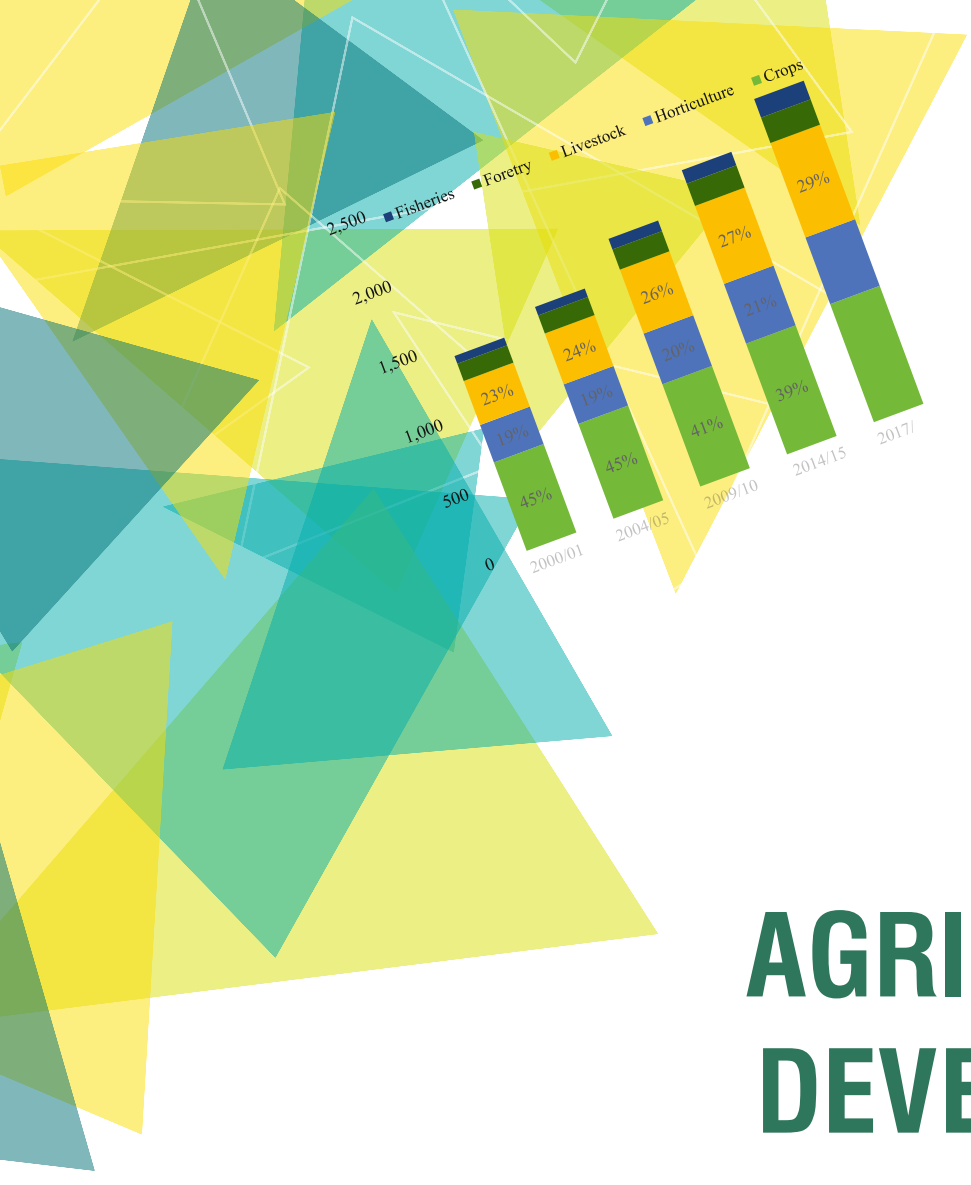

AGRICULTURAL DEVELOPMENT

REPORT 2020-21

भाकृअनुप – राष्ट्रीय कृषि आर्थिकी एवं नीति अनुसंधान संस्थान

ICAR - National Institute of Agricultural Economics and Policy Research

(Indian Council of Agricultural Research)

NIAP Publication Committee

The ICAR-National Institute of Agricultural Economics and Policy Research (NIAP) was established by the Indian Council of Agricultural Research (ICAR) to strengthen agricultural economics and policy research in the National Agricultural Research System comprising a network of ICAR institutions and State Agricultural Universities. The mandate of the Institute is:

- Agricultural economics and policy research on markets, trade, and institutions
- Growth and development models for sustainable agriculture
- Technology policy, evaluation, and impact assessment

ICAR-NIAP has emerged as a think tank in the area of agricultural policy and it has contributed to increased participation of the ICAR in agricultural policy-making. Besides ICAR, the Institute regularly provides research based inputs to the NITI Aayog, Government Departments, States, and other stakeholders for policy decisions in diverse areas related to agriculture.

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भारत सरकार
कृषि भवन, नई दिल्ली
**MINISTER OF AGRICULTURE & FARMERS WELFARE,
RURAL DEVELOPMENT AND PANCHAYATI RAJ
GOVERNMENT OF INDIA
KRISHI BHAWAN, NEW DELHI**

27th **January, 2021**

MESSAGE

The Government of India has taken major initiatives during the past few years to bring transformative changes in Indian agriculture. Important among these measures are reorientation of the schemes to double farmers' income, higher allocation of public funds, direct transfer of benefits to farmers, post-harvest management and market reforms, and better financial services like crop insurance and farm credit to farmers. These initiatives are being translated into tangible outcomes like higher agricultural growth and inclusiveness. Unprecedented agricultural growth with diversification and interrupted supply chains during COVID-19 lockdown have re-established priority of agriculture in the economic development. There is a need to properly document these achievements and make suggestions for a higher impact.

I am happy to note that ICAR – National Institute of Agricultural Economics and Policy Research (NIAP), New Delhi has taken an initiative to bring out the "Review of Agriculture" on a regular basis. I hope it will be well received by the stakeholders involved in agricultural research, planning and policy issues.

(Narendra Singh Tomar)

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सत्यमेव जयते

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राज्य मंत्री
भारत सरकार
MINISTER OF STATE FOR AGRICULTURE
& FARMERS WELFARE
GOVERNMENT OF INDIA

MESSAGE

The Government of India is committed to doubling farmers' income by 2022. The Government has launched a number of reforms for enhancing agricultural productivity, agricultural diversification, promoting secondary agriculture, and efficient marketing for improved price realization. Positive results are witnessed with higher investments for agricultural infrastructure, technological innovations, improved marketing infrastructure and higher export orientation. Changing consumer preferences and growing international trade opportunities are providing new platforms to make the country as a credible global player. Agriculture has sustained growth momentum despite slowdown in the economy. The central and state Governments have made rigorous efforts during COVID-19 pandemic to battle with its adverse impacts. The Government took timely action and provided special privilege to agriculture in resuming the supply not only domestically but also internationally.

ICAR has been continuously providing impetus to agricultural growth through various technological innovations and linkages with farmers. ICAR thorough its research, policy and capacity building activities is facilitating effective formulation and implementation of various schemes of the Government. The efforts of ICAR-National Institute of Agricultural Economics and Policy Research have also been instrumental in shaping the policy reforms. The publication of this report is timely, and it will be useful for the stakeholders. I wish the team all the best and hope that the report will improve in subsequent versions.

(Kailash Choudhary)

Dated 02.02.2021
New Delhi

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Foreword

Indian agriculture is rapidly transforming with the technological infusion, policy reforms, fast-changing food habits, and growing international trade opportunities. This sector has sustained its growth momentum despite slowdown in the economy. Agricultural sector grew by 4 percent during 2019-20 and registered a positive growth in the successive two quarters of 2021-22. Concerted efforts by the Centre and States resulted in notable progress in combating the economic and social ill-effects of the COVID-19 pandemic. The supply chains, market arrivals and prices of food commodities were significantly impacted during the lockdown. However, agricultural exports in the first half of 2020-21 were higher as compared to the previous year. The timely action by the Central and State governments through removing restrictions on agricultural and marketing activities resumed the supply of agricultural produce. Efforts made by the Government to facilitate supply chains of perishable commodities like milk, eggs, fruits and vegetables proved to be effective.

To improve the market sentiments, the Government announced a package of one-lakh crore Rupees for boosting agri-infrastructure development. Three new market legislations removing restrictions on intra- and inter-state trade, stocking limits, and assured services and price agreements were enacted to provide greater choices to farmers. The reforms shall create competition in the markets which is further likely to reduce the marketing costs, help build efficient value chains, and enable better price discovery. The prospects for 2020-21 seem to be brighter on account of higher area sown. Better infrastructure, policy reforms and technology delivery will further accelerate agricultural development in the country.

ICAR-NIAP has brought out this important publication to capture these recent developments. I compliment the entire team for their efforts in bringing out this publication, which shall be a regular activity. I expect that policy makers will take note of the findings, which shall be reflected with increased allocations for investment in the productive capacity, R&D, and rural infrastructure.

(T. Mohapatra)

Date: 19th January 2021
Place: New Delhi-110 001

Preface

We have great pleasure in bringing out first development report on Indian agriculture. The need for this report was felt for some time because of increasing policy debate and information needs to shape future of Indian agriculture. Various committees of ICAR and NIAP have also suggested for a publication on agricultural development on a regular basis. The publication should broadly cover performance of Indian agriculture and progress of various development schemes. The report has highlighted some of these developments and issues. It also provides a brief summary of research highlights of ICAR and NIAP. Impact of COVID-19 on agriculture and rural economy and measures to revive the economy are special features of the report. Recent policy reforms of the Government, future outlook and budget expectations are other important features of the report. Given the resource needs, the focus of the Budget is expected to be on revival of the economy and acceleration of the pace of agricultural growth to boost rural demand. The post-harvest reforms should continue to get high priority.

I am grateful to Sh. Narendra Singh Tomar, Hon'ble Minister of Agriculture & Farmers Welfare and Rural Development, and Sh. Kailash Choudhary, Hon'ble Minister of State, Agriculture & Farmers Welfare for their messages of encouragement and support to the Institute. I am also grateful to the Indian Council of Agricultural Research, particularly Dr Trilochan Mohapatra, Secretary, DARE and Director General, ICAR for his encouragement and guidance to bring out this publication. My colleagues deserve special thanks for their contributions for timely publication of the report. Grateful thanks are due to Raka Saxena, Prem Chand and Balaji SJ for meticulous editing and presentation of the report. Suggestions are welcome to improve the content and coverage of the report in future.

Suresh Pal
Director

Abbreviations

ACZ	Agro-Climatic Zone
AGMARKNET	Agricultural Marketing Information System
AHIDF	Animal Husbandry Infrastructure Development Fund
AI	Artificial Intelligence
AIBP	Accelerated Irrigation Benefit Programme
AIF	Agricultural Infrastructure Fund
APEDA	Agricultural and Processed Food Products Exports Development Authority
APMC	Agricultural Produce Market Committee
APMR	Agriculture Produce Marketing Regulation
ATIC	Agricultural Technology Information Centre
BIRD	Bankers Institute of Rural Development
CBT	Computer Based Test
CCA	Cultivable Command Area
CCE	Crop Cutting Experiment
CHC	Custom Hiring Centre
CMIE	Centre for Monitoring Indian Economy
CPI	Consumer Price Index
CRISPR	Clustered Regularly Interspaced Short Palindromic Repeats
DAP	Diammonium Phosphate
DAY-NRLM	Deendayal Antyodaya Yojana - National Rural Livelihoods Mission
DBT	Direct Benefit Transfer
DCCB	District Central Cooperative Bank
DFI	Doubling Farmers' Income
e-NAM	National Agriculture Market
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
FMD	Foot & Mouth Disease
FPO	Farmer Producer Organization
FY	Financial Year
GCA	Gross Cropped Area
GCF	Gross Capital Formation
GDP	Gross Domestic Product
GrAM	Gramin Agricultural Market
GVA	Gross Value Added
HCR	Head Count Ratio
ICT	Information and Communication Technologies
IT	Information Technology
KCC	Kisan Credit Card
KMS	Kharif Marketing Season
KVK	Krishi Vigyan Kendra
LAN	Local Area Network
LH&DC	Livestock Health and Disease Control
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MIS	Market Intervention Scheme
MNC	Multi-National Companies
MPCE	Monthly Per Capita Consumption Expenditure
MSME	Micro, Small and Medium Enterprises
MSP	Minimum Support Price
NABARD	National Bank for Agriculture and Rural Development

NADCP	National Animal Disease Control Programme
NAFED	National Agricultural Cooperative Marketing Federation of India Limited
NAHEP	National Agricultural Higher Education Project
NARS	National Agricultural Research System
NCDC	National Cooperative Development Corporation
NCT	National Capital Territory
NDDB	National Dairy Development Board
NDRI	National Dairy Research Institute
NEH	North Eastern Hill
NFDB	National Fisheries Development Board
NICRA	National Innovations on Climate Resilient Agriculture
NMBP	National Mission on Bovine Productivity
NPBB	National Programme for Bovine Breeding
NRM	Natural Resource management
NSA	Net Sown Area
NSC	National Steering Committee
NSSO	National Sample Survey Office
NTA	National Testing Agency
PACS	Primary Agricultural Cooperative Societies
PAN	Permanent Account Number
PDPS	Price Deficiency Payment Scheme
PDS	Public Distribution System
PFCE	Private Final Consumption Expenditure
PLFS	Periodic Labour Force Survey
PM-AASHA	Pradhan Mantri Annadata Aay Sanrakshan Abhiyan
PMFBY	Pradhan Mantri Fasal Bima Yojana
PM-KISAN	Pradhan Mantri Kisan Samman Nidhi
PM-KMY	Pradhan Mantri Kisan MaanDhan Yojana
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
PMMSY	Pradhan Mantri Matsya Sampada Yojana
PPSS	Pilot Private Procurement and Stockist Scheme
PSS	Price Support Scheme
RCP	Representative Concentration Pathway
RGM	Rashtriya Gokul Mission
RMS	Rabi Marketing Season
RRB	Regional Rural Bank
SCB	State Cooperative Bank
SDC	Supporting Dairy Cooperatives
SHC	Soil Health Card
SHG	Self-Help Group
SIA	State Implementing Agencies
SIP	State Irrigation Plan
SWMA	Supplementary Water Management Activities
TE	Triennium Ending
UER	Unemployment Rate
USDA	United States Department of Agriculture
WPI	Wholesale Price Index

कार्यकारी सारांश

भा.कृ.अनु.प.–राष्ट्रीय कृषि आर्थिकी एवं नीति अनुसंधान संस्थान, नई दिल्ली ने पहली ''कृषि विकास रिपोर्ट 2021'' प्रकाशित की है इसमें वर्षावधि 2020–21 में भारतीय कृषि में वृद्धि एवं आगामी वर्ष 2021–22 में वृद्धि की संभावनाओं का समावेश किया गया है। इस प्रकार के प्रकाशन की आवश्यकता काफी समय से महसूस की जा रही थी, क्योंकि भारतीय कृषि के भावी स्वरूप को निर्धारित करने में आकड़ों एवं नीति विचार–विमर्श की भूमिका बढ़ी है। संस्थान में शोध कार्यों की प्राथमिकता का निर्धारण कृषि में प्रमुख नीतिगत मुद्दों को ध्यान में रखकर ही किया जाता है, जिसमें कृषि में संरचनात्मक बदलाव, कृषि आय को दोगुनी करने की नीतियाँ, जलवायु परिवर्तन का प्रभाव विश्लेषण, मूल्य श्रृंखला प्रबंधन एवं स्थायी कृषि विधियाँ शामिल हैं। संस्थान के प्रमुख शोध कार्यक्रमों में बाजार समाचार एवं फसलों के दृष्टिकोण माडलीकरण भी शामिल हैं। वर्षावधि 2020–21 में प्रमुख अनुसंधान विषयों जैसेकि प्रौद्योगिकी दूरदर्शिता, कृषि में विविधीकरण, खाद्य एवं पोषण सुरक्षा, आदि विषयों पर ध्यान केन्द्रित किया गया।

भारतीय अर्थव्यवस्था में मंदी के बावजूद, कृषि क्षेत्र ने अपनी वृद्धि दर को कायम रखा। वर्ष 2019–20 में कृषि में वृद्धि दर 4 प्रतिशत रही, जबकि अर्थव्यवस्था में वृद्धि दर केवल 3.9 प्रतिशत रही। कोविड–19 महामारी के कारण 2021–22 में भारतीय अर्थव्यवस्था की वृद्धि दर में 7.2 प्रतिशत संकुचन की संभावना है, जबकि कृषि में 3.4 प्रतिशत वृद्धि का अनुमान है। खाद्य वस्तुओं के थोक मूल्य सूचकांक में सुधार हुआ है तथा कुछ कृषि वस्तुओं के निर्यात में सार्थक वृद्धि दर्ज की गयी है। इसके साथ आपूर्ति–कारकों की तरफ से संकेत मिलता है कि कृषि क्षेत्र अच्छा करता रहेगा और पिछले वर्षों की तरह इस क्षेत्र की वृद्धि से देश की अर्थव्यवस्था के साथ समावेशी रहने की आशा है। कृषि क्षेत्र ने कोविड–19 महामारी के दौरान लचीलापन दिखाया है। कटाई उपरान्त कृषि कार्यों में केन्द्रीय एवं राज्य सरकारों के बीच काफी सहयोग रहा। कोविड महामारी के बावजूद, बोआई क्षेत्रफल में विस्तार, उत्पादन कारकों एवं कृषि श्रम के प्रयोग में वृद्धि तथा अनुकूल नीतियों के कारण, कृषि क्षेत्र देश की अर्थव्यवस्था में वृद्धि को बढ़ाने में सहयोग कायम रखेगा।

कोरोना महामारी के दौरान आर्थिक एवं सामाजिक दुष्परिणामों से निबटने में कृषि क्षेत्र की भूमिका उल्लेखनीय रही। सरकार द्वारा पूर्ण प्रतिबंधों में कुछ ढील देने से कृषि कार्यों एवं गतिविधियों के परिणाम सकारात्मक रहे और आवश्यक खाद्य वस्तुओं की कीमतों पर नियंत्रण रखने में मदद् मिली। इस दौरान अधिक मूल्य वाली खाद्य वस्तुओं जैसेकि दूध, गैर शाकाहारी वस्तुओं, फलों एवं अन्य खाद्य वस्तुओं की खपत अनाजों, दालों एवं तेलों की अपेक्षाकृत कम रही। अल्पावधि में महामारी का प्रभाव दैनिक वेतन श्रमिकों एवं गरीबों के बीच सर्वाधिक होना संभावित है, यदि इनके आय में नुकसान की भरपाई नहीं की जाती है।

वर्ष 2022 तक किसानों की आय को दोगुनी करना सरकार की प्रमुख नीति कार्यक्रमों में शामिल है। इसके लिए सात आय स्रोतों यथा फसल एवं पशुधन उत्पादकता में सुधार, संसाधन उपयोग दक्षता, फसल सघनता में वृद्धि, अधिक मूल्य वाली फसलों की तरफ विविधीकरण, किसानों द्वारा प्राप्त वास्तविक मूल्य में सुधार और कृषि से गैर कृषि व्यवसाओं की तरफ बदलाव, आदि का आंकलन किया गया है। सरकार ने इस दिशा में महत्वपूर्ण प्रयास किये है। कृषि क्षेत्र में पूँजी के प्रवाह को बढ़ाया गया है। जिसके अर्न्तगत बजट आबंटन में वृद्धि, गैर बजटीय स्रोतों में विस्तार, संस्थागत ऋण में वृद्धि और व्यापार निवेश में बढ़ोत्तरी शामिल हैं। मौजूदा योजनाओं को प्रभावी बनाने के लिए इन्हें पुनर्गठित एवं क्रियान्वयन के योग्य बनाया जा रहा है। अध्ययन दर्शाते हैं कि राष्ट्रीय कृषि बाजार के क्रियान्वयन से कीमतों की प्राप्ति एवं कृषि प्रदार्थों के विपणन में तेजी, सूक्ष्म सिंचाई के प्रयोग से फसलोत्पादकता, जल संरक्षण एवं संसाधन उपयोग दक्षता में वृद्धि और मृदा स्वास्थ्य कार्ड एवं नीम लेपित यूरिया के प्रयोग से उत्पादकता में वृद्धि एवं उत्पादन लागत को कम करने में सहायता मिली है। साथ ही में अधिक मूल्य वाली फसलों की तरफ विविधीकरण का परिणाम उत्साहजनक रहा है।

राष्ट्रीय कृषि एवं ग्रामीण कृषि बाजारों को मजबूती प्रदान करने के लिए सार्वजनिक धन का आबंटन किया जा रहा है और कृषि संरचनातंत्र को मजबूत करने के लिए कृषि अवसंरचना निधि स्थापित की गई है। इसके अलावा, कृषि बाजारों को सुदृढ करने के लिए अग्रानुबंध एवं पश्चानुबंध जैसे अनेक विपणन सुधारों की शुरूआत की गयी है। जिससे किसानों को लाभकारी मूल्य सुनिश्चित हो सके। सरकार ने देश में कृषि बाजारों में सुधार के लिए तीन कानूनों को पास किया है। इन कानूनों का उद्देश्य किसानों की बाजार पहुँच में सुधार, लाभकारी मूल्य की प्राप्ति और कृषि वस्तुओं की आपूर्ति–श्रंखला बनाना है। बाजार हस्ताक्षेप के रूप में एमआइएस तथा पीएसएस किसानों के लिए लाभकारी हैं। कई अन्य योजनाओं ने पशुपालन, डेयरी एवं मत्स्य तथा किसानों के समग्र विकास में योगदान दिया है। उपरोक्त कार्यक्रमों के कुशल कार्यान्वयन से देश के किसानों की आमदनी बढ़ाने में निश्चित रूप से मदद मिलेगी।

आगामी वर्ष 2021–22 में कोविड–19 महामारी के प्रभाव की कृषि पर संभावना नगण्य है। क्योंकि वर्ष 2020 रबी सीजन में बुवाई क्षेत्रफल में बढ़ोत्तरी हुई है इससे अधिक फसलोत्पादन की आशा है, कृषि जिंसों की माँग–आपूर्ति तथा व्यापार परिदृश्यों पर आधारित दृष्टिकोण–माडल का अनुमान है कि आगामी कृषि वर्ष सकारात्मक रहेगा। नई कृषि नीतियों, जैसेकि आत्मनिर्भर भारत अभियान, बाजार सुधार और अन्य नीतियों में बदलाव से कृषि में निवेश तथा नवाचार को प्रोत्साहित करने और चुनौतियों से निपटने में सहायता मिलेगी।

पिछले कुछ वर्षों में सार्वजनिक धन के आबंटन में सार्थक बढ़ोत्तरी हुई है जिसका ज्यादातर हिस्सा राजस्व खर्च के रूप में, विकास एवं सामाजिक कल्याण योजनाओं के लिए हुआ है। अब समय आ गया है कि निवेश उत्पादन क्षमता को बढ़ाने में किया जाए। कृषि अनुसंधान एवं शिक्षा, पशुधन सेवाओं के लिए बुनियादी ढ़ांचे का विकास, सूक्ष्म सिंचाई एवं भूमि विकास, कृषि निवेश के लिये प्राथमिक आवश्यकतायें हैं। भविष्य में नीति हस्तक्षेपों का उद्देश्य 'कृषि व्यवसाय को करने में आसानी', कृषि मूल्य श्रंखलाओं के एकीकरण तथा भारतीय कृषि उत्पादों की वैश्विक प्रतिस्पर्धा बढ़ानें का होना चाहिए।

हालांकि पिछले वर्षों में कृषि अनुसंधान एवं शिक्षा विभाग के बजट आबंटन में वृद्धि की गयी है, लेकिन कोविड महामारी के कारण उपरोक्त आबंटन में भारी कटौती की गयी है, जिसे आगामी बजट में पुनः बहाल किये जाने की आवश्यकता है। इसके अतिरिक्त बड़े राज्यों जैसेकि उत्तर प्रदेश, राजस्थान तथा मध्य प्रदेश औसतन 5269 रूपये प्रति हेक्टेयेर या इससे कम खर्च करते हैं इसमें और सुधार की आवश्यकता है। राज्यों द्वारा बजट आबंटन में काफी अनिश्चितता एवं विषमता है, एवं इनके द्वारा कम राशि आबंटित किये गये क्षेत्रों में कृषि अनुसंधान एवं शिक्षा तथा भूमि विकास को मुख्य रूप से रेखांकित किया गया है। कृषि एवं ग्रामीण विकास के लिए नवीन प्रौद्योगिकियों एवं नवाचार को बढ़ावा देने के लिए बजट आबंटन की प्रतिबद्धता होनी चाहिए। कृषि में ऐसे प्रौद्योगिकियों एवं नवाचारों को बढ़ावा दिया जाना चाहिए जोकि कृषि आय बढ़ाने, संसाधनों एवं पारिस्थितकीय सेवाओं के संरक्षण एवं कृषि विविधीकरण को प्रोत्साहित करते हैं।

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Executive Summary

ICAR-NIAP has published first Agricultural Development Report in 2021, which covers the growth of Indian agriculture in 2020-21 and prospects for 2021-22. The need for such a publication was felt for some time because of increasing policy debate and information needs to shape future of Indian agriculture. The Institute research has been prioritized covering all the key policy issues of agriculture and it focused on structural changes in agriculture, strategies for doubling farm income, climate change impact assessment, value chain management and sustainable agricultural practices. Market intelligence and commodity outlook have been the prime research agenda of ICAR-NIAP. Technology foresight, diversification, food and nutritional security were also focused by the Institute in 2020-21.

The agricultural sector has sustained its growth momentum despite the slowdown in the economy. During the year 2019-20, the sector grew by 4 percent when the economy grew only by 3.9 percent, and amid COVID-19 pandemic, the sector is projected to grow by 3.4 percent in 2020-21 against the estimated contraction of 7.2 percent in the economy. WPI of food commodities improved and exports of certain commodities have also increased significantly. The supply-side factors signal that the sector shall continue to perform well in the coming year and agricultural growth shall continue to be inclusive as in the past. The sector has proved resilient to COVID-19 pandemic, and cooperation among and Centre and States in the post-harvest management and the procurement had been the key factors. With an expansion in cropping area in the post-pandemic season, accompanied by an increase in inputs use and credit, and an enabling policy environment, the sector would continue to contribute to the nation's economic growth.

Notable progress had been made in combating the economic and social ill-effects of the pandemic. The Government efforts towards easing the lockdown restrictions on agricultural operations and marketing activities have resulted in easing of prices of essential food commodities. Still, it is expected that the decline in the consumption of high value food commodities such as milk, non-vegetarian products, fruits, and other food products was comparatively higher than the staple foods such as cereals, pulses, and edible oils. The immediate short-run impacts shall be felt high among the casual workers, and poverty among them may further deteriorate if income loss is not compensated.

