



NABARD Research and Policy Series No.6/2022



Agricultural Challenges and Policies for the 21st Century

Ramesh Chand





दृष्टि

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Agricultural Challenges and Policies for the 21st Century

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Agricultural Challenges and Policies for the 21st Century

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Chairman's Message



Academic research can inform policy making. However, since each piece of research may cover certain aspects of an issue, a comprehensive review of research may help collate the findings that may lead to policy recommendations. Further, the research available may be often very technical and less communicative to the policy makers. NABARD commenced the “Research and Policy” series to commission review papers on various themes to bring research findings on a given theme in a capsule form.

With this series, veteran scholars in different fields of specialisation have been requested to document research in their field highlighting various issues, policy relevance and prescriptions, and suggestions for future research. I am glad to present the paper on “Agricultural Challenges and Policies for the 21st Century” by Dr. Ramesh Chand who has been an authority on the subject.

The series will present more such authoritative papers on various issues ranging from climate change to agricultural policy in the coming months. I hope that series will be beneficial to academicians, researchers and policy makers for use at the ground level.

My best wishes to the authors and the Department of Economic Analysis and Research (DEAR) for initiating such a wonderful series.

Dr. G. R. Chintala

Foreword



There is a vast body of research available on topics related to agriculture and rural development in the academic world. But, most of it is in the technical realm and not in a form which could feed into the policy. Research must first lead to better understanding of a subject and then into a robust policy, wherever it can, so that it touches the multitude of Indians across the length and breadth of our country through better public policy and efficient services. Discussion with my colleagues on this issue lead to this new series “Research & Policy”. We wish that

this series will provide the breadth and depth of research into an area topped up by a lucid presentation for the policy makers.

I am happy to present the sixth publication in this series on “Agricultural Challenges and Policies for the 21st Century” written by Dr. Ramesh Chand.

I wish this new series acts as a bridge between the researchers and policy makers.

P. V. S. Suryakumar

Deputy Managing Director

Preface



Agriculture sector proved a silver lining in the pandemic period registering a positive growth in the covid times. Yet it faces various structural challenges to be addressed to make it profitable. For, the majority of the population is still dependent on the sector. As we all know, investing in research is one of the best strategies to address problems of agriculture. Equally important is to communicate the research findings to policy makers to design and tweak policies that matter. During one of our meetings with Shri P. V. S. Suryakumar, our DMD, we had loud thinking if we can commission a few review papers on select themes. We thought that it is appropriate to request veteran scholars who spent prime of their life on a given research theme to attempt such a work where they will distil their understanding and the research done on the theme in a short paper. Duly encouraged by DMD and Chairman, we wrote to a dozen eminent scholars. And the response was overwhelming resulting in Department of Economic Analysis and Research (DEAR), the research wing of NABARD, initiating the 'Research and Policy Series'. The motivation is, thus, to get a few handles from research that can help effective policy intervention. This series will be useful to policy makers and researchers alike.

The 'Research and Policy' series is an attempt to get a glimpse of hardcore research findings in a capsule form thereby making it more effective and communicative to policy makers. The group of researchers who agreed to prepare a review of research have spent their life in the field of agricultural research. Our purpose here, as we communicated to them, was not just to get literature survey but to get researcher's heart and their experience which they gained during their long passionate innings. The paper is expected to highlight various issues, policy relevance, prescription, and suggestion for future papers on the themes of interest to NABARD.

Agriculture policies implemented by governments at various levels after the Independence were critical in bringing socio-economic transformation to many parts of the country. These production methods, despite their achievements, must be evaluated against the test of sustainability and the challenges they present for the sector's current growth. In view of this, the current paper on "Agricultural Challenges and Policies

for the 21st Century” written by Dr. Ramesh Chand, Member, NITI Aayog, assumes importance. Dr. Ramesh Chand has a distinguished academic career, with research interests in agriculture that include production, growth, development policy, farmers’ issues, markets, and trade.

The paper begins by examining the severity and extent of various types of challenges confronting Indian agriculture, ranging from over exploitation of natural resources to smallholder viability to agricultural research and development. It then highlights key policies and initiatives that can be put in place to address these issues. While discussing the policies, the author thoroughly reviewed the current agri-marketing and MSP policies and tried to provide solutions to major problems under the current policy setup. At the end, the author discusses various issues that must be debated to ensure sustainability of all the stakeholders in agricultural sector. Overall, the paper will give readers more to think about.

In bringing this series as planned, we would like to express our sincere gratitude to Dr. G. R. Chintala, Chairman, NABARD for his inspiring leadership, unstinted support and guidance. We also wish to express our sincere thanks to Shri P. V. S. Suryakumar, DMD, for being the inspiration and the driving force behind the publication of this first of its kind series. We are grateful to the authors of this series who agreed to write on themes relevant to NABARD in such a short period of time. Indeed, it has been a great privilege for us.

I also acknowledge the contributions of the officers of DEAR, NABARD especially Dr. Ashutosh Kumar, DGM; Mrs. Geeta Acharya, Manager; Ms Neha Gupta, Shri Vinay Jadhav, Assistant Managers, and others who coordinated with the authors and the editor to bring out the series as envisaged.

Thanks are due to Dr. J. Dennis Rajakumar, Director, EPWRF and his team for their contribution in copy editing and bringing uniformity to the document.

K. J. Satyasai

Chief General Manager

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Abbreviations

ACIAR	Australian Centre for International Agricultural Research
ACRP	Agro Climatic Regional Planning
AI	Artificial Intelligence
APMC	Agricultural Produce Market Committee
CACP	Commission for Agricultural Costs & Prices
ESCAP	Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organisation
FRP	Fair and Remunerative Price
GFCF	Gross Fixed Capital Formation
GHG	Greenhouse Gases
GVA	Gross Value Added
HYV	High Yielding Varieties
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
IOT	Internet of Things
IPC	Irrigation Potential Created
IPM	Integrated Pest Management
IPN	Integrated Plant Nutrient
IPR	Intellectual Property Right
KVK	Krishi Vigyan Kendra

(Contd....)

Abbreviations *(Concluded)*

MSP	Minimum Support Price
MSME	Micro, Small and Medium Enterprises
NARS	National Agricultural Research System
NGOs	Non-governmental Organisations
NITI	National Institution for Transforming India
PMKVY	Pardhan Mantri Kaushal Vikas Yojana
PDP	Price Deficiency Payment
PSS	Price Support Scheme
R&D	Research and Development
SAARC	South Asian Association for Regional Cooperation
SAUs	State Agriculture Universities
SDG	Sustainable Development Goal
TOT	Terms of Trade
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
USA	United States of America
UTs	Union Territories

Executive Summary

The agri-food sector in India has undergone a sea change since the onset of the Green Revolution in the late 1960s. From an uncomfortable state of acute shortage of food, widespread hunger and heavy import dependence, the country has emerged as a net exporter and surplus producer of many agricultural commodities. The overall effect of the Green Revolution technology and other aspects of the agricultural strategy and policy is that the per capita production of food in the country has more than doubled during the last 50 years, despite the 237% increase in human population.

Till a few years back, the entire agriculture strategy was focused on the single motto of 'grow more food' at any cost. This strategy brought many positive changes like food self-sufficiency, emergence of export surplus of many commodities, better nourishment, socio-economic transformation in some regions, increase in rural wages and employment, and gradual increase in farm income. But these achievements also threw up new challenges on several fronts, and some of those are formidable and require urgent attention.

The foremost challenge relates to sustainability of the current method of production. The indiscriminate use of chemical fertilizers, pesticides and weedicides, expansion of irrigation, and crop specialisations favouring a few crops, which were the main sources of growth of agriculture post-Green Revolution, played havoc with natural resources, environment and ecology. Heavy subsidy and free supply of power for irrigation led to reckless, indiscriminate and overuse of water, and brought serious distortions in crop choices.

Agriculture is quite important in determining quality of air, water and land, and pressure on land and water, which are pillars of sustainability. In order to check further overexploitation of water resources, the country should create a policy environment that leads to crop pattern and practices consistent with the natural resource endowment in various agro ecological zones. Further, without improving efficiency of water use in agriculture through modern methods of irrigation (drip, sprinkler and sensors), stress on water use and future water requirement cannot be addressed.

Despite the technological breakthroughs in many areas, our productivity levels both in crops and livestock at the national level remained lower than many other major agricultural countries. Agricultural practices involving prolific use of inputs like broadcasting of fertilizer and flood irrigation are not showing any significant improvement. In most of the crops, increase in productivity has been accompanied by an increase in average cost of production that necessitated an increase in output prices to keep incremental production profitable. The dependence of the agriculture sector on government support is rising. Because of this, the sector is becoming less competitive.

India is accumulating a large surplus of rice, wheat and sugar which involves a huge cost to state exchequer. On the other hand, deficit in edible oils is rising year after year. Disposing off surplus rice and sugar in international markets needs high level of financial support, because international prices are lower than the cost of supply or domestic price of the produce.

The country spends more than Rs. 30,000 crore each year after 2007-08 as capital expenditure and also huge amounts on operation and maintenance of canals, but area under canal irrigation has shown either stagnation or a decline. This disquieting trend necessitates a close examination and urgent action to ensure that country's resources spent on canal irrigation gives expected returns.

