than other sites may be attributed to its population density which allows indoor domestic emissions. However, in case of Khanna site, the reason of lesser improvement (55%) is different from the Khanna site, which was already having better air quality (AQI=75) and the lockdown could contribute a little to the pollution cut at this cleaner site.

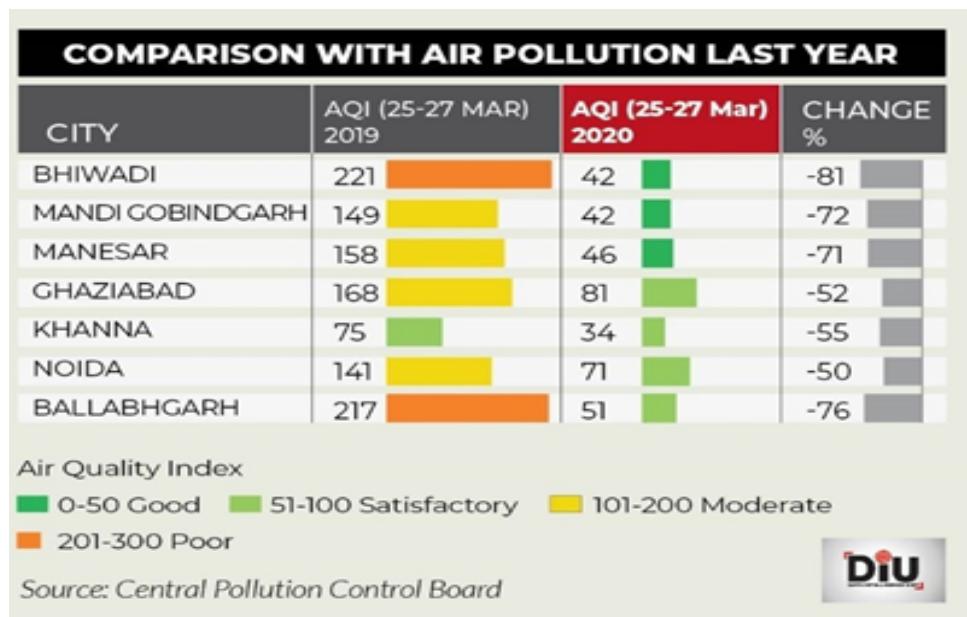


Fig. 2. Air Quality Index (AQI) at selected site in NCR Delhi.

Source: CPCB (2020).

The AQI for PM_{2.5} was 238 at Anand Vihar before the lockdown, which fell down to 97 during the lockdown. Similarly, the AQI of PM_{2.5} was recorded as 101 during the lockdown at the DTU site as compared to 244 before the lockdown.

4. Reactive Nitrogen (Nr) Pollution

NH₃ and NO₂ are the major atmospheric gases, which contribute to a large fraction of Nr species. The air quality index (AQI) for NO₂ was 75 at Anand Vihar site in Delhi before the lockdown, which was recorded as 31 during the lockdown period. Similarly, NO₂ AQI at DTU site in Delhi was 48 before the lockdown, which came down to 18 during the lockdown. The reduction of air pollution is seen across India. Maharashtra too had lower NO₂ levels during lockdown (CBCBENVIS, 2020). Therefore, the COVID-19 lockdown period is revealing the truth that the air pollution problem was largely associated with fossil fuel combustion sources. Around -18% fuel use was recorded during March 2020 as compared to March 2019.