Doubling of farmers' income by 2022 is the main policy objective of the Government. Seven sources of growth, viz. improvement in crop and livestock productivity, resource use efficiency, increase in cropping intensity, diversification towards high value crops, improvement in real prices received by farmers, and shift from farm to non-farm occupations have been identified. The Government has made serious efforts in this direction. Capital channelization into agriculture sector is picking up, as evident from higher budgetary allocations, mobilization of non-budgetary resources, enhancement in institutional credit, and higher business investment. The existing schemes are being restructured for effective orientation and implementation. Strong emphasis is being given on the productivity based gains with specific focus on certain neglected crops like pulses, oilseeds and nutri-cereals (millets). Technological innovations coupled with favorable policy environment have resulted in substantial increase in the production of pulses. The studies indicate that there has been positive impact of e-NAM in terms of price realization and volume traded; micro-irrigation on crop productivity, water conservation on resource use efficiency; and soil health cards and neem coated urea in achieving higher productivity and lower the cost

of production. Diversification towards high-value crops is producing encouraging results.

Public funds are allocated to strengthen e-NAM and GrAMs and Agricultural Infrastructure Fund has been created to build agri-logistics. Several market reforms have been rolled out for strengthening backward and forward linkages and ensuring remunerative prices to farmers. The Government has also passed three legislations for reforming agricultural marketing in the country. These legislations are aimed at improving the market access of farmers, better price realization, and create efficient supply chains for agricultural produce. The market interventions in the form of MIS and PSS have been beneficial to the farmers as well as consumers. Many other schemes have also contributed to overall development of livestock, dairy and fisheries and helped the farmers. The efficient implementation of all the programmes mentioned here will definitely help in enhancing farmers' income in the country.

The prospects for the year 2021-22 are less likely to be influenced by COVID-19 pandemic. The area sown in 2020 for *rabi* season is higher and likely to result in higher crop production. Based on outlook projections, the supply, demand and trade scenario of crops are estimated to be positive for the year 2021-22. The new policies such as *Atmanirbhar Abhiyan*, recent market reforms, and other policy changes in agriculture would stimulate investment and innovations to address the challenges of agricultural sector.

The future policy interventions should be aimed at improving 'ease of doing agri-business' and integration of agri-value chains in a sustainable manner, so as to increase global competitiveness of Indian agri-products.

The allocation of public funds for agricultural sector has increased significantly over the years; however, much of these are towards revenue expenditure for the development and welfare schemes. It is time to increase the investment in the productive capacity and the priority sectors are research and education, infrastructure development for livestock services, micro-irrigation and land development. The allocations for DARE have also increased but there was considerable cut in 2020-21 because of financial crunch arising from COVID-19. This should be restored in the forthcoming budget. The allocations by the states are quite erratic and there are considerable inter-state variations. The bigger states like Uttar Pradesh, Rajasthan and Madhya Pradesh are allocating fewer resources (Rs 5,269/ha or less) to agriculture. This needs correction. The lower allocations are translated into under-investment in some of the productive areas like agricultural R&D and land development. There should be committed funds for agriculture and rural innovations for out-scaling of proven technologies and promoting innovations. The innovations and technology for higher farm income, resource conservation, ecosystem services, and agricultural diversification should be encouraged.

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Growth of Indian Agriculture

Balaji S. J. and Kiran Kumara T. M.

Indian agriculture has sustained its growth momentum despite slowdown in the economy. During the year 2019-20, the sector grew by 4% when the economy grew by 3.9%, and amid the COVID-19 pandemic, the sector is projected to grow by 3.4% in 2020-21 against the estimated contraction of 7.2% in the economy. The supply-side factors signal that the sector shall continue to perform well in the coming year, and the growth shall continue to be inclusive as in the past.

1.1 Agricultural Growth

National scenario

Agriculture has sustained its growth momentum despite slowdown in the economy. The sector grew by 4% during the year 2019-20, slightly higher than the economic growth of 3.9% (MoSPI 2020a). In fact, when the entire economy shrank due to COVID-19 pandemic, this was the only sector to register a positive growth in successive quarters. During the first quarter of the year 2020-21, agriculture grew by 3.4% when the national growth fallen to -22.8%, and maintained the same level in the second quarter when the national average improved to -7% (MoSPI 2020b). The first advanced estimates indicate that agriculture would continue to grow at 3.4% throughout the year 2020-21 (MoSPI 2021).

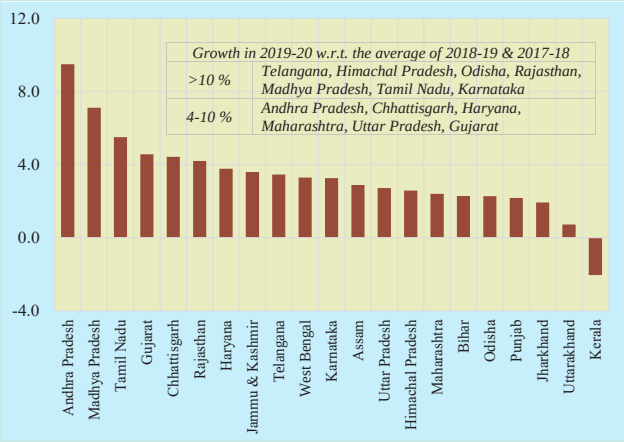
Agricultural production continued to grow like in the past. As per the latest estimates (MoAFW 2020a), the sector produced about 11.4 million tonnes of additional foodgrains, including 4.4 million tonnes of coarse cereals, 4 million tonnes of wheat, 2 million tonnes of rice, and 1 million tonne of pulses during the year 2019-20 alone. Oilseeds (+1.9 million tonnes) and cotton (+7.5 million bales) have also registered substantial rise in the production when compared with the year 2018-19. Similar was the case in horticulture production. While fruits production increased marginally by 1.1%, about 4.7% growth was observed in vegetable production during the year 2019-20 (MoAFW 2020b). The post-COVID season as well has seen notable improvements. Effective cooperation of states with the center has resulted in smooth harvests of almost all *rabi* crops. Subsequently, *kharif* season advanced to sow additional area under almost all crops. Paddy and pulses witnessed an increase in area by 5.6% and 4% respectively, and oilseeds registered as high as 9.8% increase (MoAFW 2020c).

Performance of states

Substantial growth of agriculture in certain states, and a fair performance in the rest of the states have resulted in such a stronger position of agriculture and allied sector at the national level (Figure 1). During 2011-12 to 2019-20, Andhra Pradesh and Madhya Pradesh have grown by more than 7% a year. In Tamil Nadu, Gujarat, Chhattisgarh and Rajasthan, this has varied between 4% and 6%. About seven states have grown by more

than 10% in 2019-20 (see box in Figure 1), and Andhra Pradesh, Chhattisgarh, Haryana, Maharashtra, Uttar Pradesh and Gujarat have grown between 4% and 10%. Having observed an increase in crop area in the post-pandemic seasons and a prediction of normal rainfall, we could expect a strong regional convergence in the productivity in the coming year (Pal et al., 2020).

Figure 1. Growth in agriculture and allied sector GVA (2011-12 to 2019-20, % p.a.)



Source: Based on NSO estimates

Note: GVA is at 2011-12 prices

Sources of growth

In less than a decade (2011-12 to 2019-20), the share of crops in total agricultural GVA has fallen from 65% to 56%, and livestock sector's share has risen from 22% to 29%. In other words, while growth was just 1.3% in crops, it has been 7.6% in livestock sector. The states of Madhya Pradesh, Tamil Nadu, Rajasthan and Andhra Pradesh have contributed to this livestock sector growth. Fisheries sector has grown impressively by 9% at the national level, and the contribution of Andhra Pradesh, Madhya Pradesh, Odisha and Rajasthan has substantially risen.

Crop sector has performed well in Madhya Pradesh, Andhra Pradesh, Chhattisgarh and West Bengal, and to some extent in Gujarat. One would note that horticulture contributes 36% of crop sector output. Consistent growth in horticulture, especially in fruits and vegetables, and in crops like pulses, coarse cereals, wheat, and groundnut had been the major sources of growth. Expansion of technologies such as micro-irrigation has played a crucial role in ensuring the growth. More than 11 million hectare of land has been brought so far under micro-irrigation in the country; and five states, namely Rajasthan, Andhra Pradesh, Maharashtra, Karnataka and Gujarat, cover 77% of drip and 69% of sprinkler irrigation, whose contribution to the crop sector is substantial.

Investment (public & private) in agriculture has grown by 6-8% during 2018-20, and expected positive growth in the coming years shall further enhance farmers' investment in improved technologies and high-value agriculture. Improvement in institutional lending shall support the private investment. With the recovering economic growth and household income, one can expect market-driven growth of high-value agriculture.

1.2 Fertilizer and Pesticide Use

In terms of both production and consumption, the performance of the fertilizer sector has improved. Compared with the previous year, the industry has produced about 4.5 lakh tonnes of additional fertilizers, totaling 244.5 lakh tonnes of fertilizers during the year 2019-20. The consumption has also increased. The annual consumption of urea has increased by 5.3%, DAP by 15.7%, and MOP by 3.5%. The consumption has increased significantly during the *kharif* season; an increase of 63% in use of urea and MOP, and 109% increase in DAP use is observed over the previous year (MoCF 2020). A significant rise in the procurement during the pandemic period and a rise in minimum support prices might have contributed to such change in fertilizer use.

While the consumption statistics is not available for the states during 2019-20,

observing agricultural growth in major fertilizer consuming states, we expect the trend in the previous year might continue in 2019-20 as well. For instance, in Uttar Pradesh, which consumed around 17% of fertilizers in last year, crop sector GVA growth had been more than 4% in 2019-20. Similar is the case of Rajasthan and Madhya Pradesh. These states consumed around 6% and 8% of total fertilizers and GVA growth has been 8.3% and 5.7% respectively. Observing the use of pesticides, there has been a marginal increase (1.6%) in the use in 2019-20. Maharashtra and Uttar Pradesh together consumed around 40% of pesticides in agriculture and their consumption further increased by around 9% and 12% respectively. Punjab, Telangana, and Haryana are the other major states consuming a sizeable volume of pesticides. Interestingly, Punjab has reduced its consumption by 11%. West Bengal, Gujarat and Bihar have raised their consumption between 11% and 17%.

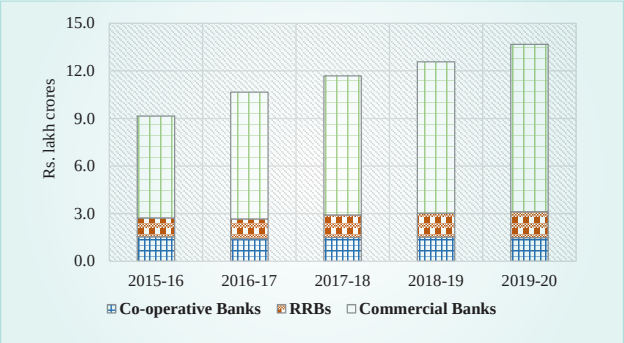
1.3 Institutional Credit

Credit augments investment in agriculture, whose multiplier effect is substantial. Credit flow has grown by 8.8% in the agricultural sector, reaching Rs. 13.7 lakh crores during 2019-20 (Figure 2). Much of this has been contributed by the Scheduled Commercial Banks (77.2%). The share of Regional Rural Banks and the Cooperatives have been 11.9% and 10.9% respectively. Despite higher credit growth, much of institutional lending has still been towards meeting short-term requirements for raising crops. For instance, of all direct credit delivered in agriculture in June 2020, only 13% is delivered for long-term asset building, and 10% towards medium-term requirements such as for livestock (RBI 2020).

1.4 Procurement and Prices

During the *kharif* marketing season (KMS) 2020-21, more than 56 million tonnes of paddy was procured, which has increased by 24% over the previous year (MoAFW 2021). About 39 million tonnes of wheat (MoAFW 2020d), 2.6 lakh tonnes of pulses, and about 3.2 lakh tonnes of oilseeds have been procured during the *rabi* (RMS) 2020-21 season. To some extent, this has had an influence on market prices.

Figure 2. Institutional credit flow in agriculture and allied sector (All-India)



Source: MoAFW (2020d) and NABARD (2020)

Note: Estimates are in nominal terms

In 2019-20, wholesale prices index (WPI) of food commodities improved by 12.1 and it improved by 0.5 in the previous year, signaling price gains to the farmers. Changes in prices in major paddy growing states have varied from -1.5% in Andhra Pradesh to 5.9% in West Bengal and Uttar Pradesh during the *kharif* harvesting season (October to December) in 2019. Wheat prices have been higher at least by 5%. Among the major wheat growing states, growth in wholesale prices had been 13.6% higher in Uttar Pradesh, 9.4% in Rajasthan, 5.7% in Punjab, and 5.5% in Madhya Pradesh. Even during the post-pandemic season, wholesale indices have shown markable improvements for a number of commodities, especially for the high-value food articles. The WPI (2011-12=100) for vegetables increased from 153.3 in May to 211.7 in August 2020, registering an improvement of 44.4%. It was 4.3% in fruits, 7.2% in eggs, meat and fish, and 5.1% in oilseeds during these reference periods. Rather, differences in cereals and pulses had been -3.2% and 1.1%, respectively.

1.5 Export Performance

Agricultural exports have fallen by around Rs. 21 thousand crores during 2019-20. Still, export of certain commodities had been fairly well. The export growth was 55% in groundnut and 47% in sugar. Spices exports grew by 10%. On the other hand, the growth was negative in cotton (-48%), oil meals (-44%), dairy products (-41%), and non-basmati rice (-32%). Items like meat, poultry products, pulses, fresh vegetables, and cashew registered a negative growth in export varying between 10% and 25%.

Interestingly, the estimates during the post-pandemic season (April-October, 2020) indicate a positive shift in agricultural and processed-foods based exports (Table 1). During this period, the exports have grown by 13.7%. Growth was as high as 57% in cereals (including an impressive growth in non-basmati rice and wheat), 29% in processed fruits and vegetables, 10% in other processed foods, and around 4% in fresh fruits and vegetables. Marine and livestock products witnessed a negative growth of 12% and 5% respectively. Having a positive growth in total agricultural output in two successive quarters of 2020-21, with an improvement in the pandemic recovery in rest of the world, one can expect a positive trend in the export in the rest of the period.

Table 1. COVID-19 and agricultural exports (Rs. crores)

Products	*Apr-Oct 2019-20*	*Apr-Oct 2020-21*	*% Change*
Cereals	24,634	38,627	56.8
Marine products	28,790	25,339	-11.99
Livestock products	15,574	14,742	-5.3
Fruits & vegetables (raw)	5,299	5,494	3.7
Fruits & vegetables (processed)	4,661	6,016	29.1
Floriculture & seeds	846	914	8.0
Other processed foods	10,832	11,929	10.1
All	90,636	1,03,061	13.71

Source: APEDA (2020); DGCIS (2020)

1.6 Way Forward

Substantial growth of agriculture in some states, and a fair performance in other states have helped agriculture to grow by 4% in 2019-20. The growth had been more than 10% in seven states, and between 4-10% in six states in this year. Appreciably, the sector has proved resilient to the COVID-19 pandemic, and cooperation among the Centre and States in post-harvest management and procurement had been the key factors responsible for this growth. Exports of food commodities have improved in the post-pandemic season. With an expansion of cropping area in the post-pandemic season, accompanied by an increase in inputs use and credit, and an enabling policy environment, the sector would continue to contribute to the over all economic growth in the country.

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2

Impact of COVID-19 on Indian Agriculture

Purushottam Sharma, Jaya Jumrani and S. K. Srivastava

This chapter discusses the impact of COVID-19 on agriculture considering three broad dimensions: impact on agricultural marketing and exports, impact of income shocks on consumption, and impact on poverty and employment. The estimates show that there is no impact on the marketing and exports while rural poverty might have accentuated temporarily.

The rapid spread of coronavirus (COVID-19) around the globe has led to an unprecedented halting of almost all economic activities. After the first COVID-19 confirmed case was reported on January 30, 2020 in Kerala, the Indian Government took proactive steps and announced a nationwide lockdown on March 24, 2020, for 21 days. Owing to the rising number of cases, the lockdown was further extended till June, 2020 with certain specific conditions. While the economy was gradually unlocked since then, economic activities were affected and supply chains were disrupted during lockdown. The nature of impact of lockdown has varied across regions and commodities. As per first advance estimates for 2020-21, the Gross Value Added at 2011-12 prices is expected to contract by 7.2% as against the growth of 3.9% previous year (MoSPI 2021). However, the agriculture sector is expected to grow at the rate of 3.4% at constant prices in 2020-21 as against 4% in 2019-20.

It was anticipated that the pandemic would have an impact on the demand for agricultural products, dislocation of the labour force and delay in the recovery of supply chains. Farmers have faced a negative impact on sales and prices (especially animal products except dairy, perishables and non-essential food commodities), which in turn has affected their income. While concerted efforts were made by the Centre and States and notable progress had been made in combating the economic and social ill-effects, the pandemic's arrival has implications for the employment, consumption, income, poverty of rural masses and in-turn the social safety net programmes of the government. This chapter discusses the impacts of COVID-19 on poverty, prices of agricultural commodities , employment and consumption pattern.

2.1 Impact on Agricultural Markets and Exports

During the start of the first phase of the COVID-19, almost all the economic activities and mobility was closed for containing the spread of virus. This has significantly impacted the food supply chain as the *mandis* were closed for a few days, and thus the supply of foodgrains, other essential commodities, and perishables got impacted during the first phase of the lockdown[1]. The market arrivals as well as the prices of food commodities were significantly impacted during the lockdown period. Trade activities in the agricultural markets halted and agricultural supply chains got disrupted. The market arrivals declined significantly during the month of March and April 2020 (Table 2). Arrivals of most of the foodgrains and oilseeds declined during this period. Prominent decline was noted in wheat, bengal gram and mustard. Vegetable arrivals were the most affected during the lockdown; the arrivals of major vegetables declined up to 60%. Arrivals of onion and potato also declined

[1] First phase: 25 March to 14 April, 2020; Second phase: 15 April – 3 May, 2020; Third phase: 4 to 17 May, 2020; Fourth phase: 18 to 31 May, 2020; Fifth phase: 1st week of June, 2020; Unlock phases started from 8 June onwards.

drastically. Market arrivals of foodgrains and oilseeds have increased in May and June 2020, while they continued to be low for vegetables in the lean season.

Table 2. Change in market arrivals for major commodities in 2020 over TE 2019 (%)

Commodities	March	April	May	June	July
Wheat	-33.06	-76.07	23.10	63.55	-19.50
Paddy Common	-20.37	-19.46	8.09	0.10	-27.43
Mustard	-52.03	-59.49	3.40	49.43	15.49
Bengal gram	-49.49	-75.59	-57.75	-1.84	-22.21
Lentil	11.21	-17.20	-0.24	11.32	-49.98
Potato	-52.37	-48.52	-42.75	-39.62	-50.70
Onion	-17.67	-58.78	-53.82	-55.77	-54.70
Tomato	-14.48	-29.51	-21.12	0.64	-9.80

Source: Authors' estimates based on AGMARKNET

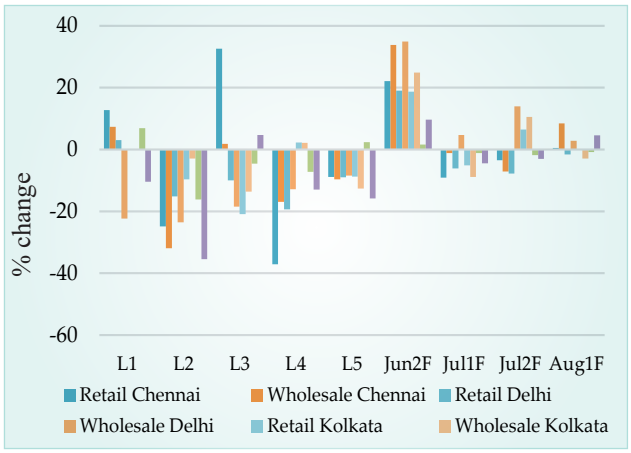
The wholesale and retail prices of foodgrains and edible oils in the four metro cities have increased moderately (less than 10%) during the fortnight ending first phase of lockdown over the pre-lockdown fortnight, except for gram *dal* in Mumbai and tur *dal* in Chennai. Pulse prices continued to increase even during the second phase of lockdown, because of the supply disruptions due to closure of *dal* mills amid non-availability of labour and lockdown restrictions. The prices of vegetables have risen significantly (15-50%) during the first phase of lockdown mainly due to disruptions in the supply chains and a large part of the price change is because of the lean season for vegetables. As the harvesting of *rabi* onion was in progress and there were sufficient supplies in the markets, onion prices eased in Delhi and Mumbai (Figure 3). The Government's efforts towards easing the lockdown restrictions on agricultural and marketing activities resulted in easing of prices of essential food commodities during subsequent phases of lockdown, except for the off-season perishable commodities with lower supplies.

Livestock and fishery products are important components of diet and their share in food expenditure has been continuously increasing. COVID-19 disrupted the consumption of some of the livestock products. The poultry industry has been severely hit in the country due to limited consumption caused by misconceptions of transmission of virus from animals to humans, and restrictions on inter-state movement. The lockdown disrupted the formal and informal dairy supply chains and affected the small farmers. India is the second largest bovine meat exporter worldwide. The exports were severely affected; prices were falling as exports have dried up with contracting export demand.

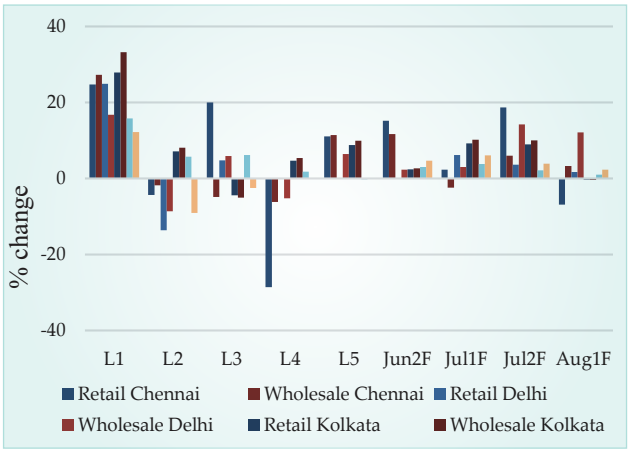
COVID-19 also affected the export of agricultural products, and in the first three months of 2020-21, the export of agricultural products such as fresh and processed fruits and vegetables, foodgrains including rice, spices, sugar & molasses and cotton were comparable or even higher than the corresponding period in 2019-20 (Figure 4). Exports of animal & marine products, tea & coffee, oilseeds & oil meals, and other processed items declined. Monthly exports data indicated that export of agricultural products got impacted to some extent in March 2020 and greatly in the month of April (lockdown period in most of the countries), although export of non-basmati rice, foodgrains and sugar has increased in April month. Agricultural exports rebounded in May and June and were even higher than in the corresponding month of previous year for many of the commodities. The disease has certainly reshaped the consumer behaviour, may be temporarily, in terms of declining demand for animal protein sources to vegetative sources, and the decline in the export of these products signifies this behaviour.

However, the timely action by the Central and State Governments through removing restrictions on agricultural and marketing activities, resumed the supply of agricultural produce. The agricultural marketing infrastructure fund and other related package were announced by the Government to boost the market sentiments. Further, the Government has revamped the marketing legislations through

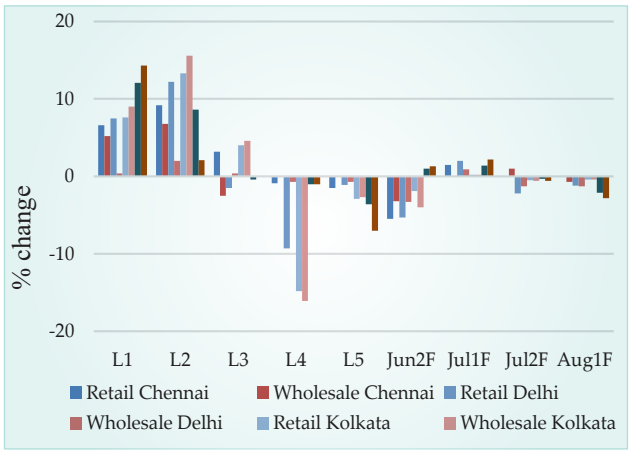
Figure 3. Trends in wholesale and retail prices of essential food items in metro cities during COVID-19 (%)



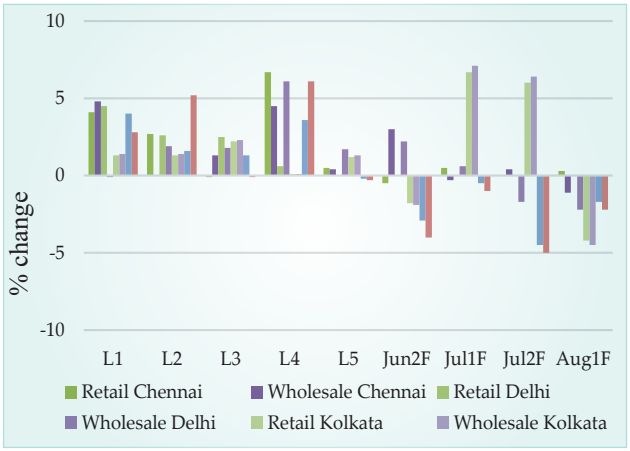
Onion



Potato



Gram dal

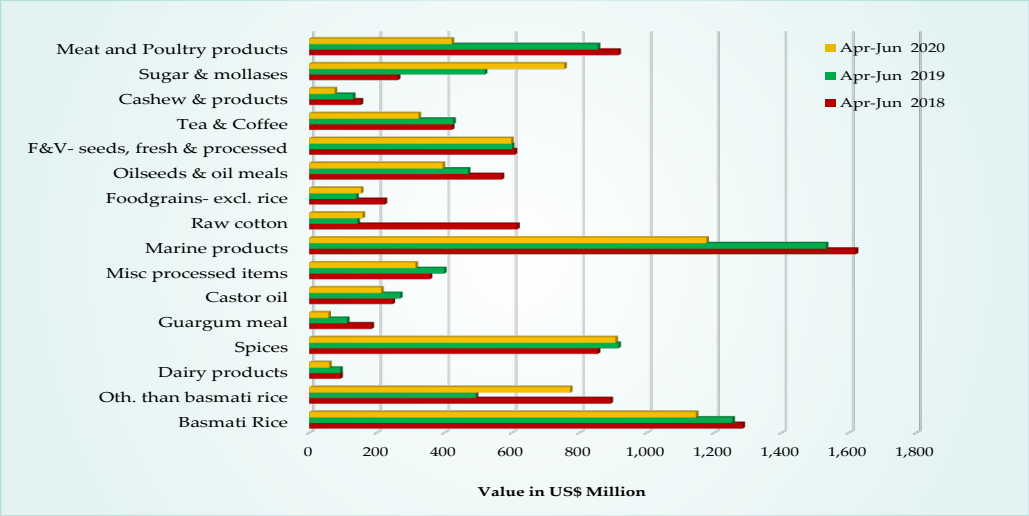


Groundnut oil

Source: AGMARKNET

Note: The change denotes % change in fortnightly average prices over pre-lockdown/ unlock period ending fortnight. L1-L5 denote five successive lockdowns; 1F and 2F are first and second fortnights respectively.