Indian diets are changing in a significant manner. Per capita absorption of cereals has witnessed the smallest increase, despite an increase in availability and heavy subsidy of cereals. There is a manifold increase in the per capita net availability of vegetables, fruits and milk for domestic consumption. However, around 16% of the population still live in hunger, and a large population remains malnourished. India presents a paradoxical situation of 'hunger in the midst of plenty'. Health of children and women is also a matter of concern.

Low intake of the total food is the main reason for widespread hunger and malnutrition. The country would need to relook at policy interventions in agriculture that are heavily biased towards rice, wheat and sugar, which are produced in excess of domestic and export demand. Further, nutrition awareness is very important to improve nutrition and health, as there is a growing tendency for preferring more of spicy, oily and sugary foods to nutritive food. Attributing poor nutrition entirely to low paying capacity is not correct.

If the current trends in agriculture are not corrected, there will be little improvement in reducing the gap between agriculture and non-agriculture income and alleviating rural distress. In this background, the present government has set a vision for a new India that involves 'Sabka Saath Sabka Vikas'. Agriculture growth is significantly beneficial for reducing poverty and increasing per capita income of low-income classes in rural India. Beside inclusive growth, agriculture matters for health and nutrition, sustainability, climate change and the quality of life in the country. All these factors underscore the need for a new vision for agriculture as we move forward in the 21st century – a vision that addresses various challenges facing agriculture.

Ironically, high growth rate in agriculture experienced during some phases did not bring down real prices of food in the country. The reason has been that the prices drove output growth rather than output growth determining prices! The goal and strategy for agriculture must shift from 'growth to efficient growth'. Indian agriculture is without the state-of-the-art technology and modern methods of farming. Application of advanced science at the farm level requires skill, knowledge, investment and improvement in human capital in farming. Upgrading farming from low-tech to high-tech (like greenhouse cultivation, poly houses, tissue culture and precision farming) will reduce the average cost, raise farmers income and address some scale disabilities.

Lately, methods that have roots in traditional Indian methods of farming like natural farming and organic farming are being proposed in place of chemical-based farming with the aim to reduce cost of production, besides also addressing adverse effects of chemicals on health, environment and natural resources. Lot of anecdotal evidence is quoted in support of benefits of the alternative system of farming. However, the scientific community in public research institutes cast doubts on the claim of benefits of traditional systems of farming and raise the issue of a significant yield discount in such methods, which could be detrimental to the food and nutrition security of the country in coming years. They feel, the breakthrough in biotechnology and scientific practices like integrated pest management (IPM) and integrated plant nutrient (IPN) systems, modern methods of fertiliser application and irrigation can address various concerns related to farming, based on the use of agro-chemicals rather than taking the risk of a shift towards natural farming. Public research system must look into various aspects of alternative methods of farming and develop best

practices to meet public preferences and the national goals of raising farmers income by lowering costs and supply of safe and healthy food.

Capital intensive production preferred by the manufacturing sector and anticipated threats to jobs posed by emerging technological innovations necessitate a rethinking of the development strategy of shifting workforce from agriculture to manufacturing and services. India should explore possibilities of creating blue collar jobs in and around agriculture.

Current and projected growth for food demand and supply reveal that India would need to add 20% - 25% of incremental output to the current level of food exports. This requires export competitiveness. At present, the minimum support prices (MSP) of some commodities recommended by the government are higher than the international prices. If such MSP is used for procurement, it will keep domestic prices higher than international prices, thus, making the exports impossible.

Keeping prices artificially above the levels dictated by demand and supply and forcing them on the market through government interventions causes serious price distortions, which have a number of implications. The best option in such situations is to pay the farmers the difference between a reasonable MSP and average market price at the state level, as is the practice in many countries.

Regulatory restrictions on marketing and absence of business-friendly environment in agriculture acts as a deterrent for corporate investment in agriculture production and marketing. This is said to be an important reason for the slow change in agriculture, the dominance of traditional marketing channels and the weak linkage between farm and fork.

Economic reforms launched in 1991 helped in doubling real per capita income in the country in just 17 years compared to 37 years it took to double per capita income before 1991. However, the gross value added (GVA) of agriculture and allied sectors doubled in about 23 years before 1991, and it took same number of years to double again. This is a major cause of rural distress. Special focus is needed to raise farmers' income at a faster rate. This requires transformation of agriculture production as well as marketing through a multi-pronged strategy that involves increase in productivity, reduction in average cost, better price realisation for farm produce, expansion of allied activities and shift of farmers to non-farm occupations. The three farm laws

enacted in year 2020, which have been repealed now because of opposition from some farmers groups, were aimed to achieve this goal.

Since long, there is a felt need to overcome the limitations and constraints of the present agricultural marketing system and to develop a competitive, transparent and barrier free markets with the choices to the farmers to sell their produce to the buyers offering better prices in a transparent manner. When states did not come on board to reform their Agricultural Produce Market Committee (APMC) Acts, despite repeated pleas and persuasions by successive governments at the centre for 18 long years, the union government in 2020 took a historical decision to take on itself the responsibility of bringing reforms in agriculture, and the three new farm acts were enacted after they were passed by the Parliament. Consequently, the three farm laws have been repealed because of farmers protest against these reforms. Nevertheless, it is very clear that the sector cannot move forward on a healthy pace without reforms.

Some farmers' groups demand legalising of MSP as a solution to low market prices. Legal MSP cannot work when they are not supported by demand and supply side factors. If we want to protect the farmers against unremunerative or uncompetitive prices through legal MSP, we should be guided by the price recommended by institutions like the Commission for Agricultural Costs & Prices (CACP), and after considering demand side factors and possible open market price.

Agricultural economists and experts need to debate about (a) what is remunerative prices for farmers and the best option for ensuring it without distortions in market; (b) sharing of responsibility for price assurance between the centre and the states; and, (c) the pathways for modernising agriculture.

Significant and sustained increase in farmers' income and transformation of agriculture require a paradigm shift in the entire approach towards agriculture sector. Changes in archaic regulations and liberalisation of the sector are a must for creating an enabling environment for a modern and vibrant agriculture. Advancement in science led technology, enhanced role of the private sector in both pre and postharvest phases, liberalised output markets, active land lease markets and emphasis on efficiency will equip agriculture to address the challenges of 21st century and contribute towards the goal of new India. A well-co-ordinated action and strategy between the centre and the states is needed to ensure that agriculture moves to next stage of development along with other sectors.

Agricultural Challenges and Policies for the 21st Century

1. Introduction

Historical experience of almost all economies shows that the share of the agriculture sector in the total employment and national income falls with the progress in economic development and growth over time. However, this decline does not diminish the need to address various challenges facing the agriculture sector from time to time because of several reasons. The foremost is the dependence of human life on food for survival. This dependence goes beyond survival to adequate nutrition for an active and healthy life. The other significant reasons for the continuing importance of agriculture is its role in:

- (i) supporting and improving rural livelihoods,
- (ii) maintaining agro ecological balance,
- (iii) mitigating climate change and global warming, and
- (iv) ensuring sustainable use of land, water and other natural resources.

Much of the economic activities including industrial production and supply chains, trade and commerce start with raw material supplied by the agri-food sector. It is, thus, obvious that agriculture remains a core concern in all the countries, both developed and developing ones. It is now recognised by the United Nations that Sustainable Development Goals (SDGs) for 2030 cannot be achieved without paying attention to agriculture, as 11 out of 17 SDGs are directly linked to agriculture.

Role of agriculture in growth of Indian economy and overall development of the country hardly needs any elaboration. However, this needs to be re-oriented in the light of the changing environment and requirements and to meet the new challenges, and also to harness new opportunities. This will require a shift in our approach and thinking towards agriculture from 'pushing for incremental change' to 'transformational change'.

2. Agricultural Challenges

There is a sea change in food situation in the country since the 1960s when India faced acute shortage of food and registered widespread hunger, and depended

on food imports to save millions of lives from starvation. The situation was so grave that the then Prime Minister gave a call to the people to observe fast for one day in a week. The High Yielding Varieties (HYV) of wheat and paddy became available around the same time, and the then government took a bold decision to adopt Green Revolution technology despite strong opposition from some quarters. The entire agriculture strategy was focused on single motto of 'grow more food'. Initially, the Green Revolution technology involving high yielding dwarf varieties of wheat and paddy, highly responsive to inorganic fertilizer, was adopted in well-endowed irrigated regions in the country. Subsequently, as irrigation expanded, the Green Revolution technology spread to wider areas. Improved and HYV were also developed in many other crops.

The new cultivars were more water intensive, and their success required better tillage, good quality seeds, use of chemical fertilisers to meet nutrition requirements, and use of chemicals to control pests, insects, diseases and of late weeds. The Green Revolution technology was more beneficial and suitable for irrigated regions compared to rainfed areas. These changes were facilitated and encouraged by favourable policy support and environment both by the centre as well as many states. The spread of the new technology package led towards enterprise specialisation, mono cropping, shifts in cropping pattern and crop sequences, withdrawal of more nutrients from the soil and more extraction of groundwater than recharge. This put serious stress on the natural resource base (land, water, ecosystem and environment), and thereby, clear signals emerged on the sacrifice of long-term interest for the short-term gains, and by future generation for current generation gains. It is now evident that the current system and practices need thorough changes and a paradigm shift. Before discussing those changes, it is imperative to discuss the severity and extent of various types of challenges facing Indian agriculture.