5. Ozone Pollution

According to the reports the ozone hole is healing at Antarctica. That is probably due to the decrease in the ozone quenching precursors. There are reports about increased ozone levels in urban areas in India during COVID-19 lockdown. This is partially due to the decrease in NOx and VOCs as the automobile transport and industrial emissions are almost negligible. But partially it is also due to lesser plastic burning. In case of Delhi National Capital Region of Delhi, a ban on plastic wastes burning was imposed by the Environmental Pollution Control Authority (EPCA) in 2018 which resulted in reduction in hydrochloric acid and chlorine emissions (Park, 1977). In the absence of chlorine, the ozone destruction is reduced which is seen as spikes in ozone concentrations (Kulshrestha and Mishra, 2019). Also, the closing of illegal factories of pyrolysis oil extracted from old tires, in the north-west NCR also contributed to the reduced air emissions of HCl, chlorine and soot etc. Hence, due to HCl/Cl₂

and NO limited atmospheric conditions, the ozone concentrations are seen building up in the NCR-Delhi and at other urban locations. In other words, the air of NCR has reached almost the level of air in rural areas where ozone is relatively higher as compared to the urban areas.

It is to be mentioned that the air quality of NCR Delhi started improving after the introduction of Graded Response Action Plan (GRAP). The task force of the GRAP holds emergency meetings and directs the industrial sources shut down according to the meteorology. The GRAP has also been an effective program for tackling the issues of transport of air pollution due to crop residue burning in nearby states.

6. Future actions

- **Defining new limits of criteria pollutants for India:** This is time of defining new normal. The COVID-19 situation has provided us the answer to the violating levels of PM₁₀ and PM_{2.5} in India especially in northern Indian where the dominance of atmospheric dust substantially contributes to the particulate levels. Considering the lockdown values as normal for this region, we need to define new National Ambient Air Quality Standards (NAAQS) values for criteria pollutants, in particular the PM₁₀ and PM_{2.5}.
- **Immediate switching over to cleaner energy:** Since, the major air pollution source category is fossil fuel and hence, as an environmentalist, every professional needs to suggest the policy makers to adopt cleaner fuels in as many sectors as possible. The most alarming situation will be through the automobile emissions, which are based on the diesel and petrol. We need to opt for battery driven vehicles, solar power-driven agricultural tube wells, solar and wind power driven industrial and domestic power supplies etc.
- **Controlled operation of industries:** After the lockdown, the industry should start under controlled emissions. The regulatory bodies must ensure for the sake of the Earth protection that all the necessary pollution control equipment are fit and operated in order. It is a general feeling of the citizens that after the lockdown, manufacturing will be the priority and the pollution control will be a secondary concern. If the pollution control is kept on the back seat, it will be disastrous for the globe. In the long term, more sufferings will be there for the temperate regions through the transport of relatively long lived species. Much more dark side of the direct climate consequences may be experienced. This may hamper the economic growth of the temperate regions. However, the tropical regions are also going to be affected but through indirect consequences of climate change. The air pollution impact of the health of humans, crops and forests might be seen as direct effects of polluted scenario with lesser care for environmental control.

Impacts of COVID-19 on Water Pollution and Strategies for Improvement

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The COVID 19 lockdown had resulted in the halting of industrial activities and curtailed people's movement which has visibly improved the surface water quality. Some studies done during this period have attempted to validate this. Theoretically, whenever such anthropogenic activities, which include point and non-point sources of pollution, are stopped we should see an improvement in the quality of the natural water systems.

Hallema et al. (2020) had mentioned that in the headwaters of a river several hundreds of kilometres away from the urban areas the pollutant input from non-point sources of pollution such as industrial gaseous emissions, mining activities and reduced agricultural runoff. In the downstream stretch near the urban zones there will be reduced pollutant input from non-point sources (motorised vehicles) and point sources (industries).

A study was done by Yunus et al. (2020) on Vembanad lake, longest freshwater lake in India and a Ramsar site. The study showed that the suspended particulate matter in the lake reduced by around 16% in the lockdown period. The lake is normally polluted with mercury and microplastics. This was the first attempt to track the impact of COVID 19 spread on the hydrosphere through remote sensing. Supporting the fact that business activities have a significant impact on the lake water. In Venice the water of the Grand canal became much clearer due to reduced boat traffic thereby reducing the suspended particulates in the near surface water.

According to the real time water monitoring data of CPCB out of 36 monitoring units placed at various points of the river Ganga, the water quality of around 27 points showed improvement. The water was found to be suitable for bathing and propagation of wildlife and fisheries. The dissolved oxygen level had increased and the nitrate levels had gone down.