Figure 4. COVID-19 lockdown and agricultural exports from India



Source: Ministry of Commerce and Industry

three new legislations removing restrictions on intra and inter-state trade, stocking limits and assured services and price agreements.

2.2 Impact on Consumption

According to the latest available 2011-12 Consumption Expenditure Survey of the National Sample Survey Office (NSSO), an average Indian household spends around 44% of its expenditure on food, and the rest on non-foods. Composition of food basket varies across expenditure classes. With an increase in income, an average household diversifies its food basket and allocates relatively higher food budget to high-value food commodities (Carmelia et al. 2019). Conversely, in case of a decline in income, they would tend towards consumption of staple foods and necessary expenses. Such behaviour has been simulated by estimating expenditure elasticities of food items and non-food expenses using the Linear Approximation-Almost Ideal Demand System (LA-AIDS) model.

The estimated expenditure elasticities of food groups and non-food expenses are presented in Table 3. The estimated elasticities varied across different commodities, implying a differential response of change in income on consumption of different commodities. Average per capita monthly consumption expenditure of Rs. 1,599 was allocated among various food and non-food items in the year 2011-12. Between 2011-12 and 2019-20, general price level (CPI) in the country increased by 48%, which inflated consumption expenditure to Rs. 2366 for maintaining the same level (2011-12) of consumption in the year 2019-20. This was taken as the consumption expenditure in the baseline (pre-COVID) year 2019-20 and allocated to food and non-food items based on 2011-12 consumption expenditure pattern.

The nationwide lockdown led to 22.8% decline in the GVA (at 2011-12 prices) during the first quarter Q1 (April-June) of 2020-21 as compared to Q1 2019-20. Consequent to the decline in income, private final consumption expenditure (PFCE) declined by around 26.68% during Q1 2020-21. The likely effect of COVID-19 led decline in income on the consumption at disaggregate level for the whole year 2020-21 was simulated under three scenarios. Scenario 1 assumes that 26.68% decline in the PFCE (at 2011-12 prices) in Q1 2020-21 over Q1 2019-20 will continue for all the subsequent three quarters in 2020-21. Thus, an overall decline in PFCE during the year 2020-21 would be 26.68% as compared to 2019-20. Scenario-2 assumes a gradual recovery wherein a change in PFCE in Q2, Q3 and Q4 of 2020-21 would be -15%, -10% and 0% over the respective quarters in 2019-20. This will result in 12.54% (weighted average) decline in PFCE in 2020-21. In Scenario-3, 100% recovery is assumed from Q2 onwards and remaining quarters in 2020-21 will witness the same level of PFCE as in 2019-20. Overall decline in PFCE in this scenario will be 6.26%.

As non-food items are relatively more elastic than food items, decline in the expenditure on non-food items would be relatively steeper than on food. The decline in the non-food expenditure is estimated to range between 7.69% and 32.79%, whereas food expenditure is expected to squeeze by 4.98% to 21.24% during 2020-21 under the different scenarios considered in the analysis (Table 3). In absolute terms, per capita monthly non-food expenditure in 2020-21 will be Rs. 101 to Rs. 432 less than in the year 2019-20. The decline in absolute MPCE is expected to range between Rs. 52 to Rs. 223. Within the food basket, cereals will witness the lowest decline in consumption (2.32% to 9.89%) as compared to the other food commodities. The decline in the consumption of high value food commodities such as milk, non-vegetarian products, fruits, and other food products (beverages, dry fruits, processed food, etc.) will be comparatively higher than the staple foods such as cereals, pulses, and edible oils.

Both Central as well as State Governments have made all the efforts to maintain easy availability of essential food commodities through

easing lockdown restrictions of agricultural production, marketing and related activities for food commodities. As the pandemic related curbs coincided with harvesting and marketing season of *rabi* crops, all efforts were made to procure farmers produce. The supply of foodgrains were also ensured to the needy population through enhanced public distribution system (PDS) supplies. The Government has also announced the economic package to boost investment in agricultural services, enhance income and consumption. Farmers also adopted many coping strategies such as direct/ collective marketing of their farm produce to nearby urban consumers, door-to-door sale, finding new markets, reducing prices, use of technology (mobile apps) for access to information and marketing of farm produce etc. The interventions by the governments and civil society organizations through various schemes, supplementary income and welfare measures were expected to reduce the COVID-19 led income-induced impacts in the economy. Overall strategy to revive economy should include demand-push measures.

2.3 Impact on Poverty and Employment

At the global level, the International Labour Organization (ILO 2020) has classified different sectors as high, medium-high, medium, low-medium and low based on the impact of the crisis on the economic output. Labour-intensive sectors such as accommodation, food, manufacturing, wholesale and retail trade are classified as high risk sectors. Even though agriculture, forestry and fisheries are classified as low-medium risk, the scale of employment in this sector and dependence of such households on non-farm employment would potentially lead to higher risk among these households. Our analysis for rural India, based on unit-level data from the Periodic Labour Force Survey (PLFS) 2017-18, reveals that about 16% of the working population is employed in high-risk sectors, 59% in the low-medium risk, and 6.3% in the

Table 3. Income induced (due to COVID-19) change in consumption expenditure in 2020-21

Particulars	Expenditure elasticity	Pre-COVID consumption expenditure (2019-20) (Rs/ capita/month)	Change in consumption expenditure during 2020-21** (%)		
			Scenario 1	Scenario 2	Scenario 3
Cereals	0.37	238	-9.89	-4.65	-2.32
Pulses	0.53	67	-14.05	-6.60	-3.30
Milk	0.89	202	-23.62	-11.10	-5.54
Edible oils	0.42	78	-11.32	-5.32	-2.66
Non-veg	0.96	77	-25.56	-12.02	-6.00
Vegetables	0.58	100	-15.42	-7.25	-3.62
Fruits	1.25	32	-33.43	-15.71	-7.84
Other foods	1.29	256	-34.30	-16.12	-8.05
Total Food	0.80	1048	-21.24	-9.99	-4.98
Non-food	1.23	1318	-32.79	-15.41	-7.69

Source: Srivastava and Sivaramane (2020)

***Scenario 1: With same decline in PFCE as during April-June; Scenario 2: With gradual recovery in remaining quarters; Scenario 3: With 100% recovery in remaining quarters*

low-risk category. The agricultural sector which consists of about 59% of rural employment, also contributes significantly to female employment. Within agricultural sector, about 28% workers are women. Most of these women are often involved in precarious activities. Majority of the work undertaken by women in the farm activities largely remain unaccounted.

The share of households and the incidence of poverty in rural and urban India as per different employment categories are given in Table 4. Given that the latest poverty estimates are not available, the estimates for 2011-12 from the Consumer Expenditure Survey of the National Sample Survey Office (NSSO) have been used. About 13% rural and 12% urban households are employed as casual labour in the non-farm sector in 2011-12. In addition, there are 21% of households working as casual labour in agriculture in 2011-12, which reduced to 12% in 2017-18. The immediate short-run impacts of the lockdown would be felt most among these casual workers. Some of small and marginal farmers and casual agricultural labour also work in the rural non-farm sector, and these may also be affected to the extent of employment lost. The incidence of poverty is high among these casual workers in rural and urban areas, which may further deteriorate if income loss is not compensated.

We evaluated the impact on poverty (headcount ratios) due to the contractions in income, i.e. monthly per capita consumption expenditure (MPCE) under certain assumptions. We evaluate three scenarios – low risk (5% contraction in consumption), medium risk (10% contraction) and high risk (20% contraction). In rural India, there are about 792 million people, of which 201 million reside below the poverty line. It is expected that there will be an addition of around 37 million to 172 million poor people ranging across low-risk and high-risk scenarios. This might translate into an increase of headcount ratio ranging from 30% to 47% across these scenarios. As expected, the proportion of people below the poverty line is lower among urban areas. About 43 million are found to be poor out of the total 317 million urban people. There will be an addition of around 7 million to 37 million urban poor people ranging across low-risk and high-risk scenarios. This might translate to an increase of headcount ratio ranging from 16% to 25% in these scenarios in urban India.

This increase in the incidence of poverty is subject to the condition of no income transfer or usual public distribution by the Government. The Government, however, has taken several steps to support the agricultural and allied sector by exempting the sector from the lockdown, undertaking public distribution of foodgrains and direct cash transfers. The poverty impacts may thus act as a temporary shock and long-term impacts may occur through a lower rate of growth in other sectors. These poverty impacts shall have strong implications on food and nutritional security, particularly among the vulnerable sections such as children and women. One of the ramifications of the COVID-19 has been the closure of schools that has led to the suspension of mid-day meal and supplementary nutrition programmes such as the Integrated Child Development Services Scheme.

Monthly unemployment rates reported by the Centre for Monitoring Indian Economy (CMIE) show that the unemployment rates increased from 8.7% in March 2020 to 23.4% in April, which continued in May 2020 (23.5%) (Figure 5). These two months coincide with the lockdown period. The unemployment rates declined later after June 2020 to the pre-lockdown period levels. As expected, there was reverse migration because of the lockdown. We attempt to track migration based on the total migration data as provided in the Census 2011. We analyse the inter-state migration status (for less than 1 year) to capture the seasonal migration patterns. As the Census data show, out of the total rural to

Table 4. Employment categories and the incidence of poverty in India

Household Type	Share of households (%)		Poverty (HCR, %), 2011-12	5% hit - Poverty headcount ratio (%)	10% hit - Poverty headcount ratio (%)	20% hit - Poverty headcount ratio (%)
	2011-12	2017-18				
Rural						
Self-employed in agriculture	34.3	37.8	22	26	32	44
Self-employed in non-agriculture	15.5	14.3	19	23	28	40
Regular wage/ salary earning	9.6	12.7	11	13	16	24
Casual labour in agriculture	21.0	12.1	40	46	53	65
Casual labour in non-agriculture	13.5	12.9	33	38	44	57
Others	6.1	10.1	18	22	27	34
Overall	100	100	25	30	35	47
Urban						
Self-employed	35.3	32.4	15	18	21	28
Regular wage/ salary earning	41.7	41.4	7	8	10	15
Casual labour	11.8	11.8	33	36	40	54
Others	11.2	14.4	8	9	11	13
Overall	100	100	14	16	18	25

Source: Authors' estimates based on Consumer Expenditure Survey data, 2011-12, PLFS data 2017-18.
Note: State-level poverty line estimated using Tendulkar methodology for 2011-12 (GoI 2014a).

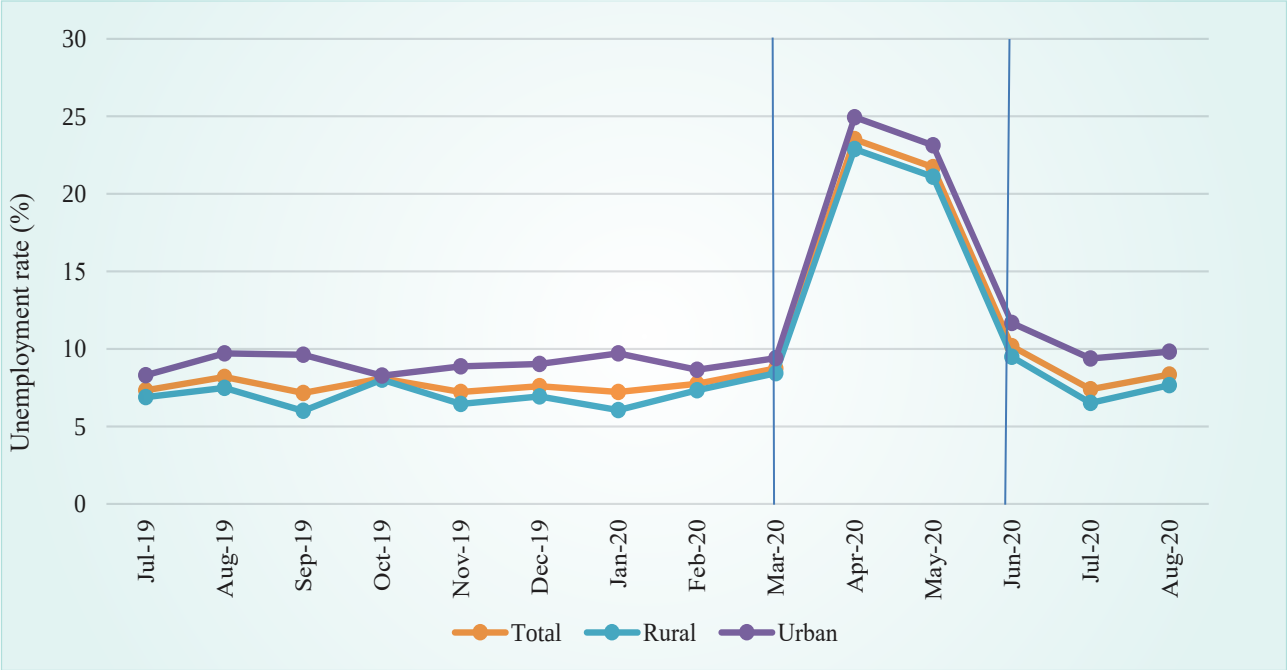
urban migration, 23.7% migrate for work, 29.6% for marriage and 36.2% for house.

The major states (>70,000 migrants) by migrant origin are Uttar Pradesh, Bihar, Karnataka, Andhra Pradesh, Madhya Pradesh, Rajasthan and Gujarat. The major migrant destinations are Maharashtra, NCT of Delhi, Gujarat, Haryana, Karnataka, Jharkhand, Gujarat, Uttarakhand, West Bengal and Punjab. This reverse migration would plausibly have an effect on labour supply in agricultural states like Haryana and Punjab. Farmers in these states have resorted to direct sowing of rice or to other crops such as cotton that require lesser labour during the sowing season. On the other hand, the migrant origin states are predominantly agriculture oriented and the reverse migration coinciding with the agricultural season has led to higher labour availability, which is reflected in a recent increase in the reported sowing area.

2.4 Summing Up

Three broad dimensions were considered in this analysis to provide insights into the impacts of COVID-19 on agriculture sector in India. Pandemic-led lockdown restrictions to curb spread of virus halted almost all the economic activities for a period significantly impacting all the sectors of economy including agriculture. The impact was, however, not as severe in agriculture as was in other sectors. Existence of adequate buffer stocks has proved to be vital for ensuring the food demands of a significant share of the distressed population. Transfer payments in the form of different

Figure 5. Monthly unemployment trend



Source: Statistical Profiles - Unemployment in India, CMIE

Note: CMIE conducted a face-to-face interview of a sample of 5, 22,000 members (who were older than 15 years) from 1, 74,405 households. The full survey of 1, 74,405 households took over four months. Monthly data computed using 30-day moving average of unemployment rate in India every day, using the data collected during the preceding 30 days. Unemployment Rate (UER) is the ratio of persons who are unemployed, willing to work and are actively looking for a job to the labour force.

commodities were made available to the homeless and migrant labourers. More and varied commodities were also distributed in the PDS.

Efforts made by the Government to facilitate supply chains of perishable commodities like milk, eggs, fruits and vegetables have proven to be effective. Digital contacts were used to address the bottlenecks and strengthen direct contacts of traders and farmers for repeated transactions. The decline in consumption is expected to be least for staple commodities like cereals, edible oils, pulses, as compared to other food commodities. Composition of household budgets would also change, as households will reallocate expenditure from non-essential to essential items. The incidence of poverty is usually high among casual workers in rural and urban areas, which may further deteriorate if their income losses are not compensated for. In rural India, this might translate to an increase of headcount poverty ratios ranging from 30% to 47% across the various risk scenarios. Poverty impact may however be a temporary phenomenon and long-term impact may occur through a consistent lower rate of growth in other sectors.

The timely actions by the Central and State Governments through removing restrictions on agricultural and marketing activities have helped to resume the supply of agricultural produce. To improve the market sentiment, the Government has announced a package of Rupees one-lakh crore for boosting agri-infrastructure development. The agricultural sector is expected to grow at 3.4% in 2020-21 and no major long-term impact of COVID-19 on Indian agriculture is anticipated.

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3

Agricultural Policy Reforms

Raka Saxena, Purushottam Sharma, Abimanyu Jhajhria and Subash S. P.

This chapter discusses the major policy reforms in the Indian agricultural sector. It highlights the progress and achievements in various sources of growth of farm income. It also deliberates on the recent agricultural marketing and input sector reforms in the country. These reforms are likely to contribute to improved efficiency and growth in the agriculture sector.

3.1 Doubling Farmers' Income

The Government of India is committed to double the farmers' income by 2022 with the DFI strategies now under implementation. The Government considered the year 2015-16 as the base year for tracking of incomes. Seven sources of growth, viz. improvement in crop and livestock productivity, resource use efficiency, increase in cropping intensity, diversification towards high value crops, improvement in real prices received by farmers, and shift from farm to non-farm occupations have been identified. ICAR-National Institute of Agricultural Economics and Policy Research (NIAP) is the Knowledge Partner to the Department of Agriculture, Cooperation and Farmers' Welfare and has closely worked in formulation of DFI strategic framework and facilitated the implementation of the strategies. Over the last three years, the Government has made serious efforts in doubling farmers' income. Capital channelization into agriculture sector is picking up as evident from higher budgetary allocations, mobilization of non-budgetary resources, enhancement in institutional credit and incentivizing corporate investments. Special credit needs of the smallholders are being given due emphasis. Disbursal of farm credit has exceeded targets in recent years. Kisan Credit Card (KCC) facility has been extended to fisheries & animal husbandry related activities. Announcement of Rupees one lakh crore fund to finance agricultural infrastructure projects will help create affordable and financially viable post-harvest management infrastructure at the farm gate and aggregation points. Also, Rs. 500 crore has been allocated to extend Operation Greens which comprises the three most price volatile commodities, namely tomato, onion and potato (TOP) to all fruits and vegetables. The existing schemes are being restructured for effective orientation and implementation.

Strong emphasis is being given on the productivity based gains with specific focus on certain neglected crops like pulses, oilseeds and nutri-cereals (millets). Technological innovations coupled with favorable policy environment have already resulted in substantial increase in production of pulses in the country. A roadmap for increasing area and production of nutri-cereals has also been prepared. The roadmap targets an output of 21 million tonnes by 2022-23. The Government has launched a sub-mission on nutri-cereals. A roadmap for oilseeds for bridging the deficit in domestic production of edible oils is also underway. Oilseeds production has increased from 27.5 million tonnes and the productivity of 1075 Kg per ha (2014-15) to 32.3 million tonnes and 1265 kg per ha, respectively (2018-19). Edible oil production increased from 9.8 million tonnes (2014-15) to 12.9 million tonnes (2018-19).

The area under horticulture has increased under the Mission on Integrated Development of Horticulture. Diversification towards high-value crops is producing encouraging results. There has also been an increase in cropping intensity. For effective risk management, Pradhan Mantri Fasal Bima Yojana (PMFBY) was launched in 2016 to provide insurance cover for all stages of the crop cycle, including post-harvest risks in specified instances.

Studies indicate that there had been positive impact of micro-irrigation on crop productivity and water conservation, resource use efficiency and cost reduction; and soil health card and neem coated urea in achieving higher productivity and lower cost of production. The coverage of area under micro-irrigation under PMKSY has increased from 5.5 lakh ha in 2015-16 to 11.7 lakh ha in 2019-20. The impact study of soil health cards indicates a decline in use of chemical fertilisers by about 8-10 per cent (Reddy 2017). An overall increase in the yield of crops to the tune of 5-6 per cent due to application of fertilizers and micro nutrients as per the recommendations available in SHC was also reported (Reddy 2017). Micro-irrigation resulted in reduction of irrigation cost by 20 to 50 per cent, electricity consumption by about 31 per cent, saving of fertilizers between 7-42 per cent and increase in average productivity of fruits and vegetables by about 42.3 per cent and 52.8 per cent, respectively (GoI 2014b). Overall income enhancement of farmers was about 20-68 per cent. Increase in farm mechanization is directly linked to enhancement in crop production and productivity. There was an enhancement in farm mechanization level from 1.94 kW/ha (2012-13) to 2.02 kw/ha energy use (2018) through distribution of agri-machinery and establishment of custom hiring centers, hi-tech hubs and farm machinery banks under the Sub-Mission on Agriculture Mechanisation (NABARD 2018). The target is to increase to 4 kW/ha by 2022.

Funds are allocated to strengthen e-NAM and GrAMs and Agricultural Infrastructure Fund (AIF) has been created to build agri-logistics. Several market reforms have been rolled out for strengthening backward and forward linkages and ensuring remunerative prices to farmers. The recent reforms include The Farmers Produce Trade and Commerce (Promotion & Facilitation) Act, 2020; The Farmers (Empowerment & Protection) Agreement on Price Assurance and Farm Services Act, 2020, and amendments to the Essential Commodities Act, 1955. These Acts aim at enhancing farmers' income through improved price realization, reducing price risk and strengthening agricultural supply chains. The Government has adopted new basis for notification of MSP for 23 commodities. As a result, the terms of trade has shown an improvement. The Government is also targeting promotion of 10,000 FPOs by 2024. The Government has adopted a new umbrella scheme called "Pradhan Mantri Annadata Aay Sanrakshan Abhiyan" (PM-AASHA) to broad base its procurement across crops and regions. The e-NAM was intended to be a market-based mechanism for efficient price discovery in the market. Around 1000 markets across 18 States and 3 Union Territories have been covered under e-NAM. Farmers have been allowed to sell and transport directly from registered warehouses and FPO stores.

Enhancing agricultural export also remains a thrust agenda and Agri-Export Policy targets to double agri-exports by 2024. Marine products, rice, cotton, meat and horticultural commodities are the major contributing commodities in agricultural exports. Agri-Export Policy envisages exports of $60 billion by 2022. The exports have increased significantly during 2020 despite the pandemic restrictions and impacts.

Major steps undertaken under Atma Nirbhar Bharat

- Funds worth Rs. one lakh crore to be given to agricultural cooperative societies, farmer producer organizations and start-ups for boosting farm-gate infrastructure.
- Rs. 10,000 crore has been allotted for formalization of micro-food enterprises and cluster-based farming approach to be followed.
- Under PM Matasya Sampadana Yojana Rs. 20,000 crore has been allocated for fishermen. This is expected to pave the way for additional fish production of 70 lakh tonnes over 5 years.
- Rs. 13,000 crore has been appropriated to achieve 100% vaccination of cattle, buffalos, sheep, goats and pigs.
- A boost of Rs. 5,000 crore has been granted for animal husbandry infrastructure.
- Rs. 4,000 crore has been allotted for promotion of herbal cultivation. The move aims to cover 10 lakh hectares under herbal cultivation in 2 years.
- Beekeeping initiatives have been allocated Rs. 500 crore.

Pradhan Mantri Kisan Sampada Yojana (PM-KSY) aims at enhancing agro-processing and development of agro-processing clusters. Promotion of allied enterprises and secondary agriculture will provide boost to farmers' income. National Bamboo Mission has been effective from 2018-19, promotion of aromatics and medicinal plants has been allocated special funds. Additionally, Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) was introduced with a view to provide income support to all farmer families across the country along with Pradhan Mantri Kisan Maan Dhan Yojana (PM-KMY) to provide social security net for small and marginal farmers.

3.2 Agricultural Marketing Reforms

Agricultural markets were brought under the ambit of regulation during the 1960s to ensure price discovery and fair transactions to save farmers from exploitation by market intermediaries and provide remunerative prices for their produce. The establishment of regulated markets for orderly marketing of agricultural produce is the major intervention made by most of the State Governments in India. The regulated markets were designed as a decentralized system with physical auctions as the basis of price discovery and licensing of traders as a way to ensure payment, controlled and managed by Agricultural Produce Market Committee (APMC). However, the system could not take the desired shape, achieved limited success and ultimately resulted in higher dependency of farmers on commission agents/ traders, vested interests took over time. APMCs turned out to be more limited of a revenue-generating institution rather than an institution facilitating efficient marketing of agricultural produce for the benefit of all the stakeholders.

With the changing scenario, particularly after the liberalization of the Indian economy, further opening up of agricultural markets was necessitated. An expert committee on agricultural marketing constituted by the Government of India in 2001 suggested marketing reforms, and based on that a Model APMC Act was circulated among states in 2003 for implementation. The major provisions of the model act to provide options for the establishment of private markets, direct marketing, contract farming, futures trade, etc. Several states amended their APMC Acts as per the provisions in the Model Act, and many have partially implemented or adopted one or the other provisions but not in letter and spirit of the provisions in the Act. To furthering the reform process in agricultural marketing in India, the Central Government again drafted model Agricultural Produce and Livestock

Marketing (Promotion and Facilitation) Act, 2017 and model Agricultural Produce and Livestock Contract Farming and Services (Promotion and Facilitation) Act, 2018, and circulated to the states for implementation. These reforms processes successively enlarged the scope of providing alternatives to the farmers to bring in competition and services for sell of farmers' produce.

The issues in the present marketing system include fragmented supply chains, a large number of intermediaries (formal or informal channels), high transaction costs, inadequate price discovery and competition in the markets, and poor market infrastructure. Large variations in the provisions, fee and charges across states led to fragmented markets. The regulated inter-state movement of agricultural produce reduces the competitiveness and impeded the emergence of a common national market. Further reforming the agricultural marketing system in the country is necessary for competition, efficient price discovery, reducing intermediation, reducing marketing cost and wastages, strengthening supply chains through private participation for investment in infrastructure and services, and providing choices to the farmers.

3.2.1 Recent agricultural marketing reforms

The Government of India passed three legislations for reforming the agricultural marketing in the country. These legislations aimed at improving the market access and price realization to the farmers, functioning of agricultural markets, remove inter-state and intra-state trade barriers and create efficient supply chains for agricultural produce.

1. The Farmers Produce Trade and Commerce (Promotion and Facilitation) Act, 2020 (FPTCA) envisages to create an ecosystem where the farmers and traders have the freedom to sale and purchase the produce and facilitate remunerative prices through competitive alternative trading channels. These are also likely to promote efficient, transparent and barrier-free inter-state and intra-state trade and commerce of farmers' produce outside the physical premises of markets or deemed markets notified under various state agricultural produce market legislations. Also, no market fee, cess or levy outside APMCs shall be levied on any farmer or trader or electronic trading and transaction platform for trade and commerce in farmers produce. With the introduction of this legislation, buyers with PAN and sellers of agricultural produce are free to transact outside the regulated market yard, and such transactions need not to pay mandi fee. Thus, these trade areas shall be new alternative marketing space and expected to work across the country.
2. The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act, 2020 (FAPAFSA) provides a national framework on farming agreements that protect and empower farmers to engage with agri-business firms, processors, wholesalers, exporters or large retailers for farm services and the sale of produce at a mutually agreed price in a fair and transparent manner.
3. The Essential Commodities (Amendment) Act, 2020 (ECA) attempts to remove the unpredictability and arbitrariness in notifying stocking limits by the Government, and pre-defined the criteria for imposing stocking limits based on the price rise. Even these regulations for stock limits shall not apply to a processor or value chain participant, if such stock limit does not exceed the installed processing capacity or export demand'. This will certainly pave the way for higher private investment for storage (godowns, warehouses or cold storages) and modernization of the food supply chain.