2.1 Overexploitation of Water Resources

Assured irrigation and access to water are crucial for raising crop productivity, crop intensity and output quality, and lowering risks in agriculture. Expansion in irrigation, along with technology and fertilizer, have been the major instruments fuelling agriculture growth. Over time, huge public and private investment have been made to expand the area under irrigation. Seeing the critical role of water in raising yields, some states started subsidising or supplying power for irrigation free

Table 1: Changes in Irrigation and Status of Groundwater

Irrigation/Water use	TE 1972-73	TE 2017-18
Gross irrigated area (million hectare)	38.6	98.3
Gross cropped area irrigated (%)	23.5	49.4
Groundwater irrigated area in total irrigated area (%)	28.2	46.0
Overexploitation of ground water (% blocks)		36.0
Share of agriculture in total water use (%)		88.8

Note: TE stands for Triennium Ending

Source: 1. Directorate of Economics and Statistics, *Land Use Statistics*, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi. Accessed from <https://eands.dacnet.nic.in/#>
 2. Central Ground Water Board (2021): *Dynamic Groundwater Resources of India 2020*, Ministry of Jal Shakti, Government of India, New Delhi.

of charges. This led to reckless, indiscriminate and overuse of water, and brought serious distortions in crop choices. With marginal cost of using water being close to zero, farmers started growing water intense crops in low rainfall areas and adopted water-based practices and off-season cultivation. It is evident from the emergence of monoculture of paddy in traditionally groundnut and cotton growing areas in Punjab, Haryana and Rajasthan; expansion of sugarcane in Maharashtra and Uttar Pradesh; groundnut cultivation in peak summer time in Rajasthan and many such cases. Thus, a new geography of crops appeared in complete violation of agro climatic suitability of various agro climatic zones in the country. Broad changes in area and sources of irrigation are presented in Table 1.

Though half of the agricultural area is rainfed and without access to irrigation, the sector uses close to 90% of the total water used in the country. Further, the groundwater table show small to very high decline in 36% of the blocks mainly due to water withdrawal exceeding water recharge. This is being experienced even in water rich middle Indo Gangetic region. Farmers in some parts of the country are chasing groundwater beyond 1,000 feet below ground level. This is water mining, and has very serious implications for water quality, aquifer health and availability of water in future.

2.2 Disregard for Nature and Loss of Crop Diversity

The guiding principle and recommendations for crops suitable for different regions are available in literature on Agro Climatic Regional Planning (ACRP) published by

Table 2: Crop Shifts Towards Water Guzzling Crops in Selected States and All-India

	Area Under Cultivation: Million Hectare		Share in Total Net Sown Area (%)	
	TE 1972-73	TE 2017-18	TE 1972-73	TE 2017-18
1. Area under paddy				
India	37.4	44.3	26.8	31.8
Punjab	0.44	3.0	10.8	73.3
Haryana	0.28	1.4	8.0	39.5
2. Area under sugarcane				
India	2.50	5.00	1.80	3.59
Maharashtra	0.20	0.84	1.15	4.94
Uttar Pradesh	1.35	2.21	7.77	13.39

Note: TE stands for Triennium Ending

Source: Author's calculation based on data derived from Directorate of Economics and Statistics, *Agriculture Statistics At A Glance*, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi. Accessed from: <https://eands.dacnet.nic.in/#>

erstwhile Planning Commission for 15 major agro zones and at a disaggregate level by Indian Council of Agricultural Research (ICAR) for 127 zones in the country. The suggested crops and crop pattern are based on natural resource endowment and agro-climatic conditions prevailing in various parts of the country, and are thus considered sustainable. Actual crop pattern and acreage allocated to various crops are at significant variance with what is suitable from the agro climatic point of view. The deviation is mainly caused by policy support and disparities in advancement in technology for various crops. Technological and policy bias in favour of Green Revolution technology and a few crops not only caused distortions in crop pattern, it also resulted in increased concentration of area under some crops and a sharp decline in crop diversity. This is illustrated in Table 2. In the early 1970s, paddy cultivation was undertaken on 10.8% of the net sown area in Punjab and 8% in Haryana. This share has increased to 73.3% in Punjab and 39.5% in Haryana. Similarly, area under sugarcane cultivation quadrupled in Maharashtra and doubled in Uttar Pradesh after the onset of the Green Revolution.

Such changes in crop pattern have serious implication for sustainable use of natural resources, complementarity among crops, outbreak of diseases and pests. These consequences are also transmitted to human health and nutrition, and environment quality.

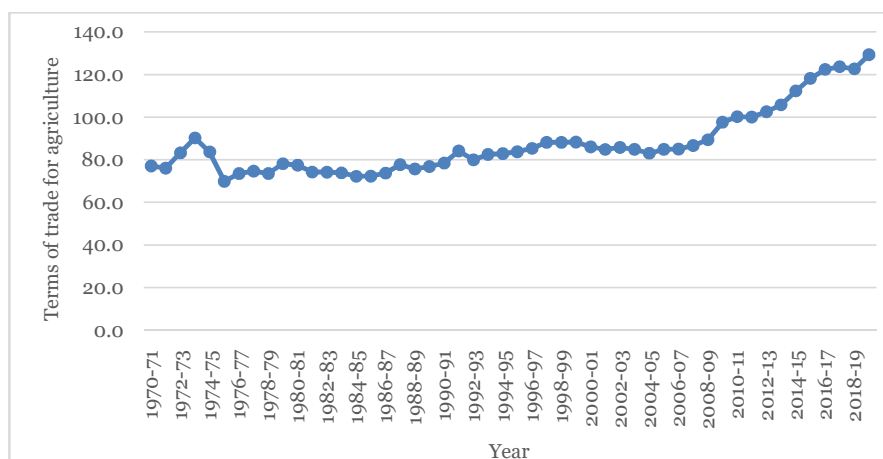
2.3 Low Efficiency and Price Led Growth

India's growth in agriculture sector, though impressive in most products and states, has remained lower than the potential. Our productivity levels are lower than major agricultural countries. The sector is witnessing slow modernisation. The much-needed changes in technology, method of production and postharvest value addition are not visible on a large scale. Agricultural practices involving prolific use of inputs like broadcasting of fertilizer and flood irrigation are not showing any significant improvement. In most of the crops, increase in productivity has been accompanied by an increase in average cost of production, which necessitates an increase in output prices to keep incremental production profitable. The dependence of the agriculture sector on government support is rising. Because of this, the sector is losing its competitiveness.

The role of incentives like output price support and subsidies, and non-price factors like irrigation, new seed, fertilizer, technology and institutional reforms in improving the growth of the agriculture sector is very well documented in the literature. While non-price factors create potential for growth, remunerative prices incentivise farmers to harness this potential. Thus, both sets of measures are crucial for growth and development of the agriculture sector. Over time, farmers have focused more on prices support than making a balanced demand to include non-price factors in policy support. This was because of a couple of factors. Implementation of MSP and procurement of rice and wheat in selected states allowed remarkable stability in prices received by farmers with zero price risk, and assured higher income than through their sale at market prices. This attracted attention of other producers, who were not able to sell their crops at MSP, for a similar treatment to them and their crops. And also, MSP has been made more and more remunerative over time, and increased year after year irrespective of glut in supply and fluctuations in open market or international prices.

After submission of report of National Commission on Farmers, chaired by eminent agriculture scientist Dr M S Swaminathan, in 2006, farmers have rallied around the commission recommendation for a 50% margin over costs while fixing MSP. This recommendation was a surprise for many economists, as the commission did not give any rationale or justification for this recommendation that has far-reaching implications. The recommendation became quite popular among farmers throughout the country, as it involves a high rate of return over their cost. Political

Figure 1: Movement in Terms of Trade for Agriculture



Note: Terms of trade for agriculture is the ratio of implicit price deflator of gross value added (GVA) of agriculture to that of the non-agriculture sectors.

Source: Author's calculation based on data derived from National Statistical Office: *National Accounts Statistics*, Ministry of Statistics and Programme Implementation, New Delhi, Various Issues.

parties also started promising MSP based on the Swaminathan Commission report to appease and seek farmers' support. The decision of the central government to accept Swaminathan Committee recommendation to fix MSP at least 50% above the cost of production in 2018 further raised the attractiveness of MSP and pushed the MSPs much above open market prices. Increase in average costs of cultivation due to higher use of inputs has forced the farmers to rely more on support prices, though increased use of inputs has improved crop productivity.

Changes in prices of agriculture relative to prices in the non-agriculture sector can be seen from the terms of trade (TOT) for agriculture. The TOT is taken as ratio of implicit price deflator of agriculture sector to implicit price deflator of non-agriculture sector. Generally, TOT is expected to move cyclically with the phase of rise followed by the phase of decline, and vice versa. But since 2005-06, TOT for agriculture have moved on a rising trend (Figure 1). This implies that price trends have been more favourable towards farmers' output since 2005-06.