This is attributed to the stopping of industrial effluents from entering into the river and also that the industries were no longer lifting water from the river for industrial use. Hence, the flow was more cleaner and hence, pollutants were more diluted.

The Ganga water at Haridwar and Rishikesh was reported to be fit for drinking due to reduced inflow of both sewage and industrial effluents. Likewise, the waters of river Yamuna also showed some improvement. Reports suggest that the river Ganga was remarkably clean at several places which is attributed to increased snow melt, prevention of industrial effluents from being discharged into the river and reduced commercial use of water.

Besides this water also serves as route for the spread of SARS COV 2 virus. A COVID 19 patient will have RNA fragments in the stools. Sewage from hospitals, quarantine centers and homes where COVID 19 patients are residing will be having the virus. If the sewage is not treated completely and disinfected and then discharged into the fresh water body then it moves into the rural community through consumption of such waters. In urban areas the water from fresh water body is treated in a water treatment plant and supplied for use. Leakage and contamination in the distribution system there will lead to a spread of the disease in the urban zones.

Future strategies

- Complete treatment of waste water at the sewage treatment plant followed by disinfection.
- At rural level boiling of water for 15 minutes should be compulsory whether or not there are cases of the disease.
- In rural areas there are septic tanks for the treatment of sewage where it does not get disinfected. Here only the solid component gets treated through anaerobic digestion. Therefore minimum lateral distance of 30 m needs to be maintained between the septic tank and the fresh water source.
- Chlorination of the treated water with proper dosing in the water treatment plant so that the residual chlorine level is not less than 0.5 mg/l at the consumer end.
- Less than 40% of the sewage generated in the country is treated. Therefore, wherever we can we should adopt decentralised method of waste water treatment followed by disinfection. Treat the water where it is produced. Reuse is as much as possible and the rest can go to the STP.
- Industries will need to adhere to the discharge norms very strictly. Try to achieve zero liquid discharge.
- There is a need to maintain a river flow to keep it clean.
- First we are abstracting a given volume of water and the half of this is returned back to the river in the polluted state. Hence, the industries need to reduce abstraction from the fresh water body through recycle and reuse approach and completely treat the effluent before it is discharged back into the natural system.
- In the lockdown period the discharge of industrial effluents was stopped and as a result improvement in the surface water quality was observed to some extent. Though the quality of water was still not pristine, the quality was not fit for drinking after conventional treatment. Hence besides dealing with the industrial discharge we need to handle the domestic sewage generated which is largely untreated and let out into the natural water resources.

The COVID-19 pandemic clearly showed the negative effect which humans have on the environment. Environment is a gift to us and the very basis of our existence. Non-interference with nature for a short period of time had improved the water quality for a short term. It is indeed a wakeup call, a reminder to us that we should be more responsible with respect to our actions striking a balance between economic development and the cause of our existence on this planet. Be it controlled discharge of treated effluents, responsible tourism, handling the discharge of human waste, etc. for a long term post COVID-19 positive impact on the environment.

Impacts of COVID-19 on Soil Pollution and Strategies for Improvement

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Soil is the foundation of human civilization, since it meets all our basic needs. However, unsustainable intensification of agriculture leads to soil pollution, which disrupts planetary processes and impairs soil's ecosystem services resulting in increased human-animal interactions. This culminates in emergence of pandemics like Covid-19, Ebola, Marburg, etc. On emergence, the pandemic (COVID-19) has created both a financial and human health crisis across the globe, and also intensified soil pollution. Such pollution occurs mainly through disposal of contaminated sewage with fragments of COVID-RNA generated by infected personnel along with a huge amount of unsegregated and untreated domestic and medical wastes onto agricultural land. Existence of a significant positive correlation between RNA fragments of COVID per ml of sewage water and number of infected individuals supports the pathway. This is reinforced by the fact that more than 76% of the sewage produced in India is discharged untreated and used for fish culture, vegetable production and irrigation of crop fields. Overflowing of such sewage water in the cities and streets during monsoon season may further aggravate the spreading of the Covid-19 and cause the soil pollution.