Prospects and challenges: The package of three legislations in agricultural marketing practically enables the barrier-free intra-state and inter-state movement or transaction of agricultural commodities in a competitive way. Assurance of price, better market risk management through contract farming, opening up of private investment opportunities in the supply chain are also expected. This may certainly result in the integration of agri-produce supply chains, reduction in transaction costs, and thus improve the competitiveness of agricultural products domestically as well as internationally. Through farm service, contracts shall help improve the quality of agricultural produce. A study by Chatterjee (2018) reported that inter-state barriers to trade results in about 11 percent decline in farmers' price realisation, and now with these regulations in place, farmers' price realisation may increase considerably. Major challenges with the introduction of these new legislations are:

1. The transactions in the 'trade area' (outside regulated mandi yards/sub-yards) and electronic transactions platforms will lack a transparent recording of transactions and a credible regulatory architecture. This is likely to jeopardize both the price discovery mechanism as well as the agricultural market information system in the country. Thus, these areas should also come under regulation and regulatory oversight, and the mechanism of data recording needs to be devised.
2. Although the legislations certainly incentivize the private players to invest in supply chain infrastructure and services and directly transact with the farmers, there is a fear of exclusion of remote and less productive areas, as the agribusiness will invest/operate only in better endowed, high productive and profitable areas with better infrastructure and less competition. Also, the marketing exclusion of the produce below the desired quality may be a concern.
3. In order to ensure competition in the agricultural markets, the re-orienting and strengthening of the existing regulated mandi system is inevitable. This is likely to ensure that the private players will not be able to exert monopoly power in the market.
4. The misconceptions of relating these bills to abolishing procurement at MSP or the existing mandi system need to be tackled through campaigns and focused discussions.

The three new agricultural marketing legislations would free the farmers from the restrictive trade practices and cartelized operations of traders and shall, increase competition and farmers' price realization. It would be desirable to monitor the progress of these legislations and take corrective measures if needed.

3.3 Regulatory and Policy Reforms in Agricultural Input Sector

The agriculture input sector in India has been undergoing numerous regulatory reforms in last two decades (Subash et al. 2020). Several reforms such as Cotton Seed Price Control Order 2015, Draft Framework for Genome Editing (2020), Neem Coated Urea (2015), Direct Benefit Transfer (2017) in fertiliser sector, and proposed Pesticide Management Bill (2020) and Insecticides (Amendment) Draft Rules (2020) have several implications on input markets. The trends in seed, fertiliser and pesticide consumption show that there is a steady increase in their use in the period 2001 to 2019 (Figure 6). The average certified seed use increased from 4.88 kg/ha in 2001-02, to 16.22 kg/ha in 2018-19. The pesticide consumption was on an average around 0.23 kg/ha in the period 2001-2010, which increased to 0.28 kg in the period 2011-19. The fertiliser consumption increased from 92.33 kg/ha in 2001-02 to 133.12 kg/ha in 2018-19. The period of shift in consumption of input coincides with regulatory and policy reforms undertaken during the same period.

The shift in fertiliser consumption after 2004-05 coincides with the New Pricing Scheme

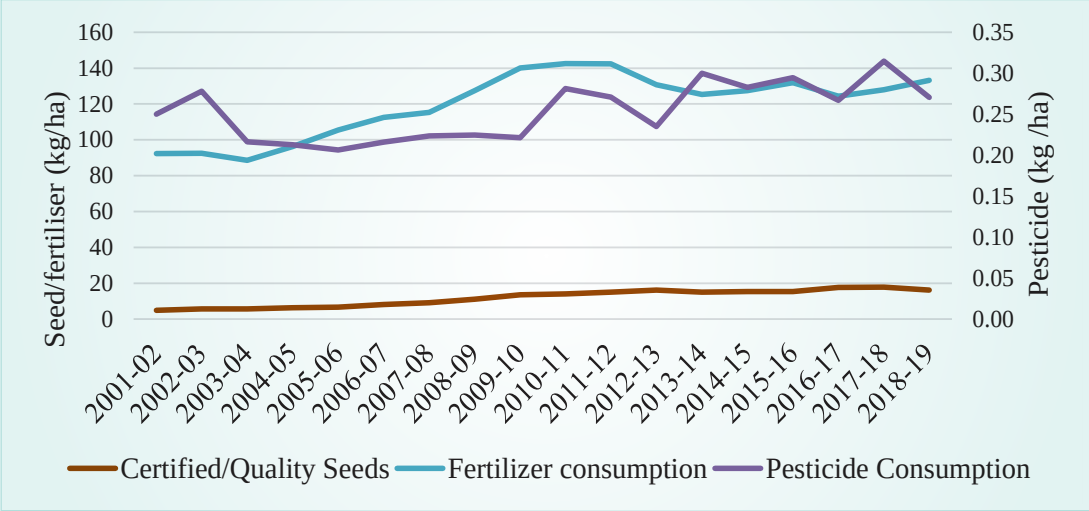
(NPS) in fertilisers (Praveen 2017); change in pesticide consumption coincides with the Patent (Amendment) Act 2005; and the increase in certified quality seed production after 2007-08 coincides with implementation of Protection of Plant Varieties and Farmers Right Act, 2001 (PPV&FRA 2001) which became operational after 2007. In the last decade several new regulatory reforms were brought in seed, fertiliser and pesticide sector. Few regulatory policies were brought to reinvigorate the older regulations. A brief summary of these major regulatory (acts and amendments) and policy reforms in the agricultural input sector for the last five years (2015-20) are discussed below.

In 2015, Department of Agriculture issued the Cotton Seed Price (Control) Order to regulate Bt cotton seed prices. The order brought cotton seed under Section 3 of the Essential Commodities Act (1955). As a result of this regulation, the price of 450 gms of Bt cotton seed reduced from Rs. 1,250 for Bollgard-I and Rs. 1,700-1,800 for Bollgard-II in 2002-05 to Rs. 635 for Bollgard-I and Rs. 740 for Bollgard-II in 2018. On the one hand, this act ensured a fair and reasonable price for cotton seed, and on the other hand, it restructured the industry (Subash et al. 2020).

In 2015, the Government of India mandated 100% of neem-coating in domestically produced and imported urea. The policy decision was done to prevent the leakage of urea to chemical industry and as adulterants in Milk. According to the Economic Survey (2016), about 41 per cent of the heavily subsidized urea was used in non-agricultural purposes. This was leading to a heavy cost on the exchequer as urea accounts 75 per cent of the total fertiliser subsidy (Subash et al. 2020). Other than this, neem coating also benefited farmers and environment as it helped in gradual release of urea, resulting in higher yield and lower water contamination due to leaching. This had led to significant reduction in leakage of urea and improvement in the productivity.

The Direct Benefit Transfer (DBT) in fertilizers was initially rolled as a pilot project in 7 states in 2017 and later in 2018, and scaled up to 12 major states. The programme is designed to provide subsidy directly to the companies once farmer buys fertilizer after a biometric identification from input dealer (retailer). It is designed to pay the subsidy based on actual physical offtake of urea based on physical offtake by farmers. The

Figure 6. Trends in certified seed use and consumption of fertilisers & pesticides



Source: MoAFW (2020e)

policy would also help reduction in diversion of urea for non-agricultural purposes. Studies have shown that this programme has less challenges than Direct Cash Transfer to farmers (Kishore et al. 2013).

The Pesticide Management Bill (2020) was introduced to replace the existing Insecticide Act, 1968. The bill focuses on the production and distribution of safe and effective pesticides and penalizes spurious and substandard pesticides. Counterfeit and spurious pesticide account about 30 per cent of the pesticide market. The bill also makes provision for the compensation of losses due to poor quality pesticides. It also brings stringer regime for license manufacturers, distributors and retailers.

3.4 Summing Up

The regulatory and policy reforms in agriculture are reshaping this sector. These policies were formed as a result of rapid advancement in the sector and institutional change needed to accelerate the pace of transformation. Several initiatives of the Government related to DFI have started yielding positive results, and the growth momentum can be expected to pick up further. The recent marketing reforms have the potential to bring structural transformation of the supply chains. The new regulations and policies in the input sector are framed for the changing undercurrents and are envisioned to have greater implications on the sector. There is a need for monitoring the impact of these reforms on the efficiency and farmers' welfare for taking necessary corrective measures, if needed.

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4

Flagship Schemes of the Government

Khem Chand, Subhash Chand and Vikas Kumar

This chapter explains flagship programmes of the Government related to natural resource management, insurance to cover production risk, procurement of agricultural commodities, credit schemes for boosting investment in agriculture and other schemes for overall development of crop and livestock sector in India.

Agricultural production is an outcome of biological activity which is highly sensitive to changes in weather, the erratic and uneven distribution of monsoon rains perpetuated yield/price volatility and hence increased farmer's exposure to risk and uncertainty. Hence, distributing risk is an important aspect of decision making to farmers. The production/income risk of the farmers can be minimised through ensuring assured irrigation facilities and maximum coverage of farmers under crop insurance scheme. Besides, the availability of credit at reasonable interest rates is also an important factor to free the farmers from high interest burdens and making investment decisions in farming to adopt new agricultural technologies. The Government has initiated various flagship programmes like PMKSY, PMFBY, interest subvention scheme, etc. for the benefits of farming community. Further, to reduce price risks, Central Government in collaboration with State Governments intervene in agricultural market and procure farm commodities at Minimum Support Prices (MSP) under Market Intervention Scheme (MIS) and Price Support Scheme (PSS). Information collected from different sources has been synthesized and logical inferences drawn for all schemes are presented in subsequent sections.

4.1 Prime Minister Krishi Sinchayee Yojana (PMKSY)

Government of India is committed to accord high priority to water conservation and its management. To this effect, PMKSY has been formulated with the vision of extending the coverage of irrigation '*Har Khet Ko Pani*' and improving water use efficiency. The scheme got approval in 2015 by amalgamating ongoing schemes related to irrigation expansion, water use efficiency and watershed development.

There are four major components of the scheme (1) *Accelerated Irrigation Benefit Programme* (AIBP) focuses on faster completion of ongoing major and medium irrigation including national projects; (2) *Har Khet Ko Pani* aims to enhance the physical access of water on the farm and expand cultivable area under assured irrigation; (3) *Per Drop More Crop* aims to enhance water use efficiency at farm level by appropriate technological and supplementary water management activities (SWMAs); and (4) *Watershed Development* aims to enhance recharge of aquifers and introduce sustainable water conservation practices.

The final outcome of PMKSY is to ensure access to efficient delivery and application of water at every farm thereby enhancing agricultural production & productivity, State Agriculture Department is the Nodal Department for implementation of PMKSY.

PMKSY ensures convergence with all rural assets/infrastructure based programmes related to water conservation and management programmes/ schemes like Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) and Rashtriya Krishi Vikash Yojana (RKVY) etc.

It is estimated that the PMKSY, when implemented fully in 10 years, can add a total value of Rs. 23 lakh crore to the gross domestic product (GDP), assuming that an investment of Rs. 2.52 lakh crore is made by the central and state governments in the form of incentives. The total cost including farmers' contribution would be Rs. 4.67 lakh crore (including farmers' share of 10% in watersheds and 50% in other interventions). Accelerated irrigation benefits under the PMKSY can be achieved by reducing the transmission losses and adopting the goal of 'zero flood irrigation by 2020' and popularizing micro-irrigation (MI) systems with need-based irrigation scheduling for the crops rather than calendar-based irrigation. The benefit-cost ratio (BCR) for the PMKSY at macro level are expected to be about 9.2:1 while at individual farmers' level, the benefit expected to vary from Rs. 3,000 to 150,000/ha/year with different technologies. Higher returns are likely in rainfed areas with BCR at 9.6:1 compared to the returns from irrigated areas with BCR at 8.2:1.

Presently, 11.4 m ha area has been brought under MI, 53.1 per cent of which is covered under sprinkler system (6.06 m ha) and 46.9 per cent under drip system (5.35 m ha) of which around 44 per cent has been added during last six years. However, the share of area under micro irrigation in gross irrigated area/gross sown area varied significantly across the states (Figure 7). Presently, 11.8 per cent of gross irrigated area in the country is covered under micro irrigation. Andhra Pradesh, Maharashtra and Karnataka are the leading states wherein 38.7 per cent, 33.9 per cent and 31.3 per cent of the gross irrigated area, respectively was covered under micro irrigation.

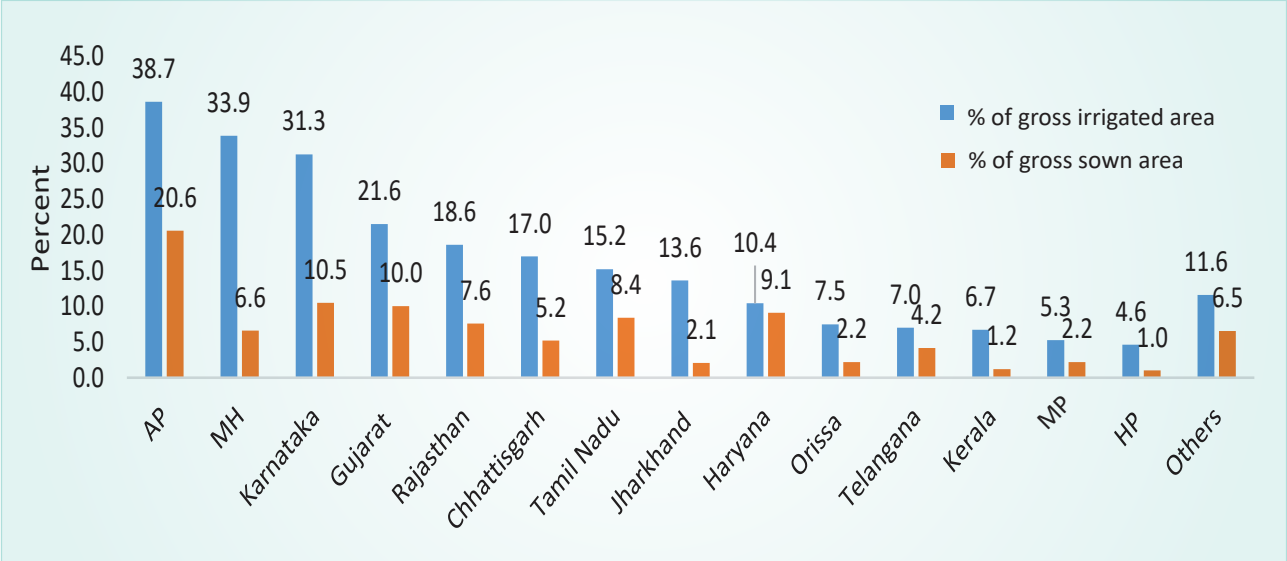
The impact of the micro irrigation in terms of increasing yield and saving of water, energy and other inputs, and enhancing income was studied by various researchers across states in the country and found that micro irrigation helps in conserving and restoration of natural resources. The water savings across the states varied from 37% to 90% which again depend on other factors like topographical and nature of the crops. Similarly, energy and fertilizer saving varied from 30–40% and 28–90%, respectively. The income increased due to adoption of micro irrigation was in the range of 12 to 52% (Chand et al. 2020). Adoption of micro irrigation provides better employment and income generation opportunities to rural youths by attracting them towards agriculture.

In spite of numerous advantages, the adoption of micro irrigation is still low in the country. Therefore, the awareness and mass contact programs should be a continuous process, so that more farmers can be brought in ambit of MI. Availability of liquid chemicals and fertilizers at local level should be ensured for encouraging fertigation and thereby improving the nutrient use efficiency. Few specific recommendations are i) Avoiding land celling condition of 5.0 ha for availing subsidies under PMKSY ii) Adoption of cluster based approach for selection of beneficiaries for better coordination and monitoring of the project interventions iii) Covering water buyers under the scheme for encouraging sharing of water resources iv) Making post installation maintenance services as an integral part of micro-irrigation system. Similarly, the water storage tanks, electric motors and pump sets should be part of MI system.

4.2 Pradhan Mantri Fasal Bima Yojana (PMFBY)

After reviewing the erstwhile crop insurance schemes, a new area based scheme, PMFBY was started from *kharif* 2016. The scheme aimed to

Figure 7. Penetration of micro irrigation across states in 2018-19



Source: Chand et al. (2020).

provide insurance cover to farmers suffering crop loss due to any natural calamities and other risks for sustainable income. Initially, 21 states implemented the scheme in *kharif* 2016 whereas in *rabi* 2016-17, 23 states implemented it. The main objectives of PMFBY is to provide financial support to farmers suffering crop loss/damage arising out of unforeseen events and stabilizing the income of farmers and encouragement for modern agricultural practices.

The Scheme covers all food & oilseed crops and annual commercial/horticultural crops for which past yield data is available. All farmers including sharecroppers and tenant farmers growing the notified crops in the notified areas are eligible for coverage. Different crop risks leading to crop loss covered under the scheme are prevented sowing/planting/germination risk, non-preventable risks like drought, dry spell, flood, inundation, widespread pests and disease attack, landslides, fire due to natural causes, lightening, storm, hailstorm and cyclone, post-harvest losses, etc. and add-on coverage for crop loss due to attack by wild animals. The premium rates for *kharif*, *rabi* and annual commercial/horticultural crops are 2 per cent, 1.5 per cent, 5 per cent of sum insured, respectively, or actuarial rate whichever is lower. Use of technology like encouraging use of drones to minimize traditional methods of loss estimation through crop cutting experiments (CCEs) and mobile phones for uploading crop cutting data on apps/online to reduce delays in claim settlements is another key feature of the scheme.

PMFBY scheme has made significant progress since its inception in year 2016 and large number of farmers registered and benefitted (Table 5). National Crop Insurance Portal (NCIP) has been launched with its integration with different stakeholders like Banks, Insurance Companies (ICs), Common Service Centers (CSC), and access to individual farmer; Crop Insurance App etc. Annually, on an average 53.91 million farmers are being insured and 14.73 million farmers are benefitting from the scheme (Table 5). Studies have indicated that the assured income has led to higher and timely application of required input and technology in turn higher production, market surplus and income (Singh 2018; Ghosh 2019).

Challenges in crop insurance

Researches of the crop insurance found two key problems: the lack of the insurer's efforts

for defining insurance product benefits and on the other side, insufficient interest of farmers – potential insureds. Thus, in this case, the role of the state is necessary in promoting insurance in agriculture as well as in financing researches that are not exclusively commercial (Njegomir 2018). The other important challenges are:

Majority users in four states: 61 per cent of registered farmers are from four states of Maharashtra, Rajasthan, Madhya Pradesh and Uttar Pradesh.

Large number of CCEs required: There are large number of Crop Cutting Experiments (70 lakhs per year) required to find the status during the short harvesting season. Manual crop cutting experiments (CCEs) are inadequate and these are prone to human error and manipulation by different stakeholders. This may also lead to bias as some of the cases have been reported in Karnataka and Gujarat (Ghosh 2018).

Limited use of CCE App: It is found that there are limited use of CCE app by states (below 15% of total CCEs conducted).

Delay in availability of final data: Delay in approval of data on CCE App/sharing CCE yield data with insurance companies by State Governments.

Delay in sharing of subsidy and claims: Delay in sharing of subsidy by the states leading to delay in claims settlement to farmers. This is mainly because of the reason that states disburse 50% of the subsidy only after receiving data from companies on insured farmers and sum insured. Moreover, insurance companies raise objections when they are doubtful of CCE data and this also delays the payment process.

Low investment: Low investment by insurance companies in terms of accessibility and outreach due to short contract durations.

Low spread of scheme in north east regions: Low penetration of the scheme in North-Eastern region due to financial constraints as well as no provision of identifying individual beneficiaries within community owned lands.

PMFBY is a good blend of a yield-index insurance product that takes care of systemic or covariate risks associated with widespread vagaries of weather as well as idiosyncratic losses. Insurance companies should improve Customer Relationship Management (CRM) in order to increase awareness and to give additional information to farmers as potential insured, satisfy and develop supply according

Table 5. Progress of PMFBY

	2016-17	2017-18	2018-19
Farmers insured (lakhs)	562.72	507.74	546.85^
Total sum insured (Rs. '000 crores)	194.54	191.79	220.21
Area insured (lakh ha)	553.66	494.65	499.30
Gross premium (Rs. '000 crores)	20.24	22.99	26.21
Farmers' share (%)	*18.82*	*17.14*	*16.60*
States' share (%)	*41.06*	*41.58*	*41.47*
Centre's share (%)	*40.12*	*41.28*	*41.93*
Total claims paid (Rs. in '000 crores)	15.11	19.94	17.36
Farmers benefitted (lakhs)	131.8	159.04	151.14
Benefitted farmers (% of registered)	23.42	31.32	27.64
Claims paid to farmers (claim to premium ratio)	3.96	5.06	3.99
Ratio of sum insured to premium for farmers	51.03	48.73	50.62

Source: MoAFW (2020)

to the specific needs of farmers. It is suggested for use of high technology and linking land records of farmers with their Aadhaar numbers and bank accounts for assessment and faster settlement of claims (Das et al. 2019). Few specific suggestions for improving efficiency of this scheme are i) Timely sharing of crop cutting data to insurance companies ii) Timely honouring the claims iii) Strengthening the grievance redressal cell at block level iv) rationalizing number and improving quality of crop cutting experiments, and utilizing information technology in conduct of operations and awareness creation.

4.3 Pradhan Mantri Annadata Aay Sanrakshan Abhiyan (PM-AASHA)

The PM-AASHA is an umbrella scheme to ensure Minimum Support Price (MSP) to farmers. It encompasses the erstwhile Price Support Scheme (PSS) along with two new schemes: Price Deficiency Payment Scheme (PDPS) and Pilot Private Procurement and Stockist Scheme (PPSS). Under this, the procurement of paddy, wheat, pulses and copra shall be done under price support scheme (PSS) while in case of oilseeds, states / UTs are offered to choose either of PSS and PDPS in a given procurement season for the entire State. The Department of Agriculture & Cooperation implements the PSS for procurement of oilseeds, pulses, cotton and copra through NAFED, the Central nodal agency, at the MSP declared by the government. NAFED undertakes procurement as and when prices fall below the MSP to save the farmers from distress sale. Procurement under PSS is continued till prices stabilize at or above the MSP. This scheme is implemented at the request of the concerned State Governments which agrees to exempt the procured commodities from levy of mandi tax. The main objectives of PSS scheme are i) to provide remunerative prices for agricultural commodities and ii) to save the farmers from distress sale.

Impact of PSS

Price support scheme has made significant contribution in providing remunerative prices to farmers and procuring pulses and oilseeds. During last five years (2014-15 to 2018-19), NAFED has made an unprecedented record procurement of 9.16 mt of oilseeds and pulses under the Price Support Scheme, 12 times higher than corresponding period of previous five years, i.e. 2009-10 to 2013-14.

4.4 Market Intervention Scheme (MIS)

Market Intervention Scheme (MIS) is an ad-hoc scheme for the commodities which are not covered under the Price Support Scheme (PSS). Its main aim is to intervene in the market to provide remunerative prices to the farmers in case of excess production and fall in prices. MIS is a price support mechanism implemented on the request of State Governments for the procurement of perishable and horticultural commodities in the event of a fall in market prices. It is implemented when there is at least a 10 per cent increase in production or decrease in the prevailing rates over the previous normal year. Proposal of MIS is approved on the specific request of State/Union Territory (UT) Government which are ready to share the loss with Central Government. Under the Scheme, a pre-determined quantity at a fixed Market Intervention Price (MIP) is procured primarily by NAFED and the agencies designated by the state government for a fixed period or till the prices are stabilized above the MIP whichever is earlier. The MIS has so far been implemented like apples, *kinnoo/malta*, garlic, oranges, *galgal*, grapes, mushrooms, clove, black pepper, pineapple, ginger, red-chillies, coriander seed, *isabgol*, chicory, onions, potatoes, cabbage, mustard seed, castor seed, copra and palm oil.

Impact of MIS

The procurement under MIS was conducted in many states, however, it was frequent in

few states only and for specific commodities. Since the prices are much volatile, onion is one of the important commodity procured under MIS (Table 6). The need of MIS decreases with increase of infrastructure in regulated markets in states as well as rural roads and other facilities (Jha 2018).

Impact of Market Intervention Scheme (MIS) and Price Support Scheme (PSS) have been instrumental in creating a fairly stable price environment for farmers and proved boon in distress. However, the efforts must be made to increase the coverage of schemes for more crops. The Government of India should encourage the state government to initiate market intervention operations well in advance. The operational efficiency of purchasing agencies needs to be toned up in the context of cost efficient purchases vis–á–vis competitive sales so as to avoid or reduce losses. Awareness about the schemes and Fair Average Quality (FAQ) norms should be created among the farmers (Kalamkar 2013).

4.5 Interest Subvention Scheme

The Interest Subvention Scheme (ISS) came into force from *kharif* 2006-07. Under this scheme, the Government of India provided interest subvention of 2 per cent to Public Sector Banks, Regional Rural Banks (RRBs) and Cooperative Banks in respect of short-term production credit up to Rs. 3.00 lakh to farmers at an interest rate of 7 per cent per annum. Private Sector Banks (rural and semi-urban branches) are also covered under the scheme from the FY 2013-14. The amount of

Table 6. Quantity procured under MIS during the last decade ('000 t)

State	Commodity	2011-12 to 2013-14	2014-15 to 2016-17	2017-18 to 2019-20
Arunachal Pradesh	Ginger		12.7	
Andhra Pradesh	Oil palm	90.0	115.0	
	Turmeric	54.0		12.1
	Chilli	104.0		88.3
Himachal Pradesh	Apple	89.4	27.0	
J & K	Apple			15.8
Karnataka	Arecanut	12.0	28.0	
	Onion	54.0	100.0	
	Turmeric	12.4		
Madhya Pradesh	Onion			651.0
Mizoram	Iskut (Choyae)	4.0		
	Chilli		2.9	
	Grapes		3.8	
Nagaland	Pineapple	12.7		
	Ginger		32.0	
	Potato			6.6
Rajasthan	Garlic	60.0		164.0
	Onion			280.0
Tamil Nadu	Turmeric	35.0		
	Oil palm		1.0	
Telangana	Chilli			33.7
Uttar Pradesh	Potato	300.0	100.0	300.0

Source: Annual Report (various issues), Department of Agriculture, Cooperation and Farmers Welfare.

subvention was to be calculated on the amount of crop loan from the date of disbursement up to the actual date of repayment of the crop loan by the farmer or up to the due date of the loan fixed by the banks, whichever is earlier, subject to a maximum period of one year. Year-wise rate of interest subvention made available to the banks on their own funds was 2 per cent except 1.5 per cent during 2010-11.