2.4 Imbalances and Regional Disparities

Imbalances between demand and domestic production have been growing over the years. India has been accumulating a large surplus of rice, wheat and sugar, and this in-

volves a huge cost to the state exchequer. The underlying reason for this is the rise in output price by the centre and payment of bonus for rice, and rise in fair and remunerative price (FRP) for sugarcane by some states ignoring the CACP recommendations and, for that matter, demand and supply or market situations. Where sugarcane prices ruled higher than the corresponding price of sugar prevailing in the domestic market, sugar mills started paying lower price compared to the price for sugarcane announced by the states. The net result has been an accumulation of arrears for sugarcane growers. Thus, the demands and protest by farmers to pay sugarcane arrears by the union government has become a regular phenomenon for many years. On the other hand, India's deficit in edible oil is rising year after year. The country meets 55% of its domestic requirement of vegetable oils by importing them. There is, thus, a scope in domestic market to absorb 127% increase in domestic oilseed production.

Disposing off surplus rice and sugar in international market needs high level of financial support, as international prices rule much lower than what turns out to be the cost of supply or domestic price of the produce.

Table 3: Value of Crop Output Per Hectare (ha)
During TE 2018-19

State	Crop Productivity (Rs/ha)
Daman & Diu	58501
Rajasthan	70977
Chhattisgarh	91560
Lakshadweep	95457
Dadra & Nagar Haveli	100219
Karnataka	105256
Manipur	106838
Maharashtra	108558
Meghalaya	112117
Telangana	114459
Gujarat	129835
Mizoram	131380
Nagaland	135106
Odisha	137555
Madhya Pradesh	138065
Bihar	138302
All India	138884
Arunachal Pradesh	143760
Assam	149815
Uttar Pradesh	155502
Chandigarh	164028
Goa	170647
Uttarakhand	174942
Haryana	179104
Kerala	179941
Andhra Pradesh	191992
Tamil Nadu	199046
Punjab	207743
Himachal Pradesh	219529
Jammu & Kashmir	243605
Jharkhand	253484
West Bengal	283707
Sikkim	308634
A & N Islands	348386
Tripura	358432
Delhi	403213
Puducherry	417096

Note: TE stands for Triennium Ending

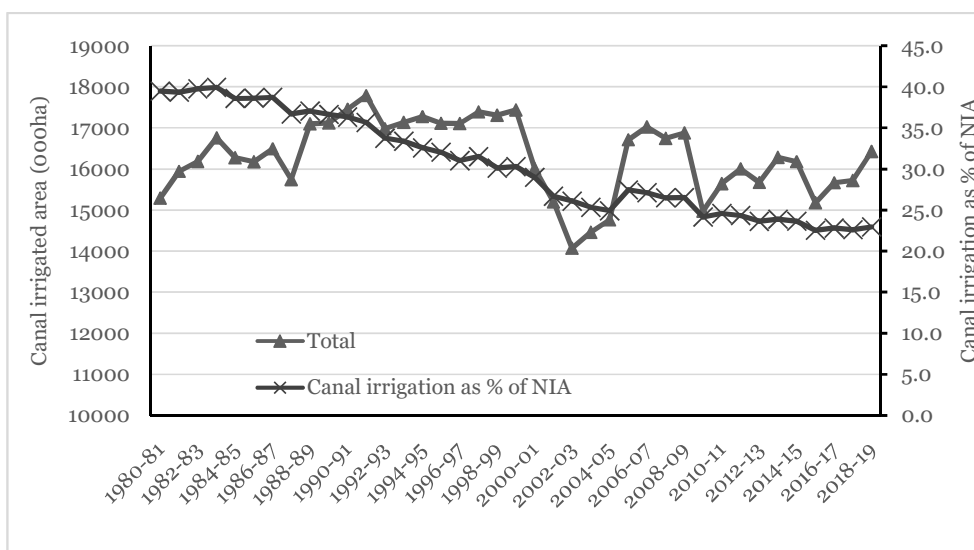
Source: Author's estimates based on data derived from State Level Value of Output of Crop Sector, in National Statistical Office: *National Accounts Statistics*, Ministry of Statistics and Programme Implementation, New Delhi, Various Issues.

Another dimension of imbalances is the variation in productivity. Though some variations are bound to be there because of natural resource endowment and access to irrigation, there are wide variations in crop productivity across states even at a similar level of irrigation. As can be seen from Table 3, value of crops harvested from one hectare of land in major states varies between Rs. 70,977 in Rajasthan and Rs. 2.83 lakh in West Bengal. Excluding Rajasthan, which has very low rainfall and dry and arid climate, per hectare productivity across major states ranges in the ratio of 1:3.1. With more than 72% area under irrigation, Bihar achieved crop productivity of Rs. 1.38 lakh per hectare – lower than average of many other states where area under irrigation is less than 50%.

2.5 Wasteful Investment

Investment in major, medium and micro irrigation constitutes a major share of public investment in agriculture. These investment were meant to increase area under surface water irrigation. The country spent more than Rs. 30,000 crore each year after 2007-08 as capital expenditure and also a huge amount as operation and maintenance of canals, but area under canal irrigation is showing either stagnation or decline (Figure 2). There are multiple reasons for this, including considerable

Figure 2: Area under Canal Irrigation and Its Share in Total Irrigated Area, All-India



Source: Same as Table 1.

delays in completion of projects resulting in very high time and cost overruns. Several major irrigation projects even after incurring most of the expenditure are held up by minor obstacles like forest clearance in small pockets, catchment area development, construction of distributaries and field channels. Interstate and intra state disputes are another factor for delay in completion of some major irrigation works.

It looks ironical that area under canal irrigation witnessed stagnation and even decline for such a long period, despite so much investment in medium and major irrigation. During 1993-2014, the country spent on an average about Rs. 17,663 crore per year at current prices on capital expenditure for major and medium irrigation projects. This disquieting trend necessitates closer examination and urgent action to ensure that the country's resources spent on canal irrigation gives expected return.

The main reason for lack of progress in the area under canal irrigation has been poor utilisation of irrigation potential created, and emergence of a big gap between irrigation potential created (IPC) and irrigation potential utilised (IPU). This is despite the fact that Rs. 1,74,473 crore were spend on major and medium irrigation projects in the Eleventh five year plan period. Though IPU remained poor, even this should have resulted in an increase in the area under canal irrigation, which is not visible in the irrigation statistics.

Due to poor progress in the area under canal irrigation, its share in the net irrigated area has declined from 37.5% in 1984-85 to 23% during 2018-19. This, in turn, is putting strong pressure on use of groundwater leading to its overexploitation, which has several adverse implications.

2.6 Technology Generation and Dissemination

Agricultural problems are becoming more complex, and research is turning more capital intensive. Climate change, share of agriculture in greenhouse emissions and sustainability concerns add to the challenges to be addressed by the research and development (R&D) system. Scope for spillover from research in the developed world is shrinking, and intellectual property right (IPR) issues are complicating and making it costly for transfer of technology from the outside world and the private sector. Thus, India needs to be self-reliant in agricultural research.

Basic and strategic research in any discipline lays the foundation for breakthroughs. Sadly, this component has weakened considerably in the National Agricultural Research System (NARS). The concentration of NARS over a period of time has shifted to applied research and problem-solving research.

Agriculture is also becoming more competitive globally with many new innovations happening in the sector. However, the rate of adoption of improved as well as frontier technology is low, mainly due to poor extension services.

Though agricultural research and higher education is largely a responsibility of State Agriculture Universities (SAUs), the ICAR is required to respond to any challenges and issues concerning the agriculture sector. Public opinion at large holds ICAR responsible for any adverse development in the agriculture sector. As a result, the portfolio of ICAR has been getting bigger and bigger over time. Load of ICAR has risen manifold with the responsibility to expand frontline extension and operate Kriishi Vigyan Kendras (KVKs) throughout the country. Many questions are raised about the effectiveness of ICAR in fulfilling the larger role it has been assuming over the years and expected to play in the field of agriculture R&D and education.

2.7 Viability of Smallholders

Agriculture in India and most of Asian countries is dominated by small land holdings. According to *Agricultural Census for year 2015-16*, 68% farm holdings operate on less than 1 hectare land area. Further, 85% of farm households undertake farming on less than 2 hectares. This size of land holding does not generate adequate income with the usual agricultural practices and products. Thus, two options are left to raise income of such farm holdings. One, enable these farmers to go for high value crops and livestock activities, where they can make optimum use of their family work force. And, two, supplement agriculture income with income from non-agriculture sources like wages and salaries, some kind of business and trade. Small holders also face the problem of scale economy in input as well as output markets that require different type of institutional help.

2.8 Nutrition, Food Safety and Health

India's nutrition indicators and child health indicators are low. According to the Food and Agriculture Organisation (FAO) of the United Nations, the largest number

of people who are hungry or undernourished live in India. According to the *Global Hunger Index*, an annual publication of two non-government organisations (NGOs), namely, the Concern Worldwide and Welthungerhilfe, India ranks low year after year on the hunger indices, even though the country has become the largest rice exporting country with about 15% of its rice production sold in overseas market. Since 1970-71, food production in the country has increased at trend rate close to 3%, while population growth in the same period was 1.86%. Further, growth rate in food production has remained in tact in the recent years, whereas population growth rate has decelerated. Clearly, per capita production of food has witnessed exponential growth. India is also having an excess stock of rice and wheat for many years in a row. Recently, a huge surplus of sugar has also accumulated. According to some observers, India represents a paradoxical situation of 'hunger in the midst of plenty'.