Another important pathway is the return of the unscientific and imbalanced fertilization practice for raising crops because of the closure of almost all the soil testing laboratories and lock down of fertilizer industries (particularly smaller ones involved in micronutrient manufacturing) due to migration of labourers for the COVID. These end up with imbalanced fertilization and deterioration of soil health.

Now question is how to rehabilitate the affected soils. Very little is known about remediation of COVID-virus affected soils. Its inactivation, fixation and mobility reduction in soils may check the spreading. Additionally, knowledge regarding interaction of COVID-19 with other microorganisms, and its transformation mechanism in soils may be useful for arresting its persistence. Further, the existing remediation regulatory laws mainly meant for chemical pollution needs to be changed to tackle viral/pathogenic infections, and the municipality solid wastes contaminated with SARS-CoV-2 need be treated similarly to medical waste by sterilization and incineration.

Impacts of COVID-19 on Climate Change and Strategies for Improvement

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What billions of dollars, 1000s of meetings, conferences, white papers, policy notes, MoUs, political postures, etc. could not do in last 2-3 decades or may be more, a tiny virus did it in few days time. The world has changed and so have we. The manifestation of the strength of sheer fear is visible everywhere. Global demand for energy is set to fall by 6%, seven times the decline seen after the global financial crisis of 2008, according to the IEA's forecast. In absolute terms the drop is unprecedented, the equivalent to losing the entire energy demand of India for one year. Locked down has impacted travel industry heavily, transport and air travel has gone down to almost zero. Thus CO₂ emission has dipped significantly. The country's CO₂ emissions fell by an estimated 15% during the month of March and are likely to have fallen 30% in April. But, we must remember that this is not going to be a permanent phenomenon, CO₂ increase will not get stopped so easily as the economic activity will start again CO₂ will get emitted and the drop may look insignificant with the surge of manufacturing, transport and other activities. At present we could see blue sky, hear the sweet chirping sounds of birds, a quitter city, overall natures seems to be loving it and so the flora and fauna.

During the lockdown due to Covid a reduction in GHG emissions and air pollutants was observed as countries had imposed lockdowns. In a study published in Nature Climate Change (Aug, 2020), researchers from University of Leeds and University of York analyzed global emissions reductions from February-June 2020 and found a major dip in them. However, this was short lived and the effect of the immediate Covid-19 related restrictions was close to "negligible and lasting effects, if any, will only arise from the recovery strategy adopted in the medium term", the study said.

This highlights that without underlying long-term system-wide decarbonization of economies, even massive shifts in behaviour, will only lead to modest reductions in the rate of warming. In the backdrop of surging climate-related disasters and IPCC's recent warning of the limited time we have to restrain global temperature rise to 1.5 degrees Celsius compared with pre-industrial times, the threat of climate change calls for a stronger collective action and a united response to address what lies ahead of us, akin to the ongoing pandemic. Unlike the pandemic, the effects of climate change will be long term, and there won't be a vaccine that can save us.

The economic challenge thrown up by the Covid-19 pandemic should not derail ambitious climate action. Instead, it should be looked at as an opportunity to bring economies back on track in a much better way, propelled by clean technology and more resilient systems.

Way forward

It is possible to reduce transport-related emissions and address air quality issues by simply curtailing unnecessary travel. The use of alternate energy sources need to given greater momentum, for example pushing the use of electric vehicles with government providing incentives for their use. The rooftop solar power generation and green building concept need to be promoted in a big way. Accurate weather forecasting for resource conservation will go a long way in supporting and building resilience of the farming community.

Question is do we need a virus to have better climate, perhaps the answer is "NO". We have proven technologies and successful policies to have a better world. What we need is the strong will to "BE THE CHANGE" and learn to live with the "NEW NORMAL". It is time

that we stop ignoring science, forge political will and combine forces to work towards avoiding a climate catastrophe while adjusting to the new normal.