Since the year 2009-10, additional incentive to prompt-paying farmers was 1 per cent during 2009-10, 2 per cent in 2010-11 and 3 per cent since 2011-12. To provide relief to farmers affected by natural calamities, interest subvention of 2 per cent has been made available to banks for the first year on restructured amount of crop loans. From 2011-12, concessional loans were extended to the farmers against negotiable warehouse receipts to discourage distress sale of produce by farmers. The scheme was extended to animal husbandry and fisheries farmers from 2018-19. To offset the economic impact of COVID-19, the Ministry of Fisheries, Animal Husbandry and Dairying has also made the provision of interest subvention on working capital loans taken by cooperatives and farmer producer organizations engaged in dairy activities for handling surplus milk and enable timely payment to the farmers. The interest subvention to Banks and Prompt Repayment Incentive to farmers is available only against KCCs from 01.04.2020.

Impact of the scheme

The credit flow under production credit (crop loan) has increased significantly after the introduction of ISS. Statistics indicate that the credit disbursement during 2016-17 to 2018-19 was more than 100% of target (Table 7). Further small and marginal farmers had about 50% share in total loan amount disbursed indicating priority of bank to help poor farmers at grassroot level.

Table 7. Agriculture credit targets and achievements (Rs. billion)

Year	Target	Achievement	Loan disbursed to small holders
2016-17	9000	10658	5344
2017-18	10000	11626	5805
2018-19	11000	12568	6261
2019-20*	13500	13737	n.a.

Source: Various issues of RBI Annual Report; MoF (2020).
*Note: * Provisional; n.a. is not available.*

4.6 Recent Initiatives

Pradhan Mantri Kisan Samman Nidhi (PM-KISAN)

This Scheme was formally launched on 24th February, 2019 and is operational since December, 2018. Initially started with small and marginal farmers possessing a combined holding of upto 2 hectares of land, it was extended to all farmers from June 2019, irrespective of the size of their land holdings. The Scheme aims to supplement the financial needs of all landholding farmers' families in procuring various inputs to ensure proper crop health and appropriate yields, commensurate with the anticipated farm income as well as for domestic needs. An amount of Rs. 6000/- per year is provided to farmers in three equal instalments of Rs. 2000/- directly into the bank accounts of eligible landholding farmer families. During each quarter of 2020-21 about 10 crore farmers have been granted direct benefit under the scheme. The farmers benefitted were 23% higher than the previous year (Table 8).

Table 8. Number of farmers beneficiaries under PM-KISAN scheme (crore)

Period	2018-19	2019-20	2020-21
April to July	-	6.63	10.48
August to November	-	8.76	10.21
December to March	3.16	8.95	9.38

Source: www.pmkisan.gov.in

Agriculture Infrastructure Fund

The Agriculture Infrastructure Fund is a medium to long-term debt financing facility for investment in viable projects for post-harvest management infrastructure and community farming assets through interest subvention and credit guarantee. The duration of the scheme shall be from FY 2020 to FY 2029. A fund of Rs 1 lakh crore has been allocated under this scheme. The Scheme aims to improve the post-harvest infrastructure, reduce national food wastage and thereby enabling agriculture sector to become competitive with current global levels. The scheme will benefit the farmers including FPOs, Primary Agricultural Cooperative Societies, Agriculture entrepreneurs, Start-ups, etc. through improved market/ logistic infrastructure and access to modern packaging and cold storage systems. This will improve the overall income of farmers.

Farmer Producer Organizations

Collectivization of producers, especially small and marginal farmers, into producer organizations has emerged as one of the most effective pathways to address the many challenges of agriculture but most importantly, improved access to investments, technology and inputs and markets. Department of Agriculture, Cooperation & Farmers' Welfare (DAC) acts as the nodal agency for the development and growth of FPOs through supportive ecosystems, liquidity and market linkage, capacity building, etc. The FPO with a minimum farmer-members of 300 in plains and 100 in hills (including such other areas of UTs) shall be eligible under the scheme. A Business Plan Linked development in both medium and long-term is the hallmark of strong business growth for FPO. So far, 886 FPOs have been registered in the country and Madhya Pradesh, Karnataka and Maharashtra are the leading states, formed more than 100 FPOs each.

Soil Health Card

Soil Health Card (SHC) scheme was launched by the Government of India in 2015 to help farmers to improve productivity and reducing costs through judicious use of inputs as well as to improve the health of soil. Under the scheme, the Soil Health Card containing status of soil considering 12 parameters (N, P, K, S, Zn, Fe, Cu, Mn, Bo, pH, EC & Organic Carbon) and crop-wise recommendations of nutrients and fertilizers based thereon is issued to the individual farmer. The scheme status indicates increasing number of beneficiaries in every succeeding year (Table 9).

Table 9. Farmers covered under SHC scheme

Year	No. of farmers (crore)
2015-16	1.19
2016-17	4.42
2017-18	5.58
2018-19	6.30

Source : https://soilhealth.dac.gov.in

Rashtriya Gokul Mission

The bovine genetic resource of India is represented by 41 registered indigenous breeds of cattle and 13 registered buffalo breeds. Indigenous bovine are robust and resilient and are particularly suited to the climate and environment of their respective breeding tracts. Rashtriya Gokul Mission (RGM) has been launched in December 2014 with an outlay of Rs 2025 crore for development and conservation of indigenous breeds through selective breeding in the breeding tract and genetic upgradation of nondescript bovine population using elite indigenous breeds like *Gir, Sahiwal, Rathi, Deoni,*

Tharparkar, *Red Sindhi* etc. The scheme comprises of two components namely National Programme for Bovine Breeding (NPBB) and National Mission on Bovine Productivity (NMBP).

Kisan Rail

To maintain national cold supply chain for perishables, inclusive of milk, meat and fish, Indian Railways has set up a Kisan Rail through PPP arrangements. In order to serve the purpose of the farming community of the country, Kisan Rail are the trains with multi commodities, multi-consignors and multi-consignees. These trains shall run between fixed Origin–Destination pairs with en-route stoppages, and loading/ unloading shall be permitted at any of the en-route stoppage. The first-mile arrangements including aggregation of consignments through FPOs, warehousing, setting-up of temperature-controlled storages, etc. shall be coordinated by the Ministry of Agriculture & Farmers' Welfare. MoA&FW will also promote startups in agri-infrastructure and new FPOs, and strengthen existing FPOs for backward integration.MoA&FW shall also ensure that information regarding Kisan Rail is duly disseminated among all the stakeholders, such as mandis, farmers' co-operatives, NGOs, etc. *Kisan Rail* and *Krishi Udaan* (agriculture flights) have made it possible for farmers to sell their crops in other states.

Transformation of Aspirational Districts

This programme aims to quickly and effectively transform aspirational districts. The broad contours of the programme are convergence (of Central & State Schemes), collaboration (of Central, State level 'Prabhari' Officers & District Collectors), and competition among districts driven by a mass movement. With States as the main drivers, this program will focus on the strength of each district, identify low-hanging fruits for immediate improvement, measure progress, and rank districts. It was decided that the baseline ranking based on 49 indicators across five sectors that include health and nutrition (30% weightage) through 13 indicators, education (30%) through 8 indicators, agriculture and water resources (20%) through 10 indicators, financial inclusion and skill development (10%) through 10 indicators, and basic infrastructure (10%) through 7 indicators. The districts were selected through a transparent process, with the capacity of states kept in mind.

National Livestock Mission

Launched during 2014-15, this was formulated for development of livestock sector with the objectives to enhance the level of nutrition and standard of living of livestock keepers and farmers especially small holders through sustainable, safe and equitable livestock development. It broadly covers all the activities required to ensure quantitative and qualitative improvement in livestock production systems and capacity building of all stakeholders.

Animal Husbandry Infrastructure Development Fund

Govt. of India has announced for setting up of Rs. 15000 crore Animal Husbandry Infrastructure Development Fund (AHIDF) under *Atma Nirbhar Bharat Abhiyan* stimulus package. The AHIDF has been approved for incentivizing investments by individual entrepreneurs, private companies, MSME and FPOs to establish (i) the dairy processing and value addition infrastructure, (ii) meat processing and value addition infrastructure and (iii) animal feed plant.

National Programme for Dairy Development (NPDD)

Implemented since 2014-15, NPDD aims to create and strengthen dairy infrastructure for procurement, processing and marketing of milk and milk products by the State Implementing Agencies (SIAs) i.e. State Cooperative Dairy Federations/ District Cooperative Milk Producers' Union.

Dairy Processing & Infrastructure Development Fund (DIDF)

Dairy Processing & Infrastructure Development Fund has been set up with a corpus of Rs. 8,004 crore with NABARD. The scheme aims to provide subsidized loan @6.5% to capital stressed milk cooperatives for primarily replacing their decades old chilling and processing plants and addition of value added product plants. Out of Rs. 10,881 crore of financial outlay for project components of DIDF, Rs. 8,004 shall be loan from NABARD to NDDB/NCDC, Rs. 2,001 as end borrowers contribution, Rs 12 crore as NDDB/NCDC's share and Rs 864 crore shall be contributed by Central Department of Animal Husbandry and Dairying toward interest subvention. The Scheme envisages providing loan assistance to State Dairy Federations, District Milk Unions, Milk Producers Companies, Multi State Cooperatives and NDDB subsidiaries across the country that are termed as Eligible End Borrowers (EEBs).

National Animal Disease Control Programme

National Animal Disease Control Programme (NADCP) is a flagship scheme launched in September, 2019 for control of Foot & Mouth Disease and Brucellosis by vaccinating 100% cattle, buffalo, sheep, goat and pig population for FMD and 100% bovine female calves of 4-8 months of age for brucellosis with the total outlay of Rs.13, 343.00 crore for five years (2019-20 to 2023-24). The overall aim of the NADCP is to control FMD and brucellosis by 2025 with vaccination and eventual eradication by 2030.

Pradhan Mantri Matsya Sampada Yojana

The scheme aims to enhance fish production to 220 lakh metric tons by 2024-25 from 137.58 lakh metric tons in 2018-19 at an average annual growth rate of about 9%. It is estimated that the Scheme will result in doubling export earnings to Rs. 1,00,000 crore and generate about 55 lakhs direct and indirect employment opportunities in fisheries sector over a period of next five years. The insurance coverage for fishing vessels is being introduced for the first time. The scheme envisages an estimated investment of Rs. 20,050 crores comprising Central share of Rs. 9,407 crore, State share of Rs. 4,880 crore and beneficiaries contribution of Rs. 5,763 crore. PMMSY will be implemented over a period of 5 years from FY 2020-21 to FY 2024-25 in all States/ Union Territories.

Kisan Credit Cards to dairy farmers

A Special Drive has been undertaken by the Department for providing all dairy farmers of Milk Cooperatives and Milk Producer Companies with Kisan Credit Cards (KCC). Under the dairy cooperative movement, approximately 1.5 crore farmers are associated with 230 Milk Unions in the country. It was proposed to provide KCC to these 1.5 crore dairy farmers belonging to Milk Unions and Milk producing Companies during 1st June-30th September 2020 under a special drive. As on 03.10.2020, under this special drive 47.81 lakh applications of Dairy farmers have been collected by Milk Unions and 36.18 lakh applications forwarded to the Banks.

4.7 Summing Up

The flagship programmes launched by the Government of India during different financial years has led to enhanced cultivated land under micro irrigation saving precious irrigation water, benefitted farmers through insurance coverage of their crops and helped in providing credit at a subsidized rate to free them from money lenders. The schemes also benefitted farmers by market interventions of the government through MIS and PSS that helped in enhancing net returns of farmers for specific commodities. Many other schemes have also led to overall development of agriculture, livestock, dairy and fisheries sector of India and helped farmers operating in different farm business activities. The efficient implementation of all the programmes will definitely help in enhancing farmers' income in the country.

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5

Research Highlights

Shiv Kumar, Prem Chand, Rajni Jain and Vinayak R. Nikam

This chapter highlights the recent key research accomplishments of Indian Council of Agricultural Research (ICAR) and major findings of agricultural policy research by ICAR-National Institute of Agricultural Economics and Policy Research. Structural changes, strategies for doubling farmers income, climate change impact assessment, value chain management and sustainable agricultural practices remained the major research agenda of the Institute. Technology foresight, diversification, food and nutritional security were also focused by the Institute.

5.1 Advancement in Agricultural Research

ICAR has played a pivotal role in making Indian agriculture sustainable through use of eco-friendly and innovative technologies which helped the country in increasing the agricultural production several fold and generating surplus for export. Much of this is attributed to technological change. Developing suitable manpower, reaching to farmers and coordinating with various stakeholders to mitigate the challenges of Indian agriculture remain the key agenda of the Council. ICAR has always come forward to meet such challenges and performed well during the Pandemic period. Timely advisories and ground-level support to farmers through ICAR institutes and KVKs network proved to be of immense importance to farming community and it was nationally and internationally recognized. Some significant research contributions in the recent period are given below[1].

5.1.1 Soil and water productivity

During 2020, the NRM division made a significant contribution in preparing Land Resource Inventory (LRI) on 1:10000 scale for 3 North-Eastern states, namely Manipur, Nagaland, and Sikkim to work out block level land use planning. Potential areas for rice and oil palm in the country were delineated.

5.1.2 Climate change and resilient agriculture

Two microbial consortia viz., *Pseudomonas putida* P7 + *Bacillus subtilis* B30 (consortia 1) and *Pseudomonas putida* P45 + *Bacillus amyloliquefaciens* B17 (consortia 2) were developed for drought tolerance and enhancing crop productivity. Multi-enterprise integrated farming system models for Andhra Pradesh, Gujarat and Rajasthan were developed. New climate resilient rice genotypes IET 24306 *(Swarna Samriddhi Dhan)* and NICRA Aerobic Dhan 1 were developed.

5.1.3 Crop improvement

During 2020-21, a total of 172 varieties/hybrids including 17 biofortified varieties were notified and released for commercial cultivation. These high-yielding varieties included 62 varieties of cereals, 23 oilseeds, 33 pulses, 39 commercial crops, 15 forage crops and other crops. Using marker-assisted selection strategy, lipoxygenase-2 free soybean variety NRC 132 was developed and identified for cultivation in Southern and Eastern zones. Besides, varieties and hybrids of fruit crops (e.g. *Arka Chandra* and *Arka Anantha* of pummelo, *Arka Supreme* of

[1] Based on Annual Report of ICAR.

avocado, ARI-516 grape, Solapur Lal biofortified hybrid of pomegranate), vegetables (e.g. *Bhima Subhra* and *Bhima Safed* of onion, *Kufri* FryoM, *Kufri Karan, Kufri Manik,* Kufri Sahyadri, Kufri Thar-1, Kufri Thar-2, Kufri Thar-3 and *Kufri Sangam* of potato, *Kashi Baingani* of French bean), spices (Ajmer *Ajwain-73* and Ajmer Nigella-1) and plantation crops (e.g. *Kalpa Haritha, Kalpa Jyothi, Kalpa Surya* and *Kalpa Srestha* of coconut, VTLCP-9 of cocoa) were developed/identified.

5.1.4 Livestock improvement

The cattle Frieswal was declared as a breed and subsequently a trademark FrieswalTM was obtained. A bull mother farm of Frieswal cattle was established at ICAR-NDRI, Karnal by selecting 208 Frieswal cows/heifers from 850 elite cows. Frieswal, a national milch crossbred cattle variety, was released. The average milk production potential of Frieswal cows based on 300 day milk yield is more than 3,335 kg. The mature lactation milk yield of Frieswal cows is 3,628 kg. Under Mega Sheep Seed Project, improvement of indigenous sheep breeds was carried out by propagation of superior germplasm in the farmers' flock. A total of 345 improved goat germplasm of different breeds were supplied to farmers and different developmental agencies for improving production performance in field conditions. The institutional flock of Jakhrana goats exhibited an average milk production of 147.72±3.66 litres in 90 days and 192.40±5.58 litres in 120 days. Besides, poultry lines were improved and crosses were also produced.

5.1.5 Fish improvement

The indigenous ornamental fish, channa stewartii, collected from beels of Assam was raised to broodstock in concrete tanks. The complete technology of breeding and seed production of ornamental fish silver moony was developed. Captive breeding and seed production of an important food fish, mangrove red snapper, was successfully undertaken, which not only is a suitable species for farming in brackishwater ponds and open cages, but it also grows fast, tolerates salinity and accepts pelleted feed.

5.1.6 Post-harvest management and value-addition

Green pea is used as fresh pea, frozen pea, canned pea and in dried pea seed from. The shelling/ de-poding of pea seeds form the matured pods is requisite operation. A small to medium scale green pea de-poding machine was developed with capacity of 45-55 kg/h, shelling efficiency of 90-95% and damage less than 2-3%. The on farm solar assisted dryer for drying groundnut pods was developed. The other machinery developed for post-harvest management and value-addition were primary *makhana* roasting machine, loading/ unloading device, poultry processing cum by-product collection unit, automated amylose detection sensor system for assessment of aging of rice grain, portable solar dryer for hills, portable ozone based fruits and vegetables washer-cum-purifier/ portable smart ultraviolet-C disinfection system.

5.1.7 Technology dissemination and farmers linkage

Technology assessment is one of the main activities of KVKs to identify the location specificity of agricultural technologies developed by National Agricultural Research System (NARS) under various farming systems. A total of 5,421 technologies of various crops were assessed at 13,094 locations by KVKs through 25,357 trials on farmers' field. Under livestock, 1,034 technologies interventions across 3,338 locations covering 5,156 trials on animals were taken up. A total of 17.27 lakh farmers/farm women, rural youth and extension personnel were trained on various aspects through 57,879 training programmes. KVKs produced technological products like seeds and planting materials of improved varieties and hybrids, bio-products and elite species of livestock, poultry and fish which benefited 26.37 lakh farmers in the country. Soil, water, plant and manure samples

brought by farmers were analysed at KVKs, and suitable advisories based on analysis were provided to them. Soil health cards (4.56 lakh) were also issued to the farmers by KVKs. During the year, 5.81 lakh farmers visited ATICs for obtaining solutions related to their agricultural problems.

5.1.8 Agricultural human resource development

Education system faced tremendous challenges due to COVID-19. Guidelines were prepared for e-learning, implementation of Student READY programme, conducting examination etc. Several new initiatives were undertaken during the year to facilitate our students and Universities, including ICAR's All India Entrance Examination in LAN-based CBT mode by the NTA. The National Agricultural Higher Education Project (NAHEP) has also increased its presence and is now being implemented in 58 agricultural universities and 3 Deemed Universities across 23 states.

5.2 Agricultural Policy Research

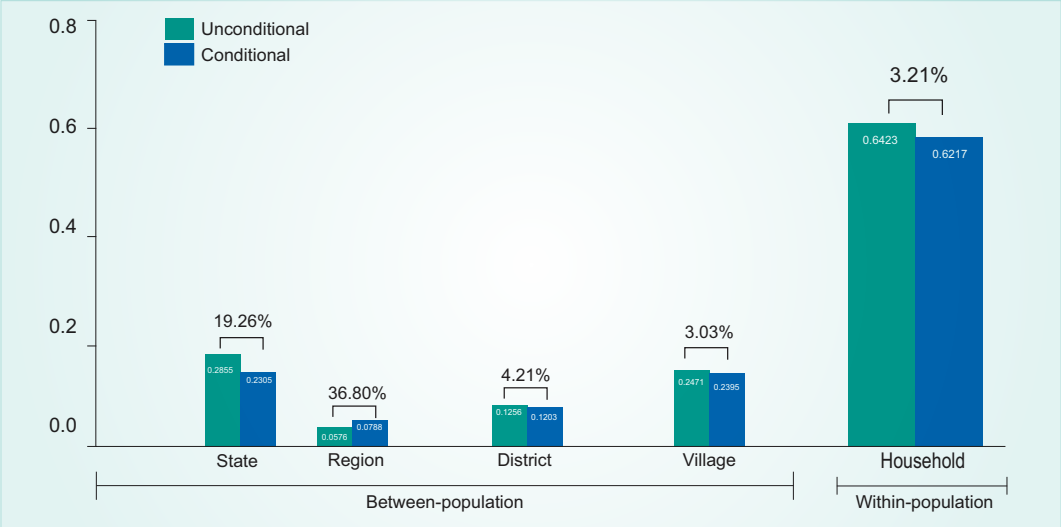
5.2.1 Technology and sustainable agriculture

Sustainable agricultural development requires identification of magnitude of sustainability, priority areas and resilient technologies, foreseeing future scenarios and accordingly designing strategies and policies for out-scaling and scaling up. The institute worked on areas like impact of climate change and adaptation strategies, agricultural sustainability assessment, optimum cropping pattern, resource use planning, farm waste management, groundwater management, efficient water-use technologies, technology foresight, agricultural patents, extension advisory services etc.

Impact of climate change and hazards: The analysis of long-term climate pattern revealed a significant departure in annual mean maximum and minimum temperature as well as rainfall across agro-climatic zones (ACZs). Climatic shocks reduce agricultural productivity, and the effects get accentuated in the long-run. The impact of climate change on crop yield was projected under various scenarios represented in the form of Representative Concentration Pathways (RCP) (in RCP 4.5: in the year 2040, emissions peak would be achieved and decline late on; in RCP 8.5: emissions continue to rise throughout the 21st century). The results discerned that yields of rice and wheat are affected adversely under both scenarios in all the zones except Gujarat Plains and Hills in case of wheat and West Coast Plain and Ghat in both the crops. The long-term impact of climate change on crop yields would be more severe under RCP 8.5 than RCP 4.5 scenario. This necessitates to build capacity of marginal farmers to make agriculture resilient, suitable and diversified livelihood as they are more vulnerable to climate shocks. Apt crop and region-specific adaptation measures are uniquely devised and needed against varying relative impacts of climate change and associated vulnerability across ACZs. Studies also indicated that the impacts of climate change are gender differentiated and female is more vulnerable than male due to more exposure and less adaptive capacity. Migration has emerged as a significant adaptation strategy to manage vulnerability and secure livelihoods to climate risks. However, it affects both the place of origin and destination via its impact on natural resources, economic security and other socio-political factors.

Impact of climate hazards especially in low-income and pre-dominantly agrarian states have more adverse effects on agricultural growth. But these adverse effects tend to dissipate over time. Irrigation and crop diversification are more effective against droughts and heat-waves, but up to certain frequency level. Moreover, livestock and fertilizer-use are more effective in rising frequency of climatic hazards. The variation in drought risk is disproportionately

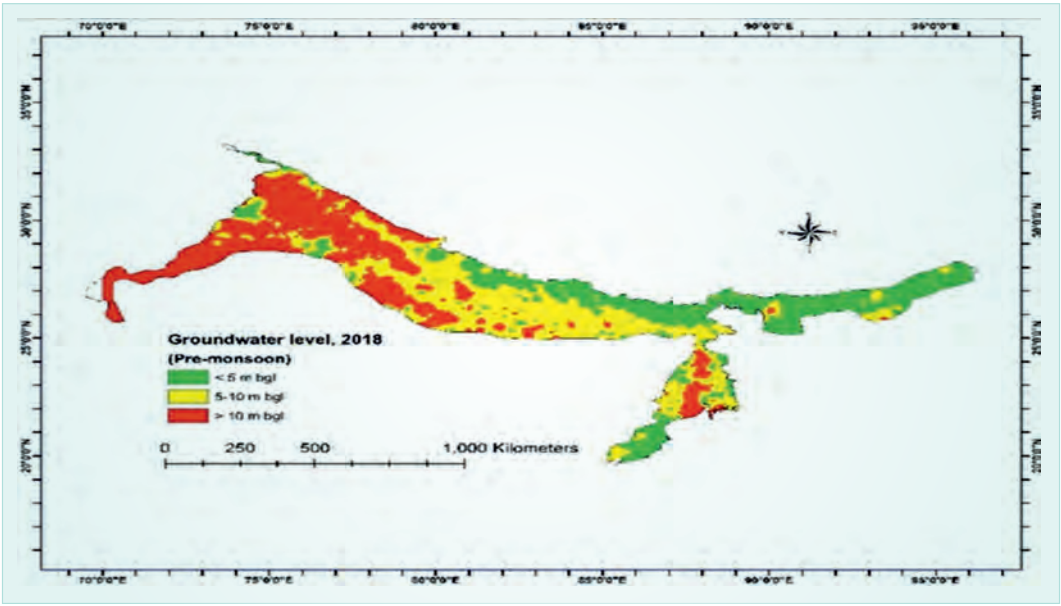
Figure 8. Per cent of the total variation in drought risk attributed to different geographical levels



distributed across states, regions, districts, villages and households, largely attributed to within households (Figure 8).

Priorities of sustainable intensification: The composite index of agricultural sustainability has been developed for the Indo-Gangetic Plains (IGP). This index deciphered that agriculture was moderately sustainable in Haryana and Punjab. Dimensions related to environment and sustainable water use management discerned the major causes of concern in the region. Enhancing crop as well as system diversity, increasing input use efficiency, particularly of canal irrigation water, rehabilitation of traditional water storage structure, land development and in-situ conservation of biodiversity must be the top priorities for sustainable intensification in the region. Within the IGP, wide spatial variations in groundwater level were observed owing to variation in rainfall as well as cropping pattern besides several socio-economic, policy and infrastructural related factors (Figure 9). Agro-climatic zones of eastern and central India are more sustainable for paddy cultivation as compared to north-western and south-eastern zones pointing towards need of cropping pattern

Figure 9. Spatial variation in groundwater level in Indo-Gangetic Plains of India in 2018



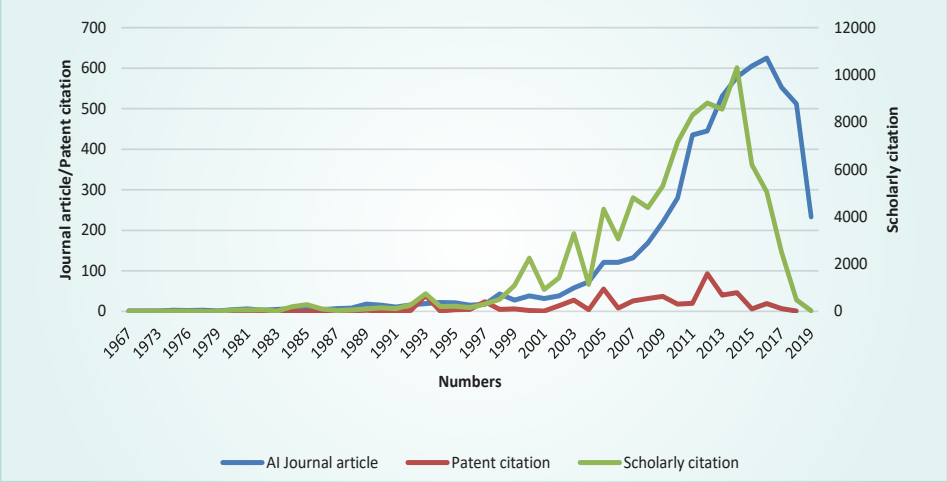
re-alignment across the zones based on water availability and footprints.