Indian diets are undergoing diversification in a significant manner. Per capita absorption of cereals has witnessed the smallest increase, despite an increase in their

Table 4: Food Supply Per Capita Kg/Year

Commodity	India			China		
	TE 1982	TE 2013	TE 2018	TE 1982	TE 2013	TE 2018
Cereals	144.7	148.7	182.0	160.0	150.4	192.7
Pulses	12.0	14.1	15.1	4.6	1.4	1.4
Edible oil	5.1	8.7	9.5	3.4	7.7	8.2
Sugar	19.3	22.9	22.8	5.7	7.1	8.0
Milk	40.6	84.7	101.6	3.2	32.6	22.8
Eggs	0.7	2.5	3.1	2.7	18.6	19.8
Meat & Fish	6.2	8.5	10.8	6.9	43.6	99.8
Onion	3.1	12.6	13.8	3.2	13.8	14.6
Potato	9.1	23.9	25.5	9.7	41.0	41.7
Tomato	2.1	12.8	13.5	5.0	29.7	34.8
All vegetables	57.4	108.6	87.7	65.6	382.2	360.2
Citrus	2.2	6.1	8.0	1.2	21.3	24.14
Fruits	23.1	47.2	59.2	6.6	69.0	97.6

- Notes:
1. Food supply represent the quantity used for food purpose, directly or indirectly.
 2. There are large difference between availability reported in official statistics of India and FAOSTAT due to variation in concept and methodology used by the two sources.
 3. FAO has further refined its methodology for estimating food availability after 2015. Therefore, Triennium Ending (TE) 2018 figures are not comparable with the previous figures, but these are comparable across countries.

Source: Food and Agriculture Organisation (FAO), *Food Balance Sheet*, FAOSTAT. Available at <https://www.fao.org/faostat/en/>

availability and heavy subsidy. This is consistent with dietary diversification seen in other countries where per capita income has also risen (Table 4). There is a manifold increase in per capita net availability of vegetables, and doubling of fruits and milk available for domestic food use. Per capita availability of domestic edible oils increased by 60% in the three decades since the early 1980s. Similar changes are seen in the food balance sheet of China. However, there is a big difference in the growth and the level of per capita supply of horticultural and livestock products between these two countries.

During the early 1980s, per capita supply of eggs and meat products in India was close to China. In the next three decades, supply of these items in China became five times that of India. Along with higher level of eggs and meat products, the Chinese use three times the vegetables and 80% more fruits than those by Indians. The data on food supply shows that though there is large shift towards horticultural and livestock products use in India, the increase is smaller compared to China, where nutrition and child and maternity health have improved considerably.

2.9 Mismatch between Structural Changes in Output and Workforce

As an economy develops, the share of agriculture in national gross value added (GVA), a measure of national income, and employment would experience a decline. Higher the growth of the economy, faster is the transformation in the structure of economy. In India, between 1950-51 and 1970-71, the share of agriculture in national income at 2011-12 prices declined from 61.7% to 49.6%, whereas the sector's share in employment remained stuck at more than 69% (Table 5). In the next two decades, the sector's share in employment declined to 59% and income to 35.1%. After 1990-91, the sector's share in employment declined to 59% and income to 35.1%. After 1990-91,

Table 5: Share of Agriculture including Allied Activities in Workforce and National Income Since 1950-51 (in %)

Year	Share in Workforce	Share in National Income	
		At Constant Prices	At Current Prices
1950-51	69.2	61.7	53.2
1970-71	69.7	49.6	43.1
1990-91	59.0	35.1	29.8
2010-11	54.6	18.3	18.4
2019-20	45.6	14.8	18.4

Source: 1. Share in Workforce - Population Census except for year 2019-20 which was taken from National Statistics Office (2021a).

2. Share in National Income – same as Figure 1.

growth rate of economy accelerated which also resulted in faster decline in the share of agriculture. However, the decline in the share of agriculture in work force did not keep pace with the decline in the sector's share in national income. In 2010-11, agriculture had a share of 18.3% and 54.6%, respectively, in national income and employment.

The latest data estimated by *Periodic Labour Force Survey for 2019-20* shows that agriculture sector as a whole (that is, including fishery and forestry) provide employment as the principal occupation to 45.6 % of the total work force in the country (National Statistical Office 2021a). In the same year, agriculture share in GVA at current prices was 18.4%. Thus, there is a need to pull workforce out of agriculture to enhance the per worker income in the sector. However, it is increasingly getting difficult to get adequate alternate jobs, especially in industry, for shifting the workforce out of agriculture. This calls for a new strategy for employment.

2.10 Low Income of Farmers

Disproportionate share of agriculture in national income and employment implies disparity in per worker income in agriculture and non-agriculture sector. At the macro level, income per worker in non-agriculture is 3.75 times the income of an average agriculture worker which includes agricultural labourers and cultivators. Lately, the Prime Minister has repeatedly called for focusing attention on raising farmers' income. However, the small and shrinking land size, excess workforce, low productivity and poorly working markets are the main causes for low per farmer income in the country. Besides focusing on raising income from farming, there is a pressing need for enhancing avenues for agricultural households to earn income from non-farm sources.

3. Policies for 21st Century

The present government has set a vision for a new India that involves '*Sabka Saath Sabka Vikas*'. Transformation of the agriculture sector is crucial for achieving this vision, as 45% of the workforce in the country is employed and dependent on agriculture for their livelihood (National Statistical Office 2021a). There is a large gap between income of agriculture workers and non-agriculture workers (Chand et al 2015; Chand 2019). Poverty and undernutrition in the country are concentrated among agricultural labour and small and marginal farmers. There is a lot of concern

relating to rural distress. If current trends in agriculture are not changed, there will be little improvement in reducing the income gap between agriculture and non-agriculture income, and alleviating rural distress.

It has been empirically demonstrated that agriculture growth is significantly beneficial for reducing poverty and increasing per capita incomes (Virmani 2008). Beside inclusive growth, agriculture matters for health and nutrition, sustainability, climate change and quality of life. All these factors underscore the need for a new vision for agriculture, as we move forward in the 21st century – a vision that addresses various challenges presented in Section I above. This section discusses and suggests policy changes and reforms needed for transformation of agriculture to help achieving the aspiration of India of the 21st century. The discussion is organised under following themes:

1. Growth and efficiency
2. R&D and innovations
3. Employment generation for decent jobs
4. Food security, nutrition and health
5. Surplus management
6. Input intensive to knowledge intensive agriculture
7. Climate change and sustainability
8. Responsible investments in agriculture
9. Farmers' income
10. Reforms in policies and regulations affecting agriculture

3.1 Growth and Efficiency

Since 1970-71, agricultural output and value added have moved on a growth trajectory of around 3.0% for most of the period. Recent years have seen an acceleration in the growth rate. It may appear strange that high growth rate in agriculture experienced during some phases did not bring down real prices of food in the country.

The reason has been that the prices drove output growth rather than output growth determining prices! Some studies on this aspect also show that during the period of high agriculture growth (above 4%), much of the growth was driven by an increase in agricultural prices (Chand 2014; Chand and Parapurathu 2012; Chand et al 2015). The strong association between agricultural prices and growth suggests that if agricultural prices do not rise faster than other prices, the growth rate of agriculture is likely to fall, which then becomes a major cause for agrarian distress, and thus, the economy as a whole. Formidable and foremost policy challenges to achieve efficient growth are:

- (i) how to sustain agriculture growth without letting food price inflation rise beyond acceptable limits?
- (ii) how to incentivise farmers to raise production without causing hardship to consumers?

The answer seems to be change in our goal and strategy from ‘growth to efficient growth’. This requires upgradation of agricultural technology, application of modern skills in farm practices, new innovation in farming, and lowering wastages in use of fertilizer, water and other inputs. This will also require change in input pricing policy to discourage prolific and indiscriminate use of inputs like water and fertiliser, and promote their optimum use. Digital technology can also play a significant role in improving efficiency through easy dissemination of technology and knowledge to farmers.

Supply of low quality and spurious inputs is an important factor for increased cost without adequate gain in productivity. Thus, beside emphasising use of modern inputs, there is a need to put in place an effective mechanism for monitoring and regulating quality of inputs like seeds, fertilisers and agro-chemicals.

Rising cost of production associated with modern technology is moving the attention towards alternative methods of farming. Methods that are rooted in traditional Indian methods of farming, like natural farming and organic farming, are proposed in place of chemical-based farming with the aim to reduce cost of production, beside addressing adverse effects of chemicals on health, environment and natural resources.