Impacts of COVID-19 on Biodiversity and Strategies for Improvement

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The world is currently impacted by the novel corona virus disease (COVID-19). The scale of the impacts is unprecedented, and studies have suggested that it might take more than a decade for the world to recover, societally and economically and might significantly compromise the progress of Sustainable Development Goals (SDGs). It is too early to evaluate the overall impacts of the corona virus pandemic on biodiversity and our ability to protect it, but some preliminary conclusions are possible. At this point, protected areas appear to be safe and, in many places, biodiversity is benefitting from reduced human activities. However, this may not be true everywhere, especially where enforcement has weakened but threats have not. Research has been disrupted, but only time will tell if this will have long-term consequences. Satellite images have shown dramatic improvements in air quality in every country affected by the pandemic, as industry and transport shut down. Shipping has declined worldwide and reduced impacts on marine systems might be expected. This year will very likely see a global decline in greenhouse gas emissions, as well as large reductions in other drivers of global warming. These may be short-term improvements, but they dramatically underline the pervasiveness and severity of anthropogenic impacts worldwide. Hidden beneath these brighter stories however, COVID-19 is also intensifying pressure on India's aquatic wildlife. In an already poverty stricken country, an additional 12 million are predicted to face extreme poverty as a result of COVID-19 (World Bank, 2020). With fish (farmed as well as marine-sourced) and meat forming a primary source of protein for many, its sudden unavailability has resulted in local communities exploiting wild populations, especially freshwater fish. COVID-19 period of unusually reduced human mobility, which also be termed 'anthropause' may provide important insights into human–wildlife interactions in the twenty-first century. International research community can use these extraordinary circumstances to gain unprecedented mechanistic insight into how human activity affects wildlife. Observations indicate that many animal species are enjoying the newly afforded peace and quiet, while others, surprisingly, seem to have come under increased pressure. Urgent steps from different stakeholder groups are needed to ensure this opportunity is not missed, and introduce global collaborative research initiatives that are currently forming to facilitate coordination. Scientific knowledge gained during this devastating crisis will allow us to develop innovative strategies for sharing space on this increasingly crowded planet, with benefits for both wildlife and humans.

Biodiversity represents the variety of life on earth; which includes species, genetic and ecosystem diversities. Due to lockdown, a large number of birds including vultures are clearly started to appear. Insect pollinators have appeared in abundance on crops and other plants. All these are good indication for ecological balance and biodiversity. Almost total lockdown due to COVID-19 outbreak has minimized the anthropogenic activities including overexploitation of natural resources. Biodiversity is crucial for the functioning of ecosystems and socio-economic development of a nation. Biological diversity is a global asset with tremendous economic values to the present and future generations. India was one of the first countries to have a proactive legislation and enacted a comprehensive Biological Diversity Act in 2002 to implement the provisions of Convention on Biological Diversity (CBD). The Act is being implemented through a three-tier structure, National Biodiversity Authority (NBA) at the national level, State Biodiversity Boards (SBBs) at the provisional level, and Biodiversity Management Committees (BMCs) at the local level. The Protection of Plant Varieties and Farmers Right's (PPV&FR) Act provides for an effective system for protection of plant

varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants.