Sustainable management technologies, practices and strategies: The studies on water efficient technologies and practices bring out that use of sprinkler irrigation contributes towards improving crop yield and income gains and has potential of augmenting an additional area of 65 to 80 m ha in the country. Amongst states, Uttar Pradesh has the largest potential (25%) followed by Rajasthan (12%) and Madhya Pradesh (11%). However, availability of groundwater and labour, intensity of pumpset, use of electricity, and subsidy are potent determinants for adoption of sprinkler irrigation. People's participation at different stages of micro-irrigation programme plays important role in its adoption. Addressing the issues of faulty water release scheduling, encroachment of water channels, delay in de-siltation of channels, and inadequate water supply would be the way-out for improving efficiency of surface irrigation.

Sustainable land use plans: Optimum enterprise plans were developed for arid, semiarid tropics and flood prone regions for sustainable use of resources. The results inferred diversion of area from cereals towards pulses and oilseeds for sustaining natural resources in Bundelkhand region. Optimum plans integrating crop and livestock (local cattle and small ruminants) lead towards more sustainable agriculture in the region. In arid region of Rajasthan, optimum plan suggested for increasing area under sorghum, sesame, green gram, guar, isabgol, gram and mustard. Cultivation of autumn rice with recommended doses of fertilizer and suitable variety (Luit, Disang), growing in flood prone winter rice varieties viz. Ranjit Sub 1 and Bahadur Sub 1 and improved goat variety (Beetle) emerged as major interventions for managing the flood in Lower Brahmaputra Valley Zone of Assam.

Foreseeing agricultural technologies: Most of the patents in agriculture granted during 1990 to 2007 are from Asian countries, particularly China. India's growth in cumulative patents filed in agriculture is higher than the global average growth during recent years. The study on trends in patents and scientific publications in two of emerging disruptive technologies of 4.0 Industrial Revolution: synthetic biology and artificial intelligence in agriculture revealed that amendment of patent law 2005 had a positive impact on patenting of agricultural technologies in India (Figure 10) . The number of patent citations is higher in synthetic biology compared to artificial intelligence, as the research from the earlier strands leads to products which are easy to patent. The analysis of the effect of regulatory policies of

Figure 10. Trends in scientific publication, patents and citation on artificial intelligence in agriculture



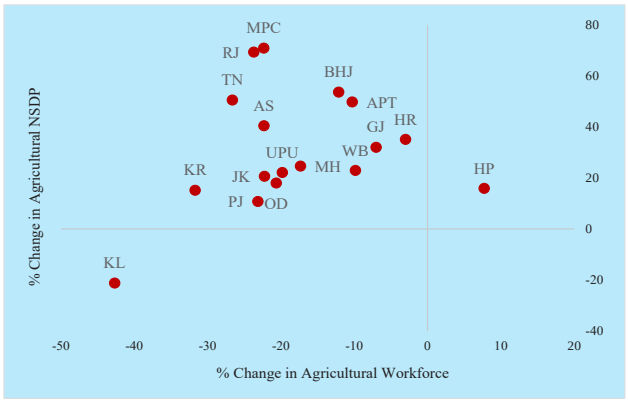
the government on anti-competitiveness in the Bt cotton industry showed that interaction of business model and regulatory policies results in anti-competitiveness in the Bt cotton industry.

Technology application: Indian extension system is of pluralistic nature and linkages with varying degree have been observed among different extension and advisory services (EAS) providers indicating convergence and coordination among them. Farm households having access to EAS operate with comparatively higher technical efficiency than those without access to EAS. Further, the social network greatly influences adoption of information communication technology by the farmers. The adoption rate of the technology can be improved by targeting the contact persons having better social network characteristics such as education level, land holding, association in village organization, frequency of interaction etc. A study on relevance of different knowledge sources, advisory methods, time allocation by different extension advisory staff showed that public institutions are important source of knowledge to other extension advisory service providers. Therefore, literature and recommendations of these institutions need to be abreast with emerging problems and changing realities in Indian agriculture. With development of ICT, internet has become a major source of knowledge for EAS providers.

5.2.2 Growth and development

Under agricultural growth and development theme, institute studied structural transformation of agriculture and rural economy and doubling farmers' income. During the period 2006 to 2016, structural change has contributed around 30 per cent of national productivity growth and states like Madhya Pradesh, Rajasthan and Tamil Nadu have generated higher agricultural output along with significant reduction in agricultural workforce. Agricultural workers have withdrawn from farming at varying rates in all the major states except Himachal Pradesh. Productivity trends in agriculture clearly indicate that the shift of labour from agriculture has not affected the agricultural output. But increase in agricultural output was in consonance with the convergence in both land and labour productivities. Expanding labour intensive industrial and services clusters in rural areas would augment this transition. On output side, investing in on-farm assets and research, realigning production to market demand and consumer taste are measures to speed-up the transformation.

Figure 11. Response of agricultural Net State Domestic Product (NSDP) to labour-shift (2005-06 vs 2015-16)



Rural employment is diversifying towards non-farm activities at varying rate across the states. During the period 2011-12 to 2017-18, rural areas in most of the states have witnessed notable increase in non-farm employment (Figure 11). Change in the share of rural non-farm employment was high in Bihar (58%), Chhattisgarh (58%) and Haryana (40%). Such transitions are helping farm households to diversify their sources of income. The increased demand for labour in non-farm sectors pushes farm wages upwards. The non-farm employment also found to have more potential of reduction in rural poverty as compared to agriculture. Marginal and smallholders are more likely to shift towards both livestock and non-farm based occupations. Similarly, higher education and training positively influence labour movement toward non-farm sectors. However, a large gap

exists in male and female labour participation in non-farm enterprises in several states, though it has reduced over time.

In 117 aspirational districts identified by NITI Aayog, farmers with marginal and smallholdings, especially male-headed households, diversified their income through non-farm participation while with medium and large land holders concentrated on agriculture as they could generate considerable marketable surplus and income. Household getting subsidised ration as well as assured labour employment were less likely to undertake non-farm business enterprises.

Improvements in productivity of agriculture and non-farm participation have raised earnings of the farm households. This has resulted in redistribution of income towards the marginalized households as the income distribution is more equal among farmers having less than 4 hectares of land (2012-13). The Gini index stands at 0.6 for this class and 0.5 for marginal and small holders. Relatively low values of Gini indices for the marginal and small farm households revealed higher degree of equality in income distribution as compared to medium and large farm households. Reversal in the declining trend in calorie intake has been observed in rural and urban India since 2011-12. The source of calories is shifting from grains to sugar, oil, meat, fish and dairy products. Increased income and reduced inequality have definite implications for nutritional intake as the estimates of elasticities of three macronutrients (calories, protein and fat) with respect to income were higher for rural as well as female headed households compared to their counterpart. However, the association between income and nutrition is diminishing over time.

Investment in productive assets is a pre-requisite for sustainable agricultural development. The average annual investment per hectare of net sown area is low and primarily contributed by farm households. It is necessary to boost private investment (including by farmers) in agriculture to fasten agricultural growth and development. The increasing trend in public sector investment and government's focus on improving farmers' income are expected to incentivize farmers to raise their investment in agriculture. It is also desirable to diversify investment portfolio towards livestock, fisheries & other sub-sectors. Amongst several interventions, diversification of agriculture in favour of high value crops, such as vegetables, fruits, spices, condiments and plantations, is contemplated as an important means of securing farmers' livelihoods, accelerating agricultural growth and reducing rural poverty. Improvement in infrastructure like net irrigated area, village electrification, road length, number of telephone, schools, hospitals, agricultural markets encourage crop diversification. A study employing a multilevel model, demonstrated that although between individual differences explain considerable variation in agricultural diversification, the contextual effects of states and villages are unequivocally important in shaping its geographical pattern. The contextual effects, however, differ across crops and farm classes.

Farm mechanisation significantly contributes to increasing paddy output across all farm-size categories. The impacts are larger on relatively small farm. Varying modes of institutional mechanisms exist for Custom Hiring Centres with respective challenges and opportunities in providing farmers' access to farm machineries. Rising farm wages and higher institutional credit to agriculture promote mechanization. Still, presence of a less-than-unitary elasticity of substitution between labour and machines (between 0.5 and 0.8) in most of the crops restrains augmenting agricultural labour productivity growth. Irrigation Water Governance Index revealed improvement in governance in public irrigation system in Rajasthan, Uttar Pradesh and Madhya Pradesh between 2003-04 and 2013-14. The coefficient of the governance index was negative and statistically significant, implying that an improvement in irrigation governance

leads to a reduction in the gap between the irrigation potential created and utilized. Raising area under non-food crops appears to be the other potential strategy to improve performance in public irrigation system. Another study revealed that government interventions in Fair and Remunerative Prices (FRP) and Public Distribution System (PDS) prices have considerable influence on sugar prices. Impacts are immediate and persist at least for two or three years.

The coverage of farmers and cultivated area under Prime Minister Fasal Bima Yojna (PMFBY) decreased, while the sum insured increased between 2016-17 and 2017-18. Yield loss estimation, standardizing the use of technology for crop loss assessment and timely settlement of claims, high actuarial premium rates, increasing the coverage of shared and tenant croppers and creating awareness among farmers on the crop insurance are the key issues of concern for PMFBY.

5.3.3 Market and trade

The key issues addressed under Markets and Trade theme are policy imperatives in agricultural value chains promotion, food quality and food safety, innovations in input markets, credits, farm services etc.

Buffalo meat (carabeef) value chain in Uttar Pradesh

Transaction costs and benefit distribution: The aggregators constituted the main link between farmers and live animal markets and accounted for 72 per cent of the total flow of buffaloes to livestock markets. Sub-traders/traders ship the bulk of the flow (94%) from markets to abattoirs. Of the total meat produced, 71 per cent is shipped directly to importing countries and the rest to local markets. From local markets, retailers and restaurants take away 87 per cent and 13 per cent, respectively. Costs (per kg carcass weight) incurred by various chain actors in purchase and sale of live animals / meat cuts were Rs. 147 for aggregators, Rs. 154 for traders, Rs. 183 for retailers, and Rs. 177 for slaughter houses. Of the total value added, traders in the domestic value chains and export-oriented units captured a significant share.

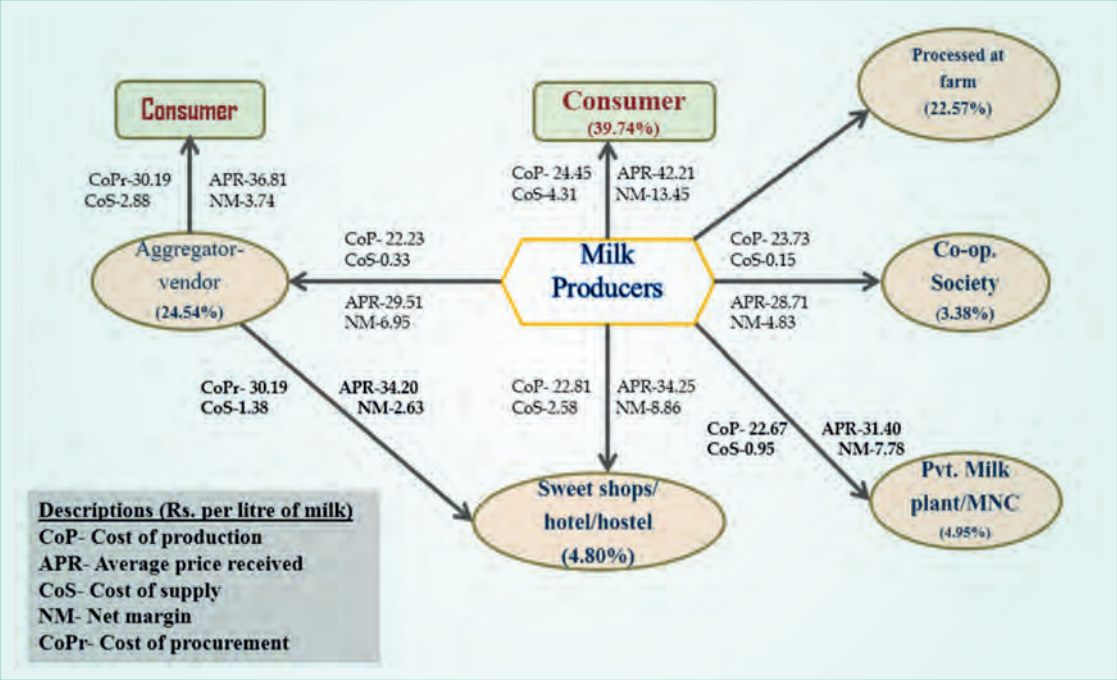
Risk analysis: Eight risk hotspots in the value chain are identified. These are overstocking of vehicles by traders, irregular ante-mortem examination in livestock markets, animals transported for long distances without health certificates, no measure for pre and post-movement isolation and testing, non-cleaning/disinfection of vehicles after each trip, no measure for check for pathogens at slaughter houses, lack of hygienic practices at retail outlets, and use of contaminated meat cutting wooden slabs. These hotspots at different levels in value chain is helpful in streamlining the animal preservation acts in the country to promote scientific practices of animal meat production, rejuvenating the scheme on salvaging and rearing of male calves for meat production and implementation of integrated and inclusive contract farming system for meat buffalo production.

Dairy value chain: Dairy start-ups

The value chain of dairy entrepreneurs (48 startups) entails from Haryana, Punjab, Uttar Pradesh, Rajasthan, Andhra Pradesh, Delhi, Uttarakhand, Gujarat, Jharkhand. The average herd size of the farm was 96 animals with daily average milk production of 19,800 litres per farm.

Dominance of Informal sector: The informal sector dominates in the dairy industry and 48.15 per cent of dairy startups adopted direct selling of milk from producer to consumer. This could be due to realization of higher profits (average price Rs. 41.21/ litre). These startups were focusing on quality milk supply mainly to urban dwellers in hygienic conditions which fetched higher price ranging from Rs. 60 in Ganganagar (Rajasthan) to Rs. 110 per litre in National Capital Region. The consumers also preferred raw fresh milk over pasteurised

Figure 12. Mapping of value chain of dairy start-ups



pouch milk. Other channels identified were selling milk to aggregator vendor and selling milk to a cooperative society. The volume of milk sold through the former channel was 24.55 per cent, whereas it was merely 3.38 per cent through later channel. The channels producer to sweetshops/hotels/hostels and producers to private milk plants/MNC disposed 22.58 per cent of the milk per day in production catchments (Figure 12). Majority of the farmers had adopted multiple channels to avoid marketing risk, to manage fluctuations in milk production and to efficiently manage fluctuating demand in the market for milk and milk products.

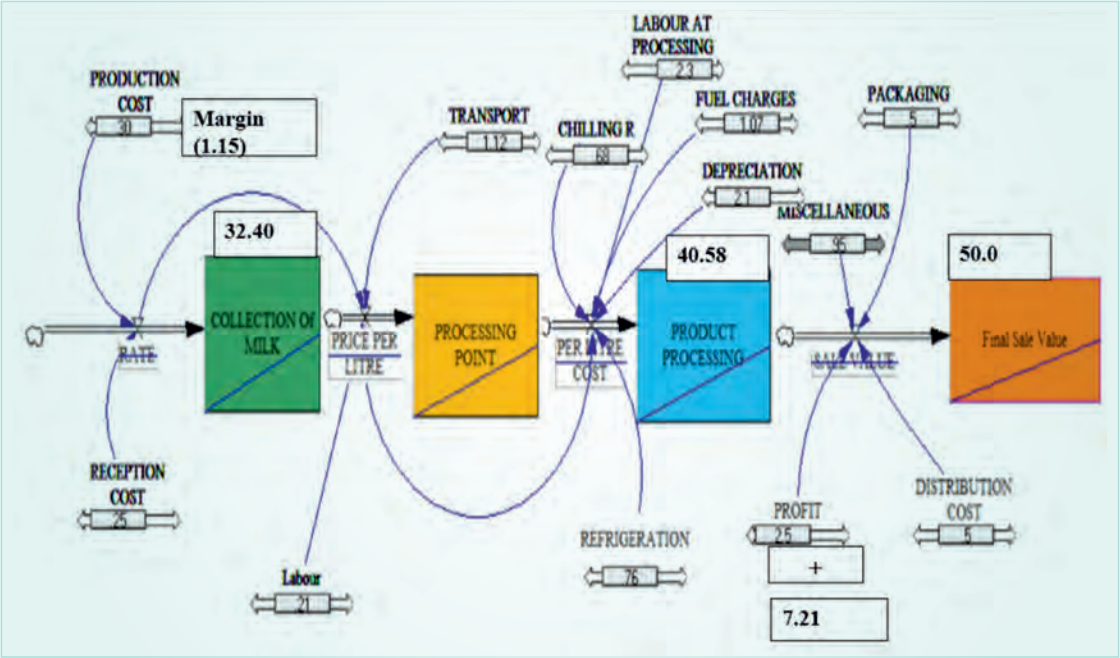
Value addition: The value addition and profits realization along the chain were higher in the value chain of integrated production and processing system. This system is able to generate the profit of Rs. 7.21/litre over and above the model profit of Rs. 2.5/ litre (Figure 13).

Value chain analysis of organic spices

Three major spices - ginger, turmeric, and chilli were analysed to work out comparative costs and returns investment and margins along the value chains. The states having the highest areas were selected and compared with the state adopting organic production practices. Sikkim was purposively chosen as control state owing largest area under organic production.

Ginger: In north-eastern region, ginger is grown in three farm situations - upland, terrace and *Jhum/Shifting* cultivation. The non-adopter states of Meghalaya, Mizoram, Arunachal Pradesh and adopter state, Sikkim were selected for the study with a total of 275 ginger growers from the non-adopter states and 84 from the organic adopter state. The per hectare cost of cultivation of ginger was reported as Rs. 77361 in Meghalaya, Rs. 82243 in Mizoram, Rs. 80030 in Arunachal Pradesh and Rs. 109880 in Sikkim. The high total cost of cultivation in organic state was due to the relatively higher price of organic rhizomes (Rs. 52016/ha) than in the non-adopter states (below Rs. 30000). The net returns, however, was highest in the organic adopter state (Rs. 94687/ha). A huge return gap of 60.98 per cent, 77.83 per cent and 64.85 per cent were observed between the states of Meghalaya, Mizoram, Arunachal Pradesh with

Figure 13. Mapping of value chain of integrated production and processing system



Sikkim, respectively. These evidences imply that cultivation of organic ginger fetches premium prices. The producers' share in the consumer rupee for the organic adopted state was fairly higher than the non-adopted states. The channels which included processing or value addition of the ginger produce, incurred a low producers' share in consumer rupee, while earning a higher net margin for the processors and retailers of the processed products.

Turmeric: For analysing value chain of turmeric, 279 growers from Meghalaya, Manipur and Mizoram states (non-adopter) and 78 turmeric growers from the organic state Sikkim were surveyed. Total cost of cultivation in turmeric was found to be the highest in Sikkim (Rs. 95749/ha). Sikkim obtained the highest yield (5.51MT) and yield difference with Meghalaya and Manipur was 8.53 per cent and 4.53 per cent, respectively. A huge yield gap (38.66%), however, was observed between the state of Mizoram and Sikkim. The marketing channels observed in all the selected states were simple and processors played a dominant role. The conversion of raw turmeric to dry flakes and powdered form was observed only in the states of Mizoram and Meghalaya, while in Manipur and Sikkim, raw turmeric was converted to powdered form only. On an average the conversion ratio of raw turmeric to dry flake was estimated at 3.5:1 to 5:1 and the conversion ratio of dry turmeric to powder form was 1.10:1 to 1.25:1. A higher share in consumer rupee was obtained for the powdered form of turmeric in comparison to the dry flakes. The producers' share for powdered turmeric form was highest in the non-adopter state, Mizoram in the value chain having direct marketing linkage between the producer and consumer. Different varieties of chilli are commonly grown in different parts of the NEH region. A total of 168 chilli growers from Mizoram and Nagaland and 75 from Sikkim were selected. The total cost of cultivation was highest in Sikkim Rs. 47742/ ha with the major cost incurred in human labour. The net returns of the chilli growers were highest in Sikkim state (Rs. 527055/ha) due to higher productivity and higher prices received by the farmers. Post-harvest activities of drying and powdering the chilli were observed only in Nagaland and Mizoram, while pickle chilli products were observed in Sikkim. On an average, the conversion ratio of raw chilli to dry form is 6.5-7:1. Producers' share was found to

be highest when the chilli was sold in the raw form and directly to the consumer. In case of the processed form of chilli, the pickled chilli in the state of Sikkim, obtained a higher producers' share than the dry form of chilli in the non-adopter states.

Price transmission

The cumin is grown mainly in western states of Gujarat and Rajasthan and contributes 55.8 per cent and 43.9 per cent to total cumin production in the country. Cumin being a risky crop in production settings witnesses high price fluctuations due to supply shocks along with international market disturbances. The Johansen's co-integration methodology was applied on the weekly price data from four major cumin markets of India viz., Unjha, Rajkot, Jodhpur, and Merta for the period 2012-2019. The results decipher that even though the selected cumin markets are isolated and spatially segmented, they are well-connected in terms of prices, and have long-run price association across them. This further confirms that the prices of cumin are stable in the long-run and any short-run deviations due to external shocks are well adjusted. The Granger causality test confirmed the occurrence of price transmission across markets, implying that bidirectional causality between all market pairs except Rajkot to Merta and Jodhpur to Merta. This implies that markets which are distant and of low volume transaction (small market) were slow in pace of price transmission to big markets. This reveals that horizontal market integration works according to the radial market theory. The major market becomes the central market due to its more concentration of market functionaries and high volume transaction. The small markets become the peripheral markets i.e. situated away from the central market. The central market forms and discovers the price due to its more intense interplay of market forces. The results of the study suggest that central market or major markets which form prices needs to be intervened first to remove all sorts of inefficiency arising in price formation. The intervention in peripheral markets needs to be taken at second stage including better integration with internet, logistics and transport infrastructure besides financial and other infrastructures.

Price volatility in onion is getting pronounced. Onion witnessed high volatility in wholesale prices with 9 structural breaks during the period 1982 to 2017. Length of the period with stable prices is reducing and shorter phases with greater instability are becoming pronounced overtime. The price transmissions from producing markets to consuming markets are taking place indicating spatial market integration with varying degree.

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6

PROSPECTS FOR 2021-22

Purushottam Sharma, Subash S. P., Kingsly I. T. and Nalini Ranjan Kumar

The chapter presents the progress of Indian agriculture and the prospects for the year 2021-22, including the international and domestic scenario of cereals, pulses, oilseeds, milk and milk products, meat and fish. The implications of technological and policy changes on agricultural marketing and agribusiness are also discussed.

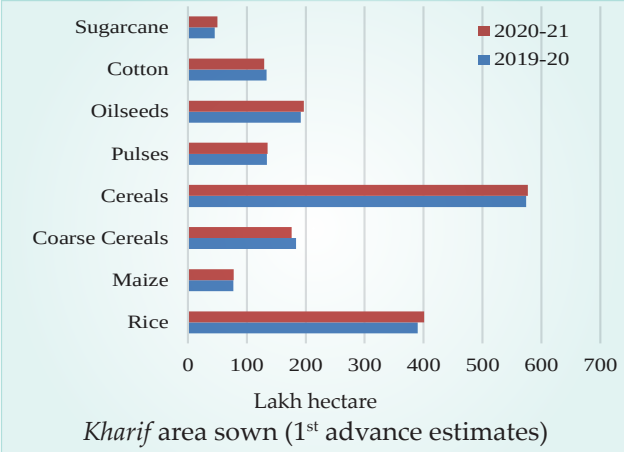
Agricultural sector in India is rapidly transforming with technological and digital revolutions, influx of start-ups, and an array of policy reforms and supporting investments. Fast-changing food habits and growing international trade opportunities have also significant impacts. Reforms and investment commitments by Central as well as State Governments shall strengthen the agricultural sector including marketing, processing and exports. The policy reforms, investment and other interventions would certainly help in this direction when supported with the private sector participation and use of technology. However, improving productivity and profitability of smallholders, shall be a major challenge. This chapter discusses the progress made and the prospects for 2021-22 followed by the prospects for the marketing and agribusiness.

6.1 Agricultural Progress in 2020-21

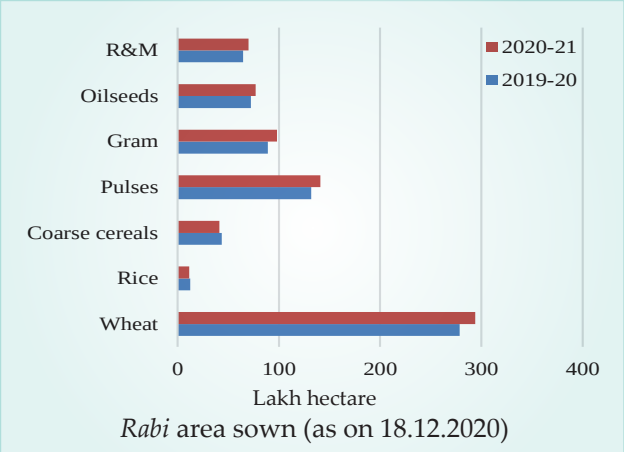
Area sown during the *kharif* season was higher in 2020-21 for oilseeds, rice, and sugarcane as compared to the previous year (Figure 14). During the *rabi* season, almost all crops witnessed higher area sown except for coarse cereals. Monsoon rainfall was almost normal with evenly distributed spatially and temporally, with some exceptions, supporting good *kharif* as well as *rabi* harvest. The production of horticulture crops such as fruits, vegetables and spices is expected to increase supported with higher export demand, and prices in the domestic markets. Milk production is likely to increase with the growing demand and higher investments in dairy sector.

Exports of agricultural commodities have also increased during first half of this year,

Figure 14. Area sown under different crops during 2019-20 & 2020-21



Kharif area sown (1st advance estimates)



Rabi area sown (as on 18.12.2020)

Source: MoAFW

particularly of sugar, spices, rice, and fruits and vegetables and the trend is likely to continue. The export of essential agricultural commodities during April-September 2020 is valued at Rs. 53,626 crores (US$ 7.3 billion), increased by 43% as compared to same period last year, which is likely to boost market sentiments.

6.2 Agricultural Commodity Outlook for 2021-22

The inferences in this section are based on the review of outlook projections by OECD-FAO (2020), FAO Food Outlook (FAO 2020), USDA (2012, 2020), NITI Aayog (2018) and Kumar et al. (2016). The global as well as Indian commodity outlook are discussed below.