Lots of anecdotal evidence is quoted in support of benefits of alternative system of farming. However, the scientific community in public research institutes cast doubts

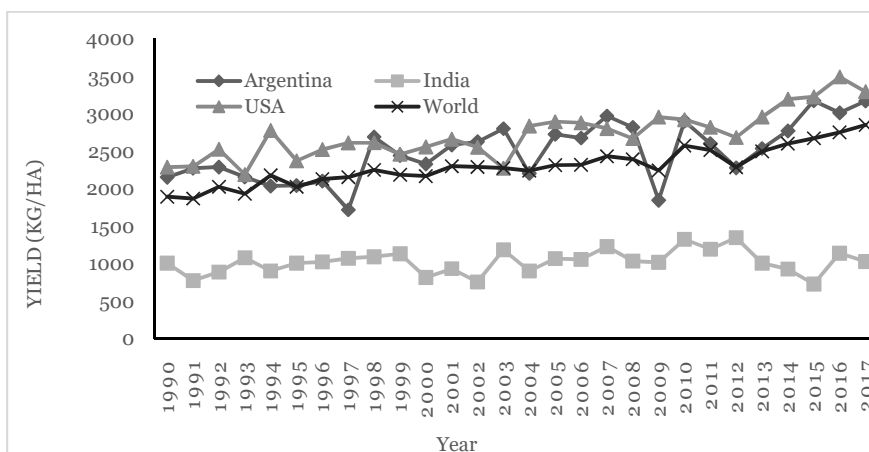
on the claim of benefits of traditional system of farming and raise the issue of significant yield discount in such methods, which could be detrimental to the food and nutrition security of the country in the coming years (NAAS 2019). They feel, a breakthrough in biotechnology and scientific practices like integrated pest management (IPM) and integrated plant nutrient (IPN) systems, modern method of fertiliser application and irrigation can address the various concerns related to farming, based on the use of agro-chemicals rather than taking the risk of shift towards natural farming. Notwithstanding this debate, public opinion is growing in favour of safe, healthy and environmentally sustainable food production. It is high time that public research system looks in-depth into various aspects of alternative methods of farming and develop best methods to meet public preferences and national goals of raising farmers' income by lowering costs, and supply of safe and healthy food.

3.2 R&D and Innovation

Efficiency is driven by strong and vibrant R&D by public or private sector. Public sector R&D in the country is suffering from resource constraint, disciplinary fragmentations, and lack of drive and inspiration. At the same time, fascinating innovation and changes in agriculture are being seen in developed world institutions and in private sector. Private sector investment in agri R&D in India is also low due to the nature of Intellectual Property Right (IPR) regime in the country. Consequently, the gap between domestic and global agricultural innovations is rising, and many fascinating changes experienced in global agriculture are missing in the country. In the absence of domestic R&D attaining global standard, agriculture is losing its competitive edge. There is a need to facilitate easy access to our farmers to global technology, high quality seeds and germplasm, and other knowledge products.

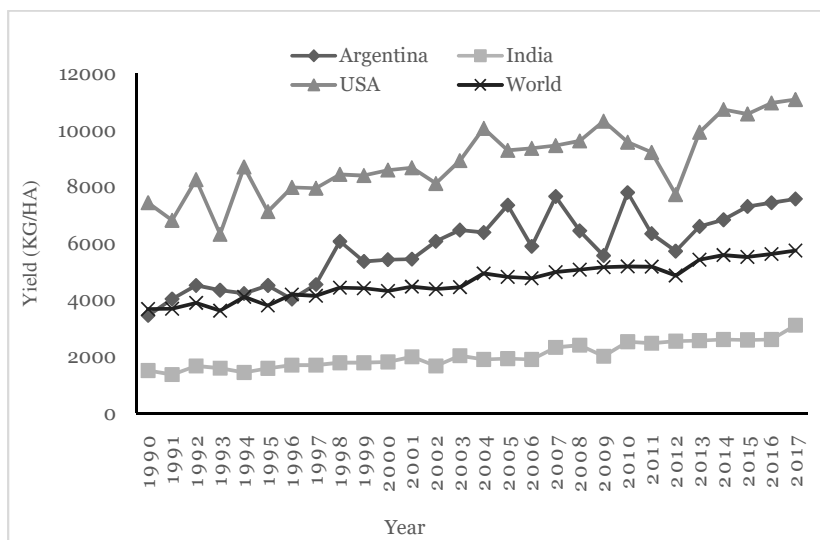
Application of biotechnology in agriculture through genetic breakthrough and genetic enhancement is playing an important role in shaping the future of agriculture. Agri biotechnology in India has occupied a backseat after the restrictions imposed on field testing and non-release of Bt brinjal. The countries which have embraced genetically modified and genetically edited technology are gaining advantage in terms of productivity and cost. A comparison of the trends in productivity of soybean and maize in India and in those countries which have adopted biotech crops presents a stark example of competitive advantage gained by the latter through agri biotechnology (Figures 3a & 3b). India will face very tough competition from biotech

Figure 3a: Soyabean Yield/Hectare in India, USA, Argentina and World



Source: Food and Agriculture Organisation, FAOSTAT. Available at <https://www.fao.org/faostat/en/>

Figure 3b: Maize Yield/Hectare in India, USA, Argentina and World



Source: Same as Figure 3a.

crops, which are leading to higher yield and lower average cost, if the country does not upgrade technology in such crops.

Basic and strategic research in any discipline lays the foundation for breakthroughs. This component has weakened considerably in NARS. The concentration of NARS

over a period of time has shifted to applied research and problem-solving research. This is giving incremental gains but not breakthroughs. Thus, to have breakthrough in agricultural R&D and technology and to have science driven growth, we need to create a new set of research institutions in agriculture on the pattern of Indian Institute of Technology, Indian Institute of Management and Indian Institute of Science.

The most important concern voiced by ICAR and SAUs is inadequate funding for research. On the other hand, state after state have been setting up new universities generally by fragmenting the existing structure to have separate universities for Animal Sciences, Horticulture, Fishery, etc. Similarly, ICAR is also setting up some new institutes to address new areas. Lack of adequate budgetary support and expansion of institutions are damaging the inter disciplinary nature of agricultural research, creating turf conflicts, hampering research and lowering the morale of scientists. We must put a stop to the growth of new institutes under NARS, particularly those which result in fragmentation of agriculture and allied disciplines. There is a need to improve quality of institutions rather than just raising their number.

3.3 *Employment Generation for Decent Jobs*

Traditional theories of economic transformation clearly established that the share of agriculture in national income and total employment declines with the economic development. This has been experienced by the most of the countries even in the recent times (Table 6). This transition has been slow in the case of India, particularly in respect of the share of agriculture in the total workforce. Between 1991 and 2019, the share of agriculture in workforce declined by less than a half in Brazil, China, and Malaysia. Labour share of agriculture in Vietnam declined by nearly 30 percentage points. As per the World Bank data, the decline has been much smaller in the case of

Table 6: Agriculture Sector's Share in National Income and Employment in Selected Developing Countries, 1991 and 2019

Country	Share in National Income (in %)		Share in Employment (in %)	
	1991	2019	1991	2019
Brazil	6.8	4.4	22.4	9.1
China	24.0	7.1	59.7	25.3
India	27.3	16.7	63.0	42.3
Malaysia	14.4	7.3	22.0	10.3
Vietnam	40.5	14.0	68.6	37.2

Source: World Bank, *World Development Indicators*. Accessed from www.worldbank.org

Table 7: Changes in Cultivators and Agricultural Labour in Rural India

(Million)

Year	Cultivators			Agricultural Labour			Agricultural Workforce		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
1993-94	85	53	138	54	37	91	139	90	229
2004-05	93	67	160	53	37	89	146	103	249
2011-12	91	49	140	48	27	75	139	76	215
2017-18	102	37	138	30	20	50	131	56	188
2018-19	100	41	140	29	19	49	129	60	188
2019-20	108	58	165	33	24	57	141	81	222

Source: Author's calculation based on data derived from:

1. NSSO Survey on Employment and Unemployment 1993-94, 2004-05 and 2011-12.
2. NSO Periodic Labour Force Survey, 2017-18.
3. Population Census of India and projected population.

India. This has created serious structural imbalances between sectoral composition of output and employment (Table 6). The primary reason for this is the failure of the industrial sector to attract and accommodate labour force from agriculture.

Recent developments in technology like automation, artificial intelligence (AI), big data, internet of things (IOT) and machine learning are further restricting the capacity of non-agriculture sector to absorb the workforce from agriculture. This has put renewed focus on agriculture to create gainful employment in postharvest value addition activities.

Empirical evidence from successive surveys on employment and labour use since 2004-05 reveals significant changes in rural and agricultural workforce (Table 7), which have important implications for agriculture and the economy. There is large scale withdrawal by female labour from agriculture (cultivators as well as labourers) in contrast to the popular perception of feminisation of agriculture. Moreover, the withdrawal from agriculture by cultivators has sharply decelerated after 2011-12, while shift of agricultural labour from the sector has accelerated. This necessitates support for mechanisation on smallholder farms. The concerns about the threat to agriculture due to youth not staying in agriculture is belied by NSO's *Periodic Labour-Force Surveys* (National Statistical Office 2021a).

An important reason for the slow shift of farm youths to non-agriculture sector is their strong preference for middle income jobs. But, in many cases, required

skill and capability for such jobs is missing. Medium, small and micro enterprises (MSME), which are labour intensive, seem to be an appropriate alternative for rural employment generation. Linking agri-food processing to production through efficient value chains, contract farming and direct linkage between factory and farm offer a considerable scope for rural employment generation as well as for raising farmers' income.