Agricultural Extension During and Post COVID-19 Scenarios

GAK Kumar^a and AK Mohanty^b

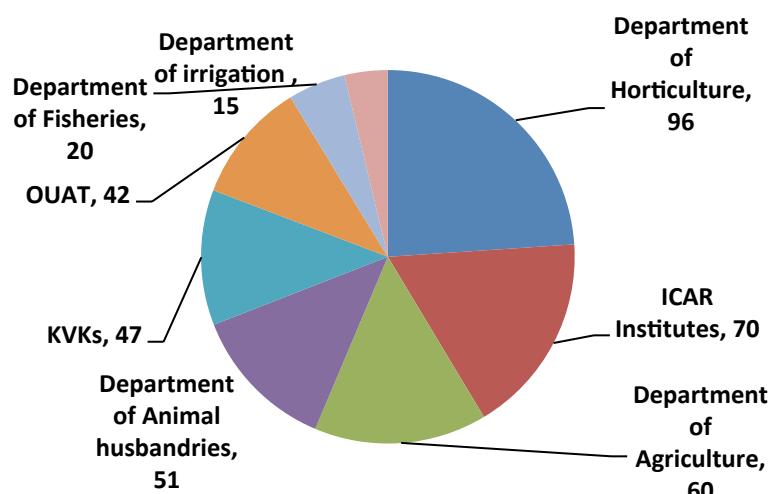
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Extension is an ongoing process of getting useful information to people and then assisting those people to acquire the necessary knowledge, attitudes and skills to utilize this information or technology for improvement of their quality of life. The term, ‘agricultural extension’, narrows the focus and defines the area to which the extension process is applied. Without extension, the farmers would lack access to the support and services required to improve their agriculture and other productive activities. In order to understand the agriculture extension situation during COVID 19 situation a study was conducted with a randomly selected sample of 100 farmers from 37 villages of five blocks of Cuttack, 24 Agri Startups of RKVY ABI, 16 PCs of KVKs out of 33 KVKs of Odisha and 25 DAO of different districts out of 30 districts of Odisha. The results are presented in ensuing graphs.

Extension services received by the farmers during COVID 19 lockdown in Odisha

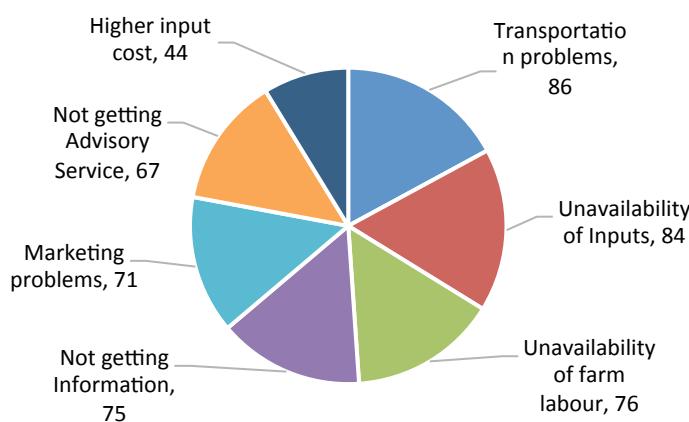
Although farmers were getting extension services from various agencies during the shutdown, it was at minimum level. Department of Horticulture, ICAR institutes, Department of Agriculture and Department of Animal Husbandries catered more than 50 per cent of the respondents. Besides, KVKs (47%), OUAT (42%), Department of Fisheries (20%) and Department of Irrigation (15%) also provided extension services to the respondents.



Whether COVID 19 affected Agriculture Extension Activities?

During the study, an effort was made to know the effect of COVID 19 on agriculture extension activities. The responses from KVKs and DAOs are represented in following

graphs. Most of the activities affected by COVID 19 were those which involved interpersonal interaction.



Problems created by COVID 19 situation for Farmers

During COVID 19 situation, farmers faced a lot of problems. Transportation was the top most problem faced by the farmers. Among other problems, unavailability of

inputs, labour and information were major problems faced by the farmers. Farmers were also affected by marketing problems, lack of timely advisory services and higher cost of inputs.

Collective action in Maharashtra to deal with COVID-19 and its impact on Agriculture

On the farmers' front, all farming operations – including procurement and marketing – abruptly stopped because of the lockdown. However, on 27 March, the government exempted all agricultural operations, agro produce marketing and its movements, harvesting activities, and procurement agencies, from the lockdown rules. In addition to this, input and fertilizer shops, and input manufacturers were also exempted, but due to fear of infection from COVID-19, the shops selling these inputs remained closed in most places. In fact, most of the wholesalers and retailers involved in these activities are also not functioning. Maharashtra found ways to face the challenges of COVID 19.