6.2.1 Global commodity outlook

Cereals: The supply, demand and trade scenario for rice are looking optimistic in 2021-22. The record global rice production is expected at 509 mt in 2020-21, with higher projections for Asia, particularly for India, and USA. The trade and food use of rice is expected to expand globally as well as in India on account of higher distribution to ensure affordable access to food to the vulnerable population. This scenario of rice is more likely to continue for the year 2021-22. Global rice trade is projected to increase by 6.3% (47.2 mt) in 2021, supported with higher projected imports by African countries. In case of wheat, the positive supply-demand scenario is expected for 2021-22. Global wheat production is projected at 774 mt for the marketing year 2021 and consumption at 771 mt. Global exports are expected to touch 190 mt and closing stocks to 270 mt leading to mostly steady international prices with marginally upward trend.

Global production of maize is projected to increase at 1173 mt in 2021, and global consumption is expected to increase at 1193 mt, mainly for feed and biofuel uses, that might leave less closing stock. The international maize markets are predicted to be competitive due to higher growth in import demand in countries like China, Mexico and other countries in Africa and South-East Asia (USDA 2012) amid increasing feed demand. In case of coarse cereals, OECD-FAO (2020) estimated global production of about 300 mt and consumption at 294 mt in 2021-22 with the stagnant global trade and closing stocks resulting in increasing trend in international prices.

Oilseeds and edible oils: As per OECD-FAO (2020), global production of oilseeds, meals and vegetable oils is projected to increase to 525 mt, 362 mt and 220.8 mt, respectively, supported with higher soybean production expected in Brazil, Argentina, Paraguay, China and India. The demand of oilseeds for crush is projected to grow rather than direct food and feed demand while vegetable oils consumption is expected to growth mainly due to growing food demand in developing countries. The world food demand for vegetable oils is expected to rise by 2% at 154 mt (2021-22), mainly due to recovering demand in world markets.

Milk and milk products: Global milk production witnessed increasing trend and projected to touch 881 mt in 2021 and 895 mt in 2022, on account of increase in milking animals as well as yield in major producers such as India and Pakistan. Most of the milk produced is consumed as fresh dairy products including pasteurized and fermented products, which is expected to increase further on the higher demand growth in India and Pakistan.

Meat and fish: This sector was most badly affected globally during the Pandemic due to negative consumer sentiments. Still it is likely to result in steady meat production globally. Pig meat is mainly affected by swine fever disease while bovine meat production is expected to drop marginally in India, Australia and Brazil. The global production of poultry meat is projected to expand slightly due to higher demand from

China. Fish production and consumption are projected to continue to decline in 2021 and turn up in 2022.

6.2.2 Indian commodity outlook

The supply, demand and trade scenario based on different outlook projections are shown in Table 10. Overall, the supply-demand scenario of crops, dairy, animal and fish products is forecasted to be positive for the year 2021-22. No major change in trade scenario is expected except for maize and coarse cereals.

Table 10. Crop outlook for 2021-22

S. No.	Commodity/ Crop	Supply	Demand	Trade
1	Rice	↑	↑	↑
2	Wheat	↑	↑	–
3	Maize	–	↑	↓
4	Coarse cereals	↓	–	↓
5	Pulses	↑	↑	–
6	Edible oil	↑	↑	↑
7	Oilseeds	↑	↑	–
8	Milk and products	↑	↑	–
9	Eggs, meat and fish	↑	↑	–

Note: Based on OECD-FAO (2020) and NITI Aayog (2018)

Rice: The rice production in India expected to increase to 121 mt and 123 mt respectively in 2021 and 2022 (OECD-FAO, 2020). The consumption is also estimated to be higher at 105 mt and 107 mt for the same period. Similar trends were also noticed in reports by NITI Aayog (2018) and Kumar et al (2016). India is a major exporter of rice and an upward trend in the export of rice is also predicted for 2021 (15 mt) and 2022 (15.5 mt). The ending stocks of rice for 2021 are expected to increase to 35 mt and this may exert pressure on prices.

Wheat: The predictions for wheat production are lower than the already achieved in the recent years, although an increasing trend in production and consumption of wheat is expected. The projected consumption data show that the demand for wheat would be higher than the increase in production during 2021 and 2022, thus, an increase in import and a decline in export of wheat is expected. The demand supply gaps are also projected to be normalized, with production surpassing the demand in 2023. On the other hand, NITI Aayog (2018) and Kumar et al. (2016) shows a positive demand supply gap till the year 2030.

Maize: The OECD-FAO (2020) projected an increase in maize production from 29.7 mt in 2021 to 30.2 mt in 2022. Though the consumption is expected to marginally increase to 29.5 mt in 2021 and 30 mt in 2022, the demand supply gap is projected to remain same. The import is expected to increase while export is predicted to decrease, due to higher domestic demand and lower supply of maize from international trade.

Coarse cereals: The production of coarse cereals (excluding maize) is likely to increase from 18 mt in 2020 to 18.5 mt in 2021 and to 18.52 mt in 2022. The consumption is likely to increase to 18.7 mt in 2022. This demand supply gap is forecasted to be compensated with increase in import and likely decrease in export. NITI Aayog (2018) predicted that the demand supply gap shall continue till 2032. Nevertheless, a growing demand for other coarse cereals is showed in all the studies.

Pulses: OECD-FAO (2020) projected increasing trend in production of pulses, mainly in Asia and Africa, driven largely by yield improvements. With the self-sufficiency of pulses in India, the global trade in pulses is likely to remain steady depending on the imports from Africa. Supply production estimates in NITI Aayog (2018) shows that the pulses supply would be around 27.55 mt which is expected to grow exponentially to an extent of 41.55 mt in 2032. On the other hand, the demand projections are predicted to remain

more or less constant for the period 2021-22 (24-25 mt), but forecasted to increase to an extent of 28-31 mt by 2033-34. The study predicts a positive demand supply gap for the period. On the contrary, Kumar et al. (2016) shows a negative demand supply gap in 2030. The commodity has good trade potential, as there is a projected demand growth in African and Asian countries (Akibode and Maredia 2011).

Oilseeds and edible oil: The production of oilseeds is expected to increase marginally with normal rainfall. The area under oilseed crops has been stagnant around 26 million ha during the last decade while production fluctuates between 25.3 mt and 34.2 mt with average yield of less than 12 q/ha. The expected production during 2021-22 likely to be around 35 mt. Edible oil consumption in the country continues to rise faster than production due to growth in population, increasing income levels and emerging dietary changes. The expected consumption of edible oil is 27 mt during in 2021-22, which consists of 17 mt import.

Milk and milk products: India is the largest milk producer in the world, and its production increases annually by 3.0%. The expected production during 2021-22 is forecasted at 177 mt. With the faster adoption of new technologies like artificial insemination, sexed semen, etc. the milk yield is expected to grow fast and contribute more to production growth. As the majority of milk is consumed domestically, India's impact on the world dairy market is negligible. Demand for dairy products is expected to grow in the coming years, driven by population growth, higher incomes and greater interest in nutrition. Consumption of processed and packaged dairy products is increasing in urban areas.

***Meat and fish*:** India is endowed with largest population of livestock and is the largest producer of buffalo meat and 2nd largest producer of goat meat. The FAO predicts that annually India produces around 8 mt of meat, 13 mt of fish and 110 billion eggs (2020-21). India's domestic consumption primarily includes sheep, goat, pig and poultry while export comprises the meat of buffaloes, cattle and sheep. With increasing per capita income and urbanization, demand for poultry meat increases faster than the other meat group. The expected consumption demand for meat and fish are 6.4 mt and 12.7 mt respectively.

6.3 Prospects in Agricultural Marketing and Agribusiness Sector

Spurred with the Governments initiatives towards aligning the sector with the changing realities through policy reforms and investment commitments, the agricultural marketing and agribusiness sector in India is poised to take a big leap forward in the coming future. The pandemic has helped develop and enhance the use of many innovative agri-tech solutions for enhancing quality production and productivity, information access, access to the markets and integrating supply chain, use of e-marketing platforms, etc. and the trend is likely to continue. The government has announced a slew of measures for minimizing the effect of the pandemic on the farming community and enhance the growth of the farming sector, through a stimulus package for investments under *Atmanirbhar Abhiyan* and reforming the agricultural marketing sector. The stimulus package for the agriculture sector includes greater allocation of funds for strengthening the supply chain infrastructure, storage, warehousing, cold chains, etc.

In addition to the economic package, the Government of India brought out Acts to reform the agricultural marketing system. These are: (i) Essential Commodities (Amendment) Act, 2020 (ii) The Farmer's Produce Trade and Commerce (Promotion and Facilitation) Act, 2020; and (iii) The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farmers Services Act 2020. Also, the government is promoting technology-driven, solution-oriented start-ups for the agricultural sector.

Increasing use of technologies such as artificial intelligence is inducing large positive changes across Indian agriculture, and an increasing number of agri-tech startups in the country are working to develop and implement AI-based solutions. AI can play a catalytic role in improving farm productivity, removing supply chain constraints and increasing market access, and thus can positively impact the entire agriculture value chain. Agri-tech startups are using predictive analytics and machine learning to integrate AI-based technological solutions across a range of uses and to solve the problem in the supply chain. For large scale quality testing and post-harvest produce handling and monitoring, imaging and AI-based solutions are being developed. Data are used to create platforms for price transparency to check malpractices in the supply chain.

The stimulus package and the reforms legislations are likely to change the agricultural marketing scenario in the country in near future. These long-awaited market reforms have the potential to evolve new agricultural market architecture aligning with the new normal in the post-pandemic period. Removal of inter-state trade barriers increases competition and would result in an increase in farmers' price realization and output (Chatterjee, 2019). A study by Purohit et al. (2017) reported that the adoption of provisions of Model APMC Act shall significantly promote not only agricultural growth but also the adoption of agricultural technology. The study further reported that effective regulation of agricultural marketing is required for attracting investment in agricultural markets and to improve agricultural growth. Under the changing circumstances, following are the prospects in the agriculture sector for the future:

- The package of three legislations in agricultural marketing practically enables barrier-free intra-state and inter-state movement or transaction of agricultural commodities. This provides alternative marketing channels along with *mandis* across the country, enhancing competition by allowing more buyers through removing license restrictions, and opening up of private investment opportunities in the supply chain activities and facilities. Targeted investment and reforms process will integrate supply chain and reduce transaction costs thus improve the competitiveness of agricultural products.
- E-commerce that directly connects producers to consumers is likely to be a new normal in post-pandemic agriculture, and is expected to induce private investment in agri-tech start-ups connecting farmers directly to the consumers. All these would bring primary processing facilities such as grading, processing, storage and branding closer to the farm-gate, and provide a big push to rural industrialization, and compel value chain participants to comply with domestic and international food safety standards.
- The stimulus package would help improve infrastructure for integrating the supply chain and insulate farmers from sudden shocks. The promotion of food enterprises is a step towards rural industrialization. All these steps along with market reforms would promote (i) start-ups, (ii) processing, and (iii) packaging and branding.
- Artificial Intelligence-based agri-tech applications are set to unleash value in agriculture, especially in wake of the recent farm reforms that have opened doors to private sector investments in agriculture. The use of technology in agriculture will improve farmers' access to markets, inputs, data, advisory, credit and insurance. Timely and accurate data coupled with analytics can help build a robust demand-driven efficient supply chain. Most of these AI models would certainly add a lot of value to the agriculture ecosystem. Increasing investment, both public and private, is needed to help scale

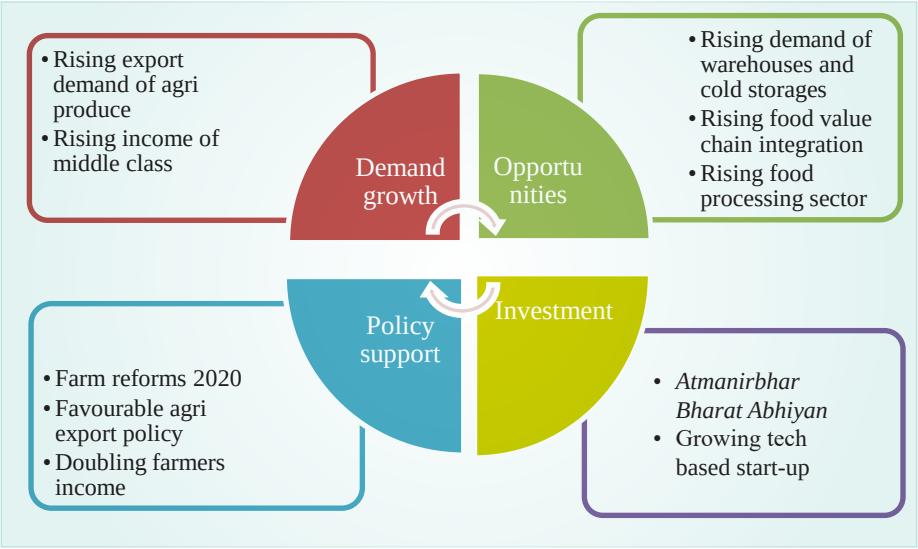
the operations of these AI solutions. Steps in promoting these tech-based solutions will go a long way in ensuring remunerative prices for farmers and reduce agrarian distress.

Increased investment and barrier-free trade coupled with the increasing use of tech-based solutions would create a new vertically coordinated marketing system, driven by the institutions, such as contract farming, cooperatives and farmer producer organizations (FPOs), will reduce transaction costs and make it easier for small farmers to access inputs, finance, services and technologies. The firms will also benefit from low cost and uncertainty in the procurement of farm produce (Figure 15). Effective regulation of agricultural trade and markets is inevitable along with infrastructure for integrating supply chains and efficient marketing. However, there is the risk of the selective presence of agribusiness in highly productive and better-connected areas to reduce transaction costs of operations, while leaving out less productive in remote areas.

6.4 Summing Up

The prospects of agriculture sector for the year 2021-22 are less likely to be influenced by the COVID-19 pandemic. Though the sector faced supply chain constraints and short term effects on prices, the sector performed better than other sectors in terms of growth. The area sown in 2020 for both kharif and rabi seasons is higher, likely to result in increased production of crops. Based on the demand and supply outlook projections, the supply-demand and trade scenarios of crops are expected to be positive for the year 2021-22. The new policies such as *Atmanirbhar Abhiyan* and recent market reforms and other policy changes in agricultural and allied sectors would stimulate investment and innovate new solutions for challenges faced in the agricultural sector. The future policy interventions should be aimed at ensuring ease of doing agri-business and also promote the integration of agri-value chains in a sustainable manner leading to increased global competitiveness of Indian agri products.

Figure 15. Agricultural growth prospects and drivers



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7

Budget 2021-22: Some Suggestions

Suresh Pal and P. S. Birthal

The agricultural sector has done well in 2019-20 and the prospectus for 2020-21 are also quite encouraging. This year should be an opportunity to accelerate the reforms and focus on exports and enhancing farm income. The actual public expenditure on agriculture has also increased significantly (Table 11 & 12). It is now time to focus on long-term sources of agricultural growth and transformation of the sector.

7.1 Government Expenditure on Agriculture

The Union Government has been making considerable allocation for agriculture development. The allocations to DAC&FW has increased considerably due to the PM-KISAN. However, most of the additional allocations have been for PM-KISAN or interest subvention scheme. Therefore, the allocations for productive capacity of agriculture should also increase proportionately. The allocations for DARE has also increased but there was considerable cut in 2020-21 because of financial crunch arising from COVID-19. This should be restored in the forthcoming budget.

The allocation by the states are quite erratic and there are considerable inter-state variations. The per hectare expenditure on agricultural and allied activities was comparatively higher – Rs. 28,557 in Tamil Nadu, Rs. 35,432 in Telangana and Rs. 37,845 in Chhattisgarh. The bigger states like Uttar Pradesh, Rajasthan and Madhya Pradesh are allocating fewer resources (Rs. 5269/ha or less) to agriculture. Even the high productivity states like Haryana, are allocating less resources to agricultural and allied activities. These lower allocations are translated into under investment in some of the productive areas like agricultural R&D and land development. Higher allocations by some of the states in a particular year is because of initiation of new scheme or financing, which were subsequently not sustained in the state budgets. This must be corrected.

Table 11. Centre's expenditure on agriculture and allied activities (Rs. crores)

Year	Department of Agriculture and Cooperation	Department of Agricultural Research and Education	Departments of Animal Husbandry, Dairying & Fisheries
2013-14	18,923	4,731	1,826
2014-15	19,255	4,840	1,822
2015-16	15,296	5,386	1,410
2016-17	36,912	5,729	1,858
2017-18	37,397	6,943	2,022
2018-19	46,076	7,544	3,171
2019-20(RE)	1,01,904	7,846	3,490
2020-21(BE)	1,34,400	8,363	4,114

*Note: RE: Revised estimate, BE: Budget estimate, * Expenditure includes both revenue and capital expenditure.*
Source: Union budget, Ministry of Finance, Govt. of India

7.2 Budget Expectations

Given the economic slowdown, in fact shrinkage, witnessed in 2020-21 due to COVID-19, the focus of the budget shall be on economic recovery through financial stimulus for both investment and demand (consumption). Some sectors like MSME and rural non-farm sector are likely to get more focus for inclusiveness and employment generation. Agricultural sector has done well and therefore can be leveraged to boost rural demand and enhance rural employment opportunities through agro-industries and startups. Since most of these enterprises shall fall in the category of MSME, the policy and financial stimulus for this sector shall be helpful in strengthening them. Some of these agro-industries and startups could be for export-oriented products and therefore may generate higher employment and increase demand for agricultural products. The following are some suggestions for Union Budget 2021-22.

Increased resource allocations to agriculture

The allocations for agricultural sector have increased significantly over the years, however,

Table 12. State-wise public expenditure on agriculture and allied activities (Rs. crores)

States	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20 (RE)	2020-21 (BE)
Andhra Pradesh	3,937	10,102	4,924	7,945	7,326	8,489	6,714	6,714
Arunachal Pradesh	606	657	666	770	769	800	1,178	1,079
Assam	1,514	2,088	1,667	2,530	2,905	2,895	6,449	4,580
Bihar	3,193	3,431	3,515	2,287	3,626	3,636	6,880	6,702
Chhattisgarh	5,152	7,726	8,325	6,769	8,781	18,020	21,470	15,607
Goa	259	258	304	293	320	331	536	569
Gujarat	3,958	4,069	4,313	5,035	7,802	8,367	7,785	7,778
Haryana	1,846	2,012	2,295	2,519	2,735	3,392	4,409	6,045
Himachal Pradesh	1,422	1,527	1,554	1,678	1,800	2,185	2,458	2,683
Jammu & Kashmir	1,392	1,389	1,774	1,955	2,032	2,840	3,048	3,823
Jharkhand	975	1,090	1,475	2,206	2,016	1,788	4,229	4,585
Karnataka	12,590	10,563	11,149	11,976	14,521	20,305	21,502	15,753
Kerala	3,893	4,322	4,799	6,088	5,528	6,193	6,010	6,930
Maharashtra	7,821	8,567	9,660	13,245	26,130	20,020	32,940	23,862
Madhya Pradesh	6,214	8,291	7,476	10,311	11,928	15,603	13,233	9,579
Manipur	347	470	374	357	471	549	875	1,113
Meghalaya	594	590	584	565	573	676	1,115	1,034
Mizoram	665	722	386	509	544	569	709	692
Nagaland	341	477	431	480	626	694	918	895
Odisha	4,701	5,613	5,802	6,497	5,801	7,843	12,104	11,554
Punjab	1,423	3,777	6,205	5,718	7,487	12,343	11,777	13,193
Rajasthan	3,522	3,989	4,021	5,140	5,114	8,376	10,865	11,182
Sikkim	236	281	309	269	300	428	726	611
Tamil Nadu	6,799	7,150	7,825	9,882	11,553	12,362	14,647	15,227
Telangana	-	5,826	6,476	6,122	6,560	12,600	21,468	25,148
Tripura	425	561	572	620	663	733	878	1,005
Uttarakhand	1,013	1,550	1,586	1,775	2,132	2,485	2,714	3,252
Uttar Pradesh	4,605	5,627	5,098	5,599	27,265	12,129	10,351	11,336
West Bengal	2,031	2,416	3,523	3,265	3,730	7,911	5,071	8,983
States' capital expenditure	6,461	9,895	15,705	17,905	20,665	19,891	17,220	20,466

*Note: RE: Revised estimate, BE: Budget estimate, * Revenue expenditure. Source: Various issues of state finances: A study of budgets, RBI.*

much of these are for revenue expenditure for development and welfare schemes. It is time to increase the allocations for investment in the productive capacity; and the priority sectors are research and education, infrastructure development for livestock services, micro-irrigation and land development. The allocation for research and education should be at least doubled in the next 2-3 years.

There should be committed funds for agriculture and rural innovations for out-scaling of proven technologies and promoting innovations. The innovations and technology for higher farm income, resource conservation, ecosystem services, gender empowerment, markets, and agricultural diversification should be encouraged.

Strengthening agricultural infrastructure

Rural infrastructure is catalyst for agricultural growth. Innovations in technology transfer to farmers, partnerships in delivery of services to farmers and rural infrastructure, business investment in agriculture, particularly marketing, ease of doing business, etc should be encouraged and some of the allocations or grants of the central schemes should be linked to these reforms. The Government has announced Agri-Infrastructure Fund of Rupees one lakh crore and the efforts should be made to achieve this target in the next three years. Cooperatives, Farmer Producer Organizations, Start-ups, and rural entrepreneurship should be encouraged through capacity building measures for investment in agri-infrastructure. The capacity should also be built at the district-level to promote agri-business opportunities.

Promoting agricultural diversification

Agricultural diversification for higher farm income, poverty reduction, resource conservation and ecosystem services is a must. Efforts have witnessed significant increase in area allocation to fruits and vegetables. To further promote farm diversification, there should be area specific schemes for product diversification. The scheme should entail market assurance, technology support and availability of credit. The proposals coming through centre-state consultation should be given priority. Similarly, the schemes for agricultural exports and infrastructure development should be given high priority.

Improving farmers' access to credit

Innovations in farm credit delivery like KCC should be strengthened and also focus should be on investment credit for agriculture. On-farm processing, product aggregation, land development, secondary agriculture etc should be given priority.

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8

Agricultural Development Indicators

Ankita Kandpal, Balaji S. J., Dinesh Chand Meena, Sant Kumar, Dilip Kumar and Sonia Chauhan

This chapter gives major indicators of agricultural development both at all India as well as state level. It broadly contains the indicators reflecting performance of agriculture sector in various key aspects such as position of Indian agriculture in the world in terms of rank in global indices, nutrition level of Indian population, export performance and major output and input indicators. Output indicators include value of output from agriculture, land productivity and agricultural growth, while major input indicators demonstrating the extent of agricultural development are certified/quality seeds availability, fertilizer and pesticide use, irrigated area, electricity consumption in the sector and extent of crop diversification. The chapter also covers environmental indicators related to agriculture viz. emissions from the agriculture and crop residue/biomass burning. The food security issues are also reflected through amount of stock handled (procurement and offtake) through PDS system. The service and infrastructure development in the sector are shown by using rural road density, market density, R&D intensity, number of Primary Agricultural Cooperative Societies (PACS) and branches of scheduled commercial banks. It also includes major constraints hindering the growth of the sector like groundwater depletion, land holding size and wasteland area.