In the wake of capital intensive production preferred by the manufacturing sector and anticipated threats to jobs posed by emerging technological innovations, there is a need for a rethink on pursuing traditional development strategy of shifting workforce from agriculture to manufacturing and services. India should explore possibilities of creating blue collar jobs in and around agriculture. This also looks desirable, as there is a serious shortage of skilled workers in agriculture (Bajar and Mushtaq 2019).

The reasons for workers preferring to move from agriculture to non-agriculture are relatively low wages in agriculture, stress of manual work and irregular employment. These three problems can be addressed by innovative approaches in agriculture production and postharvest activities. These can be harnessed by developing and promoting new farm models centred on the knowledge- and skill-based agriculture and the post-harvest value addition at the farm itself (Chand et al 2017). Pradhan Mantri Kaushal Vikas Yojana (PMKVY) can play a major role in this by promoting and imparting skills required in modern agriculture, value addition and primary processing.

3.4 Food Security, Nutrition and Health

Per capita food production in India has risen steadily over the last decades, from little more than 1 kg per person per day in the early 1980s to 1.73 kg in recent years. However, some health and nutrition indicators are awfully poor. According to *Fifth National Family Health Survey 2021*, two-third of the children below the age of 5 years, and 57% of women are found to be anaemic. Similarly, the proportion of underweight and stunted children, and child mortality are higher in India compared to many other south Asian countries. What is more worrying is that some of these health indicators have shown a deterioration between 2015-16 and 2019-20 (Table 8). Concerned with the situation, the Government of India has launched several measures to improve health and nutrition especially of children and women. Increasing nutrition density through biofortification of food can play an important role in this.

Table 8: Child and Women Health Indicators at All-India Level: 2015-16 and 2019-20

Particular	2015-16	2019-20
All women aged 15-49 years who are anaemic (%)	53.1	57.0
Children aged < 5 anaemic %	58.6	67.1
Under-five mortality rate (U5MR)	49.7	41.9
Children under 5 years who are stunted %	38.4	35.5
Children under 5 years who are underweight %	21.0	19.3
Children under 5 years who are wasted %	35.8	32.1
FAO: Prevalence of undernourishment (percent)	14.7	15.3

Source: *National Family Health Survey* -5 and 4, Indian Institute of Population Sciences, Mumbai.

Low intake of the total food is the main reason for the widespread hunger and malnutrition. The country would need to relook at policy interventions in agriculture that are heavily biased towards rice, wheat and sugar, which are produced in excess of domestic and export demand.

Some studies show that even among economically well-off households, incidence of undernutrition and underweight children is quite common (Chand and Jumarani 2013). Addressing all these concerns requires a close coordination between the strategy for food production and health. Further, nutrition awareness is very important to improve nutrition and health, as rising preference towards spicy, oily and sugary foods is the major cause for poor nutrition rather than non-availability of nutritive food. Attributing poor nutrition entirely to low paying capacity is not correct.

Beside food intake, health and absorption of nutrients by body are also affected by use of clean water, sanitation and hygiene, and balanced and diversified diet. Creating awareness about nutrition is crucial for improving health outcomes.

Food safety is emerging as a major concern, as there are overwhelming reports of excessive and unsafe use of chemicals and hormones in crops, livestock and fish food, and presence of chemical residue in food. This requires strict regulation and its enforcement in both at the production stage and in postharvest stages. Awareness should be created amongst producers, middlemen in the value chain and processors about safe agro chemicals and methods of their usage in the entire food system and food chain.

New interest has emerged in therapeutic values of food and its proper usages for maintaining immunity against various ailments and diseases and for good health. As

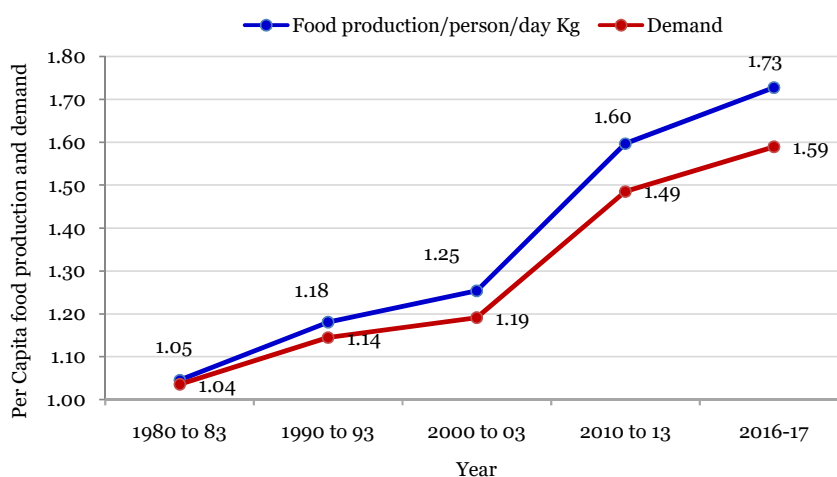
a result, demand for medicinal plants and varieties with specific attributes is on the rise. Some startups are linking consumers and producers for supply of such products. Supply of such products on a large scale will require value chain with traceability and labelling.

3.5 Surplus Management

As discussed above, domestic absorption of food has grown at a lower rate than domestic production. In the early 1980s, India produced and consumed a little more than 1 kg food per person per day. The production has gradually increased to 1.73 kg in recent years, whereas domestic absorption increased to 1.59 kg (Figure 4). This shows that food surplus (domestic production less domestic absorption) has been continuously increasing for the last 35 years. This requires a complete shift in food policy from shortage management to surplus management. This also indicates that much of the under nutrition in India is not due to non-availability of food, but it is due to low food intake. India has to look for overseas market to dispose the surplus food produce.

Agriculture production in the country is growing at a trend rate of above 3% per year. Domestic demand is projected to rise by about 2.3%. Therefore, the surplus

Figure 4: Per Capita Food Production and Domestic Absorption, 1980-83 to 2016-17



Source: Author's calculation based on data derived from Department of Economics and Statistics, *Agricultural Statistics At A Glance*, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi, Various Issues.

available for export will further grow in the coming years, and India will be required to sell a higher proportion of domestic production in overseas market. With the same trend in growth of food output, India will need to add 20% - 25% of incremental output to current level of food export. This requires export competitiveness and action in three following areas:

- prices in primary markets should be sufficiently lower than international prices.
- price spread in various stages of marketing should be reduced.
- producers should be integrated with global value chains.

At present, the MSP of some commodities recommended by the government are higher than the international prices. In such a situation, if MSP is implemented through the system of procurement, it will keep domestic prices higher than international prices, making exports impossible. Experience of many countries, also of late China, shows that paying higher than open market prices to farmers through procurement cannot be sustained. Fixing prices higher than open market price attract imports even for exportable and commodities that are surplus. More focus on supply than on demand is justified as long as demand is ahead of supply. Once demand falls short of supply, the guiding principle for price intervention should be open market price or demand side factor.

Rising surplus and export dependence for its disposal underline a strong need to let market forces to determine prices of produce. Keeping prices artificially above the level dictated by demand and supply and thrusting them on the market through government intervention causes serious price distortions, which have a number of implications. On the other hand, MSPs are considered important to ensure remunerative prices for the farmers. The best option to deal with such situations is to pay to farmers the difference between reasonable MSP and average market price at the state level, as is the practice in many countries, rather than distorting market prices through procurement (Chand 2019).

3.6 Input Intensive to Knowledge Intensive Agriculture

Indian agriculture is missing the state-of-the-art technology and modern method of farming. Advanced countries are moving towards precision farming using sensors and other scientific tools for exact practices and application of inputs. It saves costs, reduces

environmental effect and yields more and better-quality produce. We still continue to use flood method of irrigation, broadcasting fertilisers and indiscriminately spraying chemicals, whereas advanced countries are shifting towards the use of sensor-based application of inputs based on actual requirement of plants. Application of advanced science at the farm level requires skill, knowledge, investment and improvement in human capital in farming. Upgrading farming from low-tech to high-tech (green house cultivation, poly houses, tissue culture and precision farming) will reduce average cost, raise farmers' income and address some scale disabilities.

Recent years have seen a lot of interest among agri tech firms and several startups have come in agriculture. They are infusing new innovations in a range of areas like digital extension and solutions, arranging finance, agromet advisory, best practices, better crop management, disease and pest control, reading market pulses, price prediction, fetching better price for output, and so on. So far, their impact is restricted to some pockets; but it shows great promise, and is expanding.

3.7 Climate Change and Sustainability

Greenhouse gases (GHG) emitted from agricultural activities are generally not visible. The emission results from application of organic and inorganic inputs to the soil, decomposition of biomass and dead plant residues, plant respiration, livestock rearing, enteric fermentation in ruminants, manure handling and burning of crop residues. Agriculture is responsible for about 17% of GHG emission in India, which is almost same as its share in the country's GVA. This share will increase significantly if burning of crop residue, which is now spreading to all states, is taken into account. Similarly, bulk of water used in the country is used in agriculture, and more than 40% of the land area is put under agriculture. Thus, agriculture is quite significant for quality of air, water and land, and pressure on land and water, which are the pillars of sustainability.