FPOs stall in Navi Mumbai

Lessons from Maharashtra

A *Single Window System* may be developed at the District/State level for giving all permissions, license to provide essential services, and for registering available stock with producers for marketing through APMC and/or directly, so that farmers and consumers movement can be managed effectively. FPOs working in the input business, especially in seed production, and equipment and implement banks, should be approached by respective district ATMA offices and Agriculture Department for extending input service delivery to farmers of the State. Some other options should be integrating FPOs & AgriTech Start-ups; strengthening forward & backward linkages; E-NAM and FPOs; decentralized marketing and capacity building of producers and entrepreneurs.

Future strategies

In view of the prolonged restrictions due to Covid-19 pandemic suitable Extension methods should be selected following SMS (Social distancing, Mask and Sanitization) guideline for rendering the Covid-19 affected services.

- Information diffusion
 - Broadcast media - Radio, TV
 - Print media - Leaflet, folder, bulletin, newsletter, magazine
 - Electronic media – Mobile/ landline call, film, video
 - Digital media – Websites, Mobile App, WhatsApp, Youtube, Facebook, Instagram, Tweeter, Messaging services, etc.
- Bridging the gap between production and supply
 - Relaxation of COVID restrictions on essential farm operations following SMS guidelines
 - Collective efforts like FPOs
 - Integrating FPOs & AgriTech Start-ups
 - Facilitating credit provision to revive the production units (MSME)

- Best utilization of unskilled reverse migrant labourers in farm operations
- Establishing the market network
 - Encouraging online marketing for farm produce from Farm to Fork Plate
 - Facilitating mobile vending of farmers' produce to reach the customers amidst containment.
 - Facilities of E-NAM and FPOs
- Building start-ups for employment generation
 - Each district should have one ABI centre to promote start-ups and entrepreneurs. (PMGKY, PMMY, Atmanirbhar Bharat Abhiyan).
 - Utilize digital platform as much as possible. It will reduce the expenditure and enhance coverage. Eg. National Institute of Agricultural Marketing (NIAM), Jaipur has provided marketing lectures to 7,200 startups, farmers and students in last 2-3 months.
- Harnessing ICT for capacity building
 - e-Training should be imparted integrating e-learning modules using Google meet, Microsoft Teams, WebEx, Zoom, etc.
 - e-Exhibition platform can be created for virtual technology showcasing/demonstration.
 - Agro-advisory and weather forecasting services may be shared through emails, WhatsApp, messaging and texting. Namaskar India has been launched by GoI.
- Capacity of Extension professionals at grass root level need to be built to utilize digital platform.
- Village level Digital Information centre may be created or Common Service Centres (CSCs) may be upgraded to cater the needs of the farmers.
- An online Extension Resource Centre may be created as repository of all extension materials like videos, audios, photographs, charts, posters, success stories, technology bulletins, etc., which may be used by KVKS, state Govt. extension workers and progressive farmers.

Economic Impacts of COVID-19 and Policy Response

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The overall economic impacts are assessed by various international and national agencies especially the GDP growth forecast earlier done by IMF for the year 2020 was 3.4%, despite the trade war, protectionist tendencies and the wave of global slowdown. In June IMF, downgraded global growth to -4.9%. Similarly for India it predicted GDP growth rate 1.9%. Obviously this is not a good sign for overall agricultural development. Moreover in agriculture except crop sector all other sectors have faced disruption and are expected to realize lower growth numbers for which official projections are awaited. However projections made by independent agencies show % share from agriculture to GVA remains almost same i.e. 14-15% as previous year. Also there may be 15% reduced output for the FY2021 compared to FY 2020. On production some estimates suggest that over 10% of farmers could not harvest the crop and 60% of those who harvested reported yield loss owing to harvest related delays.