Table 13. Agricultural development indicators : India

S.N.	Indicator	Value	Reference year
1.	Global Food Security Index (Rank) Affordability Availability Quality and safety	72 70 61 85	2019
2.	Global Hunger Index (Rank)	94	2020
3.	Global Multidimensional Poverty Index (Rank)	62	2020
4.	Prevalence of undernourishment (%)	14	2018
5.	Children affected by wasting (%)	17.3	2018
6.	Stunted children (%)	34.7	2018
7.	Overweight children (%)	1.6	2018
8.	Emissions from agriculture (million tonnes) CO_2 N_2O CH_4	 639.42 0.72 19.78	2017
9.	Biomass burnt (million tonnes) Maize Rice Sugar cane Wheat	 9.22 24.08 2.85 12.24	2017

S.N.	Indicator	Value	Reference year
10.	Labour force employed in agriculture (million persons) Share (%) Male Female	156.23 72.5 27.5	2018
11.	Agricultural exports Value (billion US $) Share in total exports (%)	 37.05 11.43	2019
12.	Gross Value Added in agriculture, forestry and fishing at 2011-12 prices (Rs. lakh crore) Share (%) Agriculture Livestock Fisheries Forestry and logging	18.72 56.3 28.6 8.2 6.8	2018-19
13.	Agricultural growth (%)	3.43	2011-12 to 2018-19
14.	Land productivity (GVA/GCA, Rs. lakh/ha)	0.935	2018-19
15.	Food grain yield (kg/ha)	2286.21	2018-19
16.	Certified/quality seed availability (lakh quintal) Share (%) Public sector Private sector	398.88 42.8 57.2	2018-19
17.	Net sown area (mha)	139.51	2015-16
18.	Gross cropped area (mha)	200.2	2016-17
19.	NPK use (kg/ ha)	133.12	2018-19
20.	Pesticide use (kg/ha)	0.27	2018-19
21.	Irrigated area (% of GCA)	49.02	2016-17
22.	Area under micro irrigation ('000 ha)	11412.93	as in 2019
23.	Extent of crop diversification (0 to 1 scale, 1-complete diversification)	0.878	2018-19
24.	Research & education intensity in agriculture (%)	0.73	2017-18
25.	Procurement of rice and wheat (million tonnes)	80.2	2019-20
26.	Total offtake for PDS (million tonnes)	62.2	2019-20
27.	Share of GCF in agriculture & allied sector in GCF of India (%)	6.6	2017-18
28.	Disbursement of Rural Infrastructure Development Fund (Rs crore)	26266	2018-19
29.	Agricultural credit (Rs. lakh crore) Short term loans Medium term/long term loans	12.57 7.52 5.05	2018-19

S.N.	Indicator	Value		Reference year
30.	Scheduled commercial banks density (branches/'000 sqkm)	45		2019
31.	Rural road density (length in km/km^2 of geographical area)	1.27		2016-17
32.	Market density (number of agricultural markets/'000 km^2)	0.95		2019
33.	Livestock density (number/km^2)	163		2019
34.	Farmer's income (Rs./month/household)	6426		2012-13
35.	Primary Agricultural Cooperative Societies (numbers)	95995		2018-19
36.	Consumption (kg/month/person)	Rural	Urban	2011-12
	Cereals	11.22	9.28	
	Pulses	0.78	0.90	
	Edible oil	0.67	0.85	
	Fish	0.27	0.25	
	Milk (litres)	4.33	5.42	
	Eggs (No.)	1.94	3.18	
37.	Poverty (Number in thousands)	369642		2015-16
	Head count ratio (%)	27.9		
38.	Total wastelands area (% of total geographical area)	16.96		2015-16

Sources:

1. *Global Food Security Index, 2019*
2. *Global Hunger Index, 2020*
3. *Multidimensional Poverty Index, 2020, UNDP & OPHI*

4 to 10. FAOSTAT

11. *Directorate General of Commercial Intelligence and Statistics, Ministry of Commerce and Industry, GoI*

12 to 14. National Account Statistics

15 to 23. Directorate of Economics and Statistics, Ministry of Agriculture and Farmer's Welfare, GoI

24. *Combined Finance and Revenue Accounts, CAG*

25 to 29. Handbook of Statistics on Indian Economy, RBI

30. *Bank Branch Statistics, RBI*
31. *Basic Road Statistics of India, Ministry of Road Transport and Highways*
32. *AGMARKNET*
33. *Livestock Census, 2019*
34. *NSSO data as stated in Saxena et al. (2017)*
35. *National Federation of State Cooperative Banks Ltd. (NAFSCOB)*
36. *NSSO 68th round*
37. *Multidimensional Poverty Index, 2020, UNDP & OPHI*
38. *NRSC-Wasteland Atlas of India*

Table. 14 Agricultural development indicators of the states, 2018-19

State/Union Territory	GSVA (Agri & allied, Rs. '000 crores)	Foodgrains yield (kg/ ha)	Share of agriculture in State GSVA (%)	Land productivity (Rs. lakh/ha)	Agricultural growth (% growth in GSVA)
Andhra Pradesh	171.62	2694	30.71	2.31	9.57
Assam	36.66	2078	16.65	0.90	3.02
Bihar	72.93	2402	20.05	0.95	2.16
Chhattisgarh	37.43	1617	17.13	0.66	4.79
Gujarat	128.47	2134	12.61	1.07	4.73
Haryana	79.62	3981	17.05	1.23	3.24
Himachal Pradesh	13.46	2049	12.05	1.40	1.92
Jammu and Kashmir	15.84	2178	15.00	1.35	3.83
Jharkhand	25.81	1623	17.17	2.24	10.99
Karnataka	88.59	1422	8.97	0.75	2.52
Kerala	43.87	2890	8.77	1.70	-1.71
Madhya Pradesh	151.70	1970	31.43	0.63	7.25
Maharashtra	169.78	1071	9.42	0.71	2.04
Odisha	48.07	1766	13.87	0.98	1.71
Punjab	90.72	4658	24.95	1.16	2.12
Rajasthan	159.35	1437	25.04	0.61	4.16
Tamil Nadu	120.40	2972	11.05	2.35	5.19
Telangana	66.59	3035	12.21	1.12	1.59
Uttar Pradesh	228.33	2803	21.32	0.85	2.97
Uttarakhand	14.13	2247	7.91	1.31	0.69
West Bengal	146.35	2938	20.41	1.52	3.00

Sources: Column 2, 4 and 6. National Account Statistics (http://www.mospi.nic.in/); Column 3: Directorate of Economics and Statistics, Ministry of Agriculture & Farmer's Welfare, Government of India (dacnet.nic.in); Column 5. National Accounts Statistics (http://www.mospi.nic.in/); Directorate of Economics and Statistics, Ministry of Agriculture & Farmer's Welfare, Government of India (dacnet.nic.in)

Note: GSVA estimates are at 2011-12 prices, growth estimates pertain to the period 2011-12 to 2018-19

Table 15. Agricultural input use indicators : States

State	Consumption of NPK (kg/ha)	Pesticide consumption (kg/ha)	Irrigated area (% of GCA)	Area under micro irrigation ('000 ha)	Electricity use (% of total)	Extent of crop diversification (0 to 1)	Rural road density (km/ km²)	R&E intensity (% of GSVA)	Number of PACS
Year	2018-19	2018-19	2016-17	2019	2017-18	2018-19	2016-17	2017-18	2018-19
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Andhra Pradesh	173.32	0.183	48.29	1785.22	24.68	0.83	0.60	0.50	1992
Assam	73.69	0.094	11.38	2.82	0.49	0.62	3.83	0.92	766
Bihar	227.30	0.128	69.78	115.50	2.56	0.75	1.89	0.63	8463
Chhattisgarh	86.29	0.246	32.53	316.27	23.73	0.58	0.37	0.49	1617
Gujarat	135.47	0.130	49.33	1421.91	15.14	0.88	0.44	0.63	8613
Haryana	224.46	0.622	90.37	605.38	26.34	0.77	0.90	0.66	728
Himachal Pradesh	63.32	0.424	23.58	9.71	0.74	0.77	0.89	2.66	2132
Jammu & Kashmir	61.87	2.089	42.22	0.08	3.75	0.74	0.13	2.37	620
Jharkhand	59.79	0.318	15.17	36.39	1.01	0.73	0.48	0.91	0
Karnataka	183.22	0.124	30.12	1521.49	36.09	0.86	1.11	0.93	5679
Kerala	36.38	0.401	19.25	32.29	1.74	0.83	4.09	1.73	1643
Madhya Pradesh	90.29	0.036	44.07	556.62	35.17	0.81	0.75	0.12	4457
Maharashtra	125.95	0.490	19.47	1705.33	24.26	0.89	1.35	0.71	21150
Orissa	70.59	0.217	26.80	122.73	2.42	0.61	1.49	0.46	2701
Punjab	224.49	0.748	98.85	48.79	26.14	0.63	2.01	0.63	3543
Rajasthan	60.75	0.049	41.19	1890.73	42.59	0.86	0.52	0.25	6472
Tamil Nadu	186.43	0.090	55.46	675.65	12.99	0.84	1.27	1.36	4521
Telangana	245.29	0.800	50.38	262.29	39.03	0.79	0.70	0.94	799
Uttar Pradesh	170.09	0.412	80.28	154.11	19.63	0.81	1.04	0.12	8929
Uttarakhand	140.71	0.094	50.14	12.12	3.90	0.84	0.63	2.06	759
West Bengal	161.12	NR	65.68	66.69	2.75	0.66	2.22	0.15	7405

Contd...

Table 15 Contd...

States	Agricultural wage (Rs./ day)		Livestock density (number/ km²)	Market density (number /'000 km²)	Depth to water level (meters below ground level)	Scheduled Commercial Banks (branches/ '000 km²)	Agricultural credit (Rs. crore)	Farmer's income (monthly average per hh)	Avg. size of land holdings (ha)	Total wastelands (% of total area)
	Male	Female								
Year	2017-18		2019	2019	2019	2019	2018-19	2012-13	2015-16	2015-16
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Andhra Pradesh	331	239	209	1.20	13.77	44	122782	5979	0.94	14.71
Assam	278	229	231	0.29	3.04	36	7246	6695	1.09	11.48
Bihar	246	227	388	0.62	3.16	78	35828	3558	0.39	8.16
Chhattisgarh	200	135	117	1.36	3.37	20	10391	5177	1.24	8.04
Gujarat	219	196	137	1.62	11.21	43	66111	7926	1.88	11.09
Haryana	416	350	159	2.90	15.62	115	63349	14434	2.22	3.75
Himachal Pradesh	300	279	79	0.70	5.2	29	6870	8777	0.95	41.01
Jammu and Kashmir	-	-	37	0.15	2.83	8	13118	12683	0.59	79.06
Jharkhand	263	232	296	0.33	3.52	39	4092	4721	1.10	14.76
Karnataka	354	319	151	0.85	4.64	55	73419	8832	1.36	6.9
Kerala	613	482	75	2.37	10.12	170	92457	11888	0.18	5.89
Madhya Pradesh	246	210	132	0.78	3.94	23	61474	6210	1.57	12.83
Maharashtra	261	131	108	1.17	5.7	43	83570	7386	1.34	11.72
Odisha	270	227	117	0.66	2.84	33	27416	4976	0.95	11.83
Punjab	403	-	140	3.85	17.84	130	77456	18059	3.62	0.92
Rajasthan	336	269	166	0.46	24.9	22	83081	7350	2.73	23.04
Tamil Nadu	346	167	188	1.65	6.84	89	190222	6980	0.75	6.32
Telangana	-	-	284	1.59	8.95	46	57543	6311	1.00	12.71
Uttar Pradesh	241	223	282	1.08	17.3	40	89060	4923	0.73	3.54
Uttarakhand	-	-	83	0.41	18.03	73	10336	4701	0.85	23.79
West Bengal	274	236	422	0.56	5.03	101	46326	3980	0.76	1.86

Sources:

Column 2,3,4,5,6,7,11,12&17. Directorate of Economics and Statistics, Ministry of Agriculture & Farmer's Welfare, Government of India (dacnet.nic.in)

Column 8. Basic Road Statistics of India 2016-17, Ministry of Road Transport and Highways, GoI

Column 9. Combined Finance and Revenue Accounts, Comptroller and Auditor General of India

Column 10. National Federation of State Cooperative Banks Ltd. (NAFSCOB)

Column 13. Livestock Census, 2019

Column 14. http://www.agmarknet.gov.in/

Column 15. Water Resources Information System, Ministry of Jal Shakti, GoI (https://indiawris.gov.in/wris/#/DataDownload)

Column 16. Bank Branch Statistics, RBI

Column 18. NSSO data as stated in Saxena et al. (2017).

Column 19. Agriculture Census, 2015-16

Column 20. NRSC-Wasteland atlas of India 2019 (https://dolr.gov.in/documents/wasteland-atlas-of-india)

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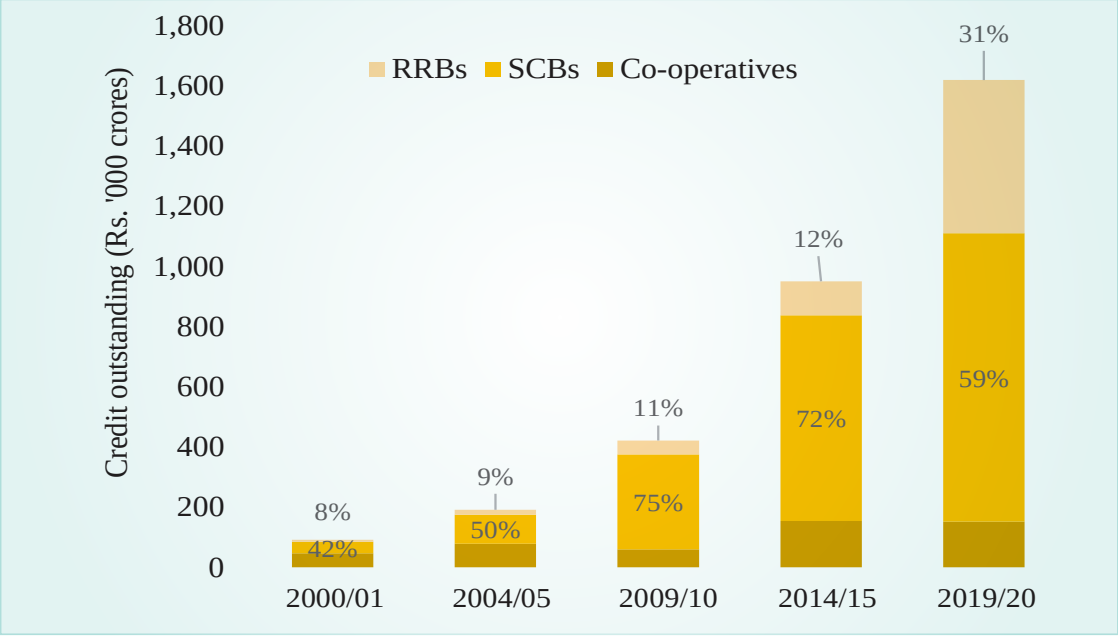
Figure 16. Share of agricultural exports and imports to national trade (2000/01 to 2019/20)

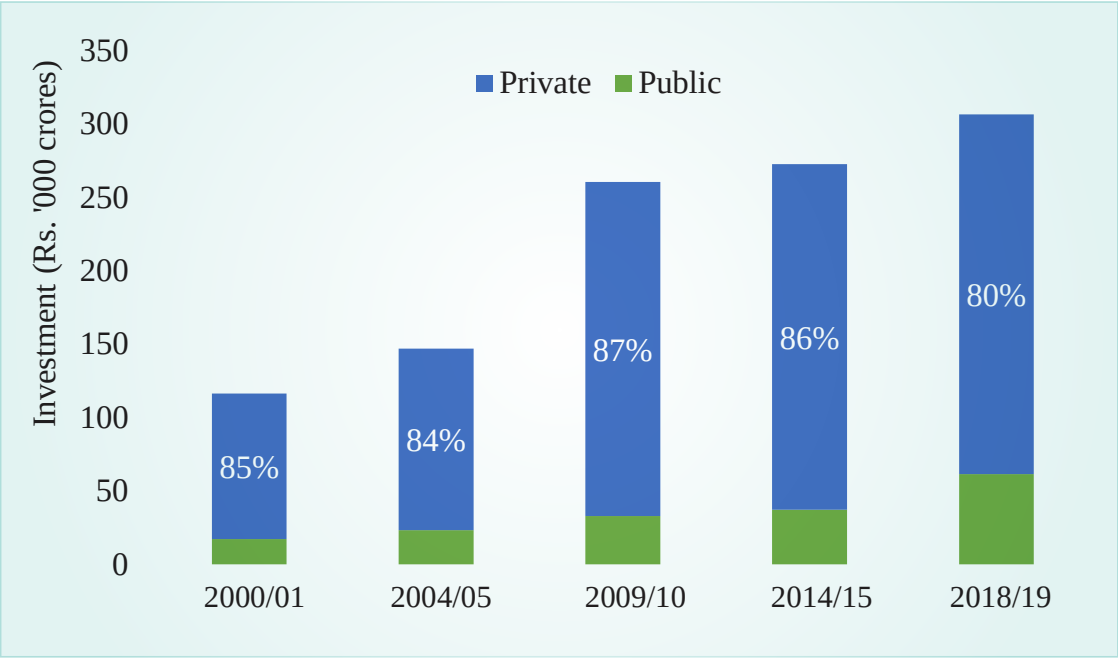
Source: Directorate General of Commercial Intelligence and Statistics

Figure 17. Institutional credit to agriculture and allied sector (2000/01 to 2019/20)



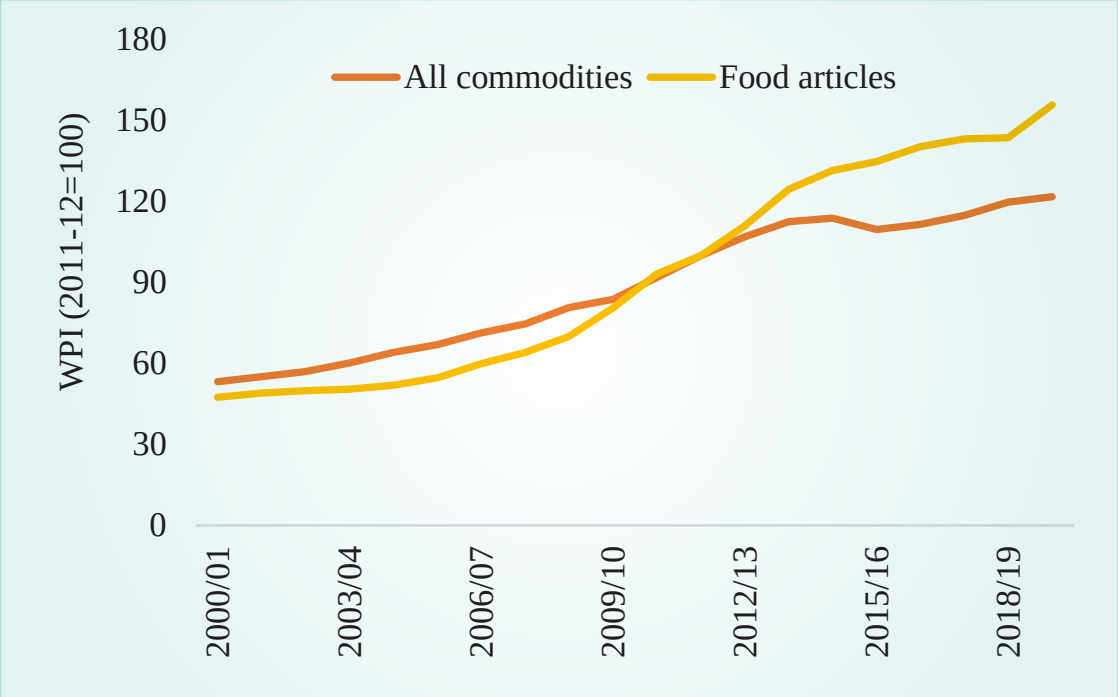
Source: Reserve Bank of India

Figure 18. Public and private investment in agriculture and allied sector (2000/01 to 2018/19)



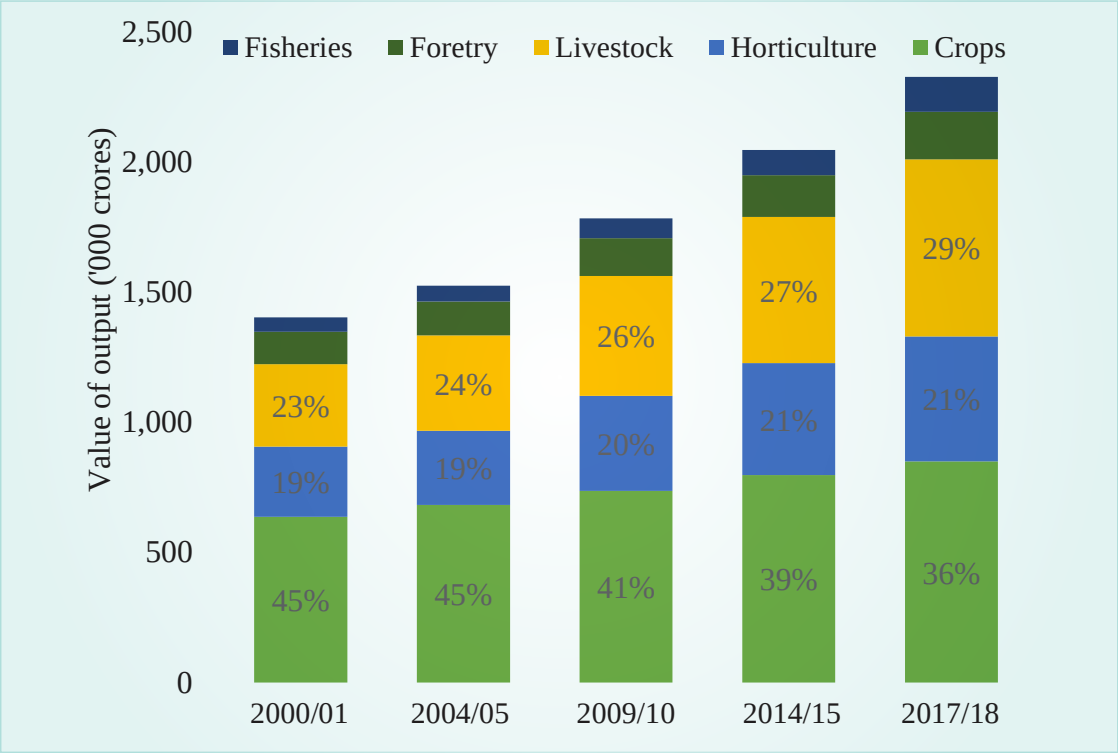
Source: Ministry of Statistics and Programme Implementation

Figure 19. Trends in wholesale price indices (Annual Average, 2000/01 to 2019/20)



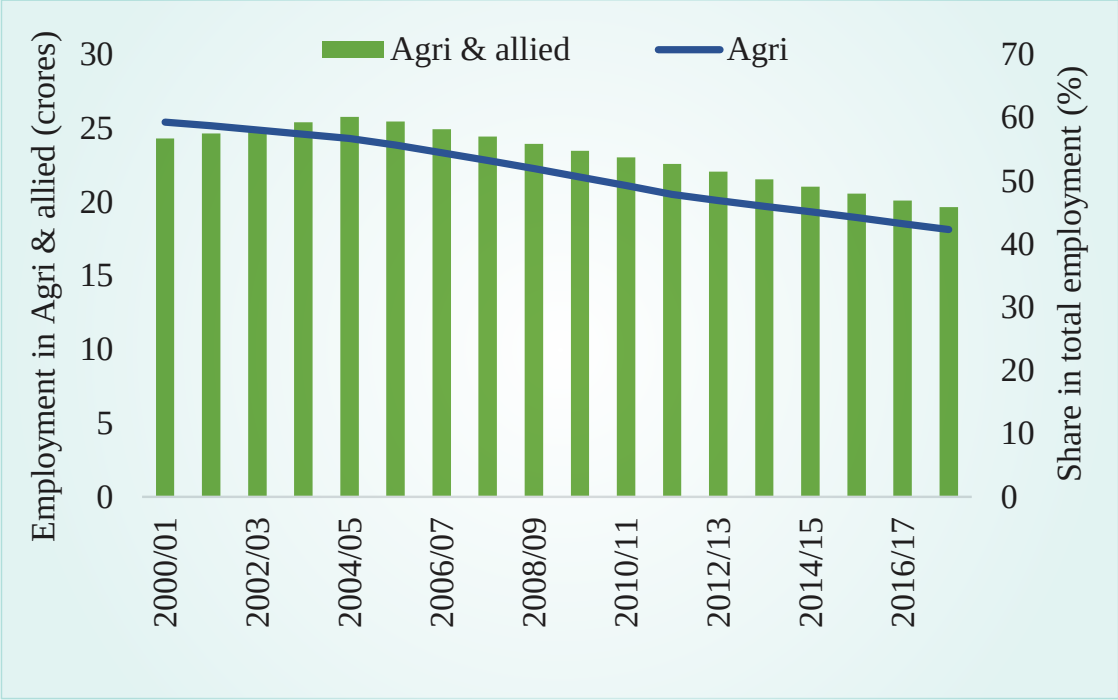
Source: Ministry of Commerce and Industry

Figure 20. Value of agricultural and allied sector output by components (2000/01-2017/18)



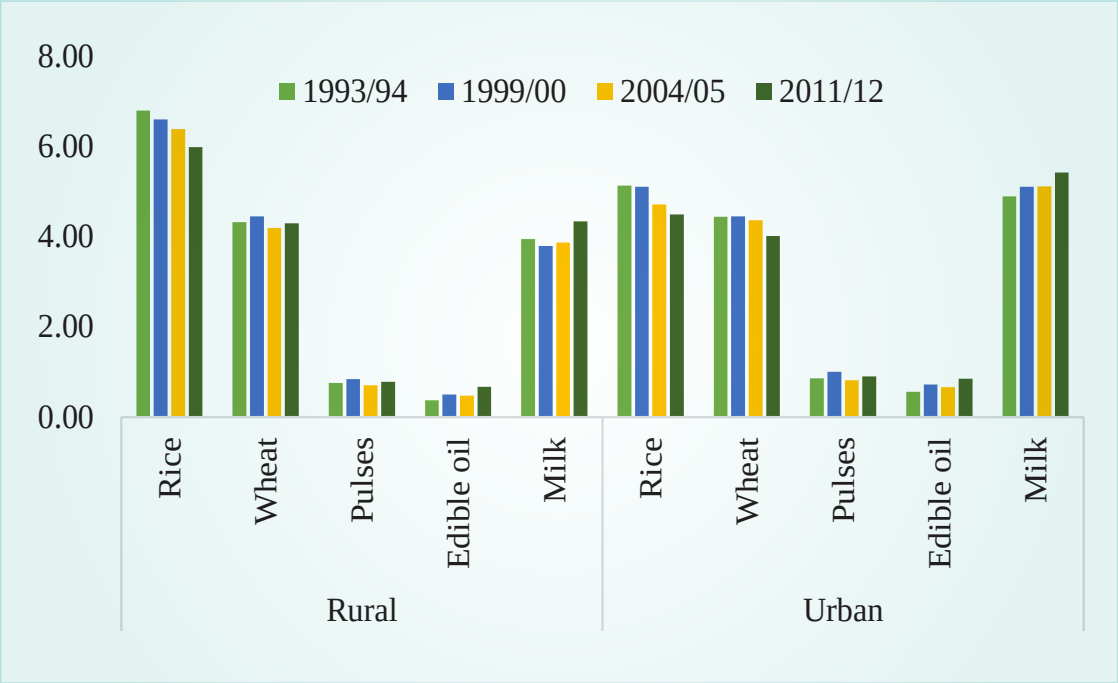
Source: Ministry of Statistics and Programme Implementation

Figure 21. Employment in agriculture and allied sector (2000/01-2017/18)



Source: Ministry of Statistics and Programme Implementation

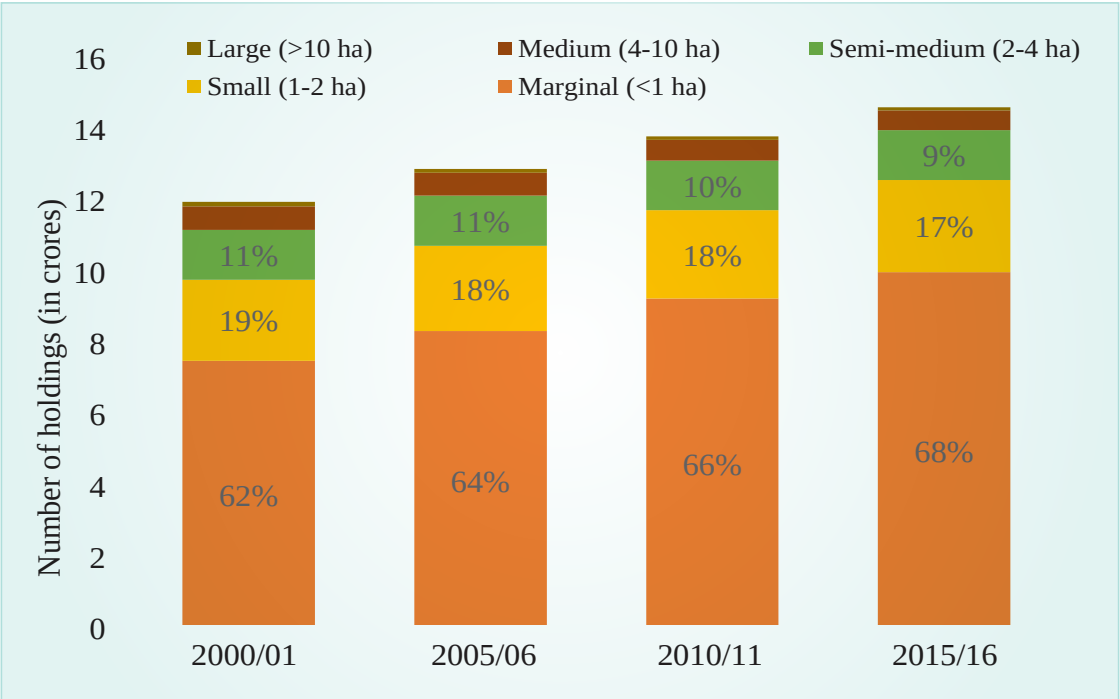
Figure 22. Changing per capita food consumption pattern (kg/month, 1993/94 to 2011/12)



Source: Ministry of Statistics and Programme Implementation

Note: Milk consumption is in litres

Figure 23. Number of operational holdings in agriculture (2000/01-2015/16)



Source: Ministry of Agriculture and Farmers Welfare

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