In order to put a check on further overexploitation of water resources, the country should create a policy environment that leads to crop pattern and practices consistent with the natural resource endowment in various agro ecological zones of the country. Further, without improving efficiency in water use in agriculture, through modern method of irrigation (drip, sprinkler and sensors), the country cannot address the stress on water use and meet the future water requirement.

3.8 Responsible Investment in Agriculture

Investment and subsidies are two important instruments for promoting growth in agriculture. Subsidies are needed in the initial phases of many economic activities to push adoption of new inputs, practices and technology. All major agriculture countries subsidise agriculture to a varying extent. The broad guiding principle for subsidy in today's context are:

- (i) should promote growth and efficiency.
- (ii) should avoid distorting input – output markets,
- (iii) should not encourage uneconomic production,
- (iv) should not damage capacity of natural resource system and sustainability,
- (v) should not create serious inequity among social and economic classes and regions, and
- (vi) should not cause adverse effect on investments.

The biggest concern relating to subsidy is that they get entrenched and hurt fiscal discipline of the centre or the states.

The trend in subsidies and public investment in agriculture sector during the previous two decades is presented in Table 9. The subsidy presented in Table 9 does not include subsidy provided by the states and union territories (UTs) on power supply to agriculture, which is as high as all other subsidies for agriculture. It also does not include support to farmers under PM Kisan Nidhi amounting to Rs. 65,000 crore (revised estimate), and most of the output price support and export subsidies. When all these are reckoned, the support to agriculture sector turns out to be much higher than the subsidy figure presented in Table 9. Even when major support to agriculture is not included in the subsidy data reported by *National Accounts Statistics*, the reported level of subsidy is still 2.27 times the amount spent on infrastructure development in agriculture – that is so important for future growth of the sector. Public investment to GDP ratio in agriculture is as low as 2.2. Total investment in agriculture by all sources was 13.3% in year 2019-20.

Sector-wise shares in the total investment in agriculture show that 82% of it comes from households (that is, farmers themselves), 17.49% from public sector and

Table 9: Public Investments and Subsidies in Agriculture and Allied Sector
(At 2011-12 Prices)

Year	Amount in Rs. Crore		As % of GVA in Agriculture and Allied Sectors at Current Price	
	Subsidy	Public Investment	Subsidy	Public Investment
2000-01	67027	16200	7.0	1.7
2001-02	76838	19827	7.7	2.0
2002-03	83850	17656	9.0	1.9
2003-04	81121	21619	8.0	2.2
2004-05	85776	27497	8.6	2.8
2005-06	84638	33162	8.0	3.2
2006-07	90805	38917	8.3	3.5
2007-08	122115	39278	10.4	3.3
2008-09	202340	34519	16.9	2.8
2009-10	156417	38582	12.3	3.0
2010-11	158337	33398	11.2	2.4
2011-12	100505	35576	6.7	2.4
2012-13	99928	35905	6.4	2.4
2013-14	90252	33631	5.4	2.1
2014-15	89663	36919	5.1	2.2
2015-16	90237	42287	4.9	2.5
2016-17	79179	47379	3.9	2.6
2017-18	98228	45918	4.5	2.4
2018-19	96475	52780	4.3	2.6
2019-20	122246	48971	5.0	2.2

Note: GVA refers to gross value added.

Source: National Statistical Office, *National Accounts Statistics*, Ministry of Statistics and Programme Implementation, New Delhi, Various Issues.

the remaining (0.54%) from private corporate sector (Table 10). During 2019-20, the corporate investment in agriculture sector accounted for a meagre percentage (0.11%) of the total investment in the economy.

Regulatory restrictions on marketing and absence of business-friendly environment in agriculture act as a deterrent for corporate investment in agriculture production and marketing. This is said to be an important reason for the slow change in agriculture, dominance of traditional marketing channels and the weak linkage between pre and postharvest agriculture phases.

A major chunk of the public investment in agriculture is spent on medium and major irrigation projects. However, these investments did not translate into creation

Table 10: Share of Various Sources in Gross Fixed Capital Formation (GFCF) in Agriculture and Total Economy at Current Prices, 2019-20

Sector	GFCF (Rs. 000 crore)	As % of GVA	Percentage Share in Total GFCF of		
			Private Corporate	Public Sector	House holds
Agriculture	435	12.8	0.54	17.49	82.0
Non-Agriculture	5416	35.9	39.2	24.6	36.2
Total	5851	31.7	36.3	24.1	39.6

Note: GVA refers to gross value added.

Source: National Statistical Office (2021): *National Accounts Statistics 2021*, Ministry of Statistics and Programme Implementation, New Delhi.

of corresponding area under irrigation at the ground level (Figure 2). The Pradhan Mantri Krishi Sinchayi Yojana, launched in 2015, aims at fixing the problem of poor performance of medium and major irrigation projects and corrects the trend in area under canal irrigation. This involves a paradigm shift in public investment in irrigation to close the gap between IPC and IPU, and targets early completion of the ongoing irrigation projects facing last mile connectivity problems. This change in approach to public irrigation is expected to help in achieving the goal of '*har khet ko pani*'.

3.9 Farmers' Income

Till recently, an increase in agri-food production remained primary focus of agricultural policy and strategy. This strategy did not specifically target improvement in farmers' income and supply of food to consumers at competitive price, which are important for welfare of farmers and consumers, respectively.

Accelerated growth in some sectors of the Indian economy, following economic reforms in the early 1990s, lifted the overall growth rate of the economy from 4.2% during the period between 1971 and 1991 to close to 7% after 1991. This helped in doubling per capita income in the country at constant prices (2004-05) in just 17 years as compared to the 37 years it took to double per capita income before 1991. However, the agriculture sector, which comprised over 40% of the Indian economy and 59% of the workforce in 1991, did not experience any permanent change in its growth trajectory. The GVA of agriculture and allied sectors doubled in about 23 years before 1991, and it took same number of years to double again. Consequently, the income of cultivators (farmers) has remained relatively low, and the gap with income of non-farm workers has enlarged. A cultivator (farmer) earns less than one-third of

Table 11: Average Monthly Income (Rs.) from Different Sources Per Agricultural Household During July 2018-June 2019 for Each Size Class of Land Possessed (ha)

Size Class of Land Possessed (ha)	Farm Size Category	Total Income (Rs.)	Share of Various Sources in Total Income (%) @		
			Net Receipt from Crop and Livestock	Wages and Salaries	Net receipt from Non-farm business
<0.01	Below Sub-marginal	11204	33.42	57.43	6.89
0.01-0.40	Sub-marginal	7522	28.44	59.70	9.35
0.40-1.00	Marginal	8571	46.88	45.57	6.65
1.01-2.00	Small	11449	62.14	31.85	5.35
2.01-4.00	Semi-medium	16435	72.91	21.59	4.61
4.01-10.00	Medium	28292	81.63	15.10	1.67
10.00+	Large	60758	90.64	6.49	1.91
All Sizes		10218	52.65	39.76	6.27

Notes: * only out-of-pocket expenses were considered for working out net receipt.

@ Shares do not sum up to 100 as income from leasing out land is excluded.

Income from non-economic activities like pension, remittances, etc., are not included.

Source: National Statistical Office (2021b): *Situation Assessment of Agricultural Households and Land Holdings in Rural India, 2019*, Ministry of Statistics and Programme Implementation, New Delhi.

the income of a non-farm worker (Chand 2019). This is major cause of rural distress. Special focus is needed to raise income of farmers at a faster rate. This requires transformation of agriculture production as well as marketing through a multi-pronged strategy with due emphasis on enhancing productivity, reducing average cost, realising better price for farm produce, expanding allied activities and shifting farmers to non-farm occupations (Chand 2017). The three farm laws, enacted in year 2020, which have been repealed now because of opposition from some farmers groups, were aimed to achieve this goal.

Beside agriculture, income from non-farm sources constitutes an important part of income of farm households. According to the *Situation Assessment of Agricultural Household 2019*, on an average, an agricultural household earns 47.4% income from non-agricultural economic activities (Table 11). This share was 40% during 2012-13. This shows that non-agriculture income sources are becoming more important.

It may be contended that agriculture households include a large number of agricultural labour households, who satisfies the definition of agricultural household and their wage earnings raise the share of non-agriculture income in the total household

income. The *Situation Assessment Survey* also provides detailed estimates of source-wise income by categories of land possessed (Table 11). The first category of below sub-marginal households (that is, those households possessing less than 0.01 hectare of land) may include households who are primarily labour households. The second and third categories sum up to marginal land holding and fourth category represents small farm size. Marginal farmers classified in the second and third sub categories of land possessed earned only 28% - 47% income from agriculture (crop and live-stock farming) and the remaining from salaries, wages and non-farm business. Small farmers and semi-medium farm households earned 37.2% and 26.2% of their total respective household income from non-agriculture sources. Furthermore, it is also observed that not only is the share of non-agriculture sources in the total household income substantial, but 68% of the farm households earned more income from non-agriculture sources than from crops and livestock production (that is, agriculture). Therefore, in order to increase income of farm households at a faster rate, both agriculture as well as non-agriculture sources need to be tapped.

3.10 Reforms in Policies and Regulations Affecting