Further the global supply chains disrupted may take much more time than usual pushing cloud over agri-export. In fact 60% of economic activities came to a halt after lockdown as a result agriculture too was affected mainly among perishables/ vegetables, fruits (Mango, Banana and Grapes), floriculture poultry, fisheries and livestock (Milk and Milk products). In addition expert feels that agriculture growth is expected to follow moderate deceleration in the medium-and long-term without sharp decline or sharp increase in output. Nevertheless, the sector is likely to witness temporary episodes of price spikes at the consumer-level and price crashes at the producer-level, with some upward pressure on price trends due to enhanced cost of production and supply side constraints.

Policy response

In order to insulate the economy from the shocks of the Covid 19, Government brought two stretches of packages, one which was initiated on 26th March, 2020 with 1.70 lakh crore and another on 12th May, 2020 Under the first package, government has frontloaded Rs. 2000 under Pradhan Mantri Garib Kalyan Yojana (PMGKY) to PM KISAN to benefit 8.7 crore farmers in the country. Moreover the increase of MGNREGA wages from Rs. 182 to Rs. 202 has also helped about 13.62 crore families including landless farmers to bear the pandemic effects to an extent.

The second package under the Atmanirbhar Bharat constituted about 10% of GDP (20 Lakh crore) wherein following salient initiations have been made:

- Concessional credit boost to farmers through KCC benefitting over 2.5 crore farmers
- Agri Infrastructure Fund of 1 lakh crore for development of agriculture infrastructure projects at farm-gate and aggregation points
- Emergency working capital of Rs. 30,000 crore will be disbursed through NABARD to Rural Cooperatives and RRBs to meet the crop loan requirement and additional Rs. 90,000 will be given through NABARD to RRBs to meet crop loan for this year to
- For fisher men under Pradhan Mantri Matsya Sampada Yojana (PMMSY) 20,000 crore has been allocated out of which 11,000 crore will be spent on activities in Marine, Inland fisheries and Aquaculture and Rs 9,000 crore will be spent for developing infrastructure (such as fishing harbours, cold chain, markets).

- For animal husbandry Rs 15,000 crore has been allocated with the aim of supporting private investment in dairy processing, value addition, and cattle feed infrastructure.

Also RBI has extended the moratorium to all crop loans upto Rs. 3 lakh till 31st August, 2020. In addition, many states have suspended the APMC act in order to facilitate farmers to sell their produce out of the markets and to ensure smooth operation of supply chains. Under the Atmanibhar Bharat, govt announced to bring changes in *Essential Commodities Act* (1955), to legislate central law for agriculture marketing by repealing APMC act and also to create legal framework of *Agriculture Produce Pricing and Quality Assurance* to enable farmers to engage with processors, aggregators, large retailers, and exporters in a fair and transparent manner.

As uncertainty persists over ending COVID 19 crisis it become imperative to give an end to end insulation to the farm operations, marketing, value and supply chain for robust food systems so that it provides time value and right prices to both the farmers and the consuming millennial. Hence, apart from above; *first*, there is also need for more agricultural market reform and digital solution to connect farmers to markets. *Second* for better dissemination of price information national level program is necessary to create dash-board of prices and its dissemination through mobile Apps. *Third*, it is necessary to weave a policy to facilitate and incentivize the mobile procurement of perishable commodities through NAFED, FPO and other agencies. *Fourth*, need to create Agricultural Development Council (ADC) in line with GST council to enhance and convince the states towards the central government policies, programmes and model acts. *Lastly* in long term government may embark moving certain subjects in agriculture from state list to concurrent list in order to keep smooth functioning of key enshrined.

To trickle down the efforts of all these measures and economic packages, it must be supplemented with institutions, agencies and civil society in protecting rural communities and migrant workers. Although presently there is moderate disruption in the supply chain activities of the farm sector, and is less than what experts have speculated during the lockdown. Unlike other sectors, Agriculture sector has showed resilience in terms of overall growth except few sub sectors. Hence, time is apt to bring paradigm shift in the policy space to use this crisis as opportunity to structurally strengthen the farm sector for welfare of millions of farmers and their households.

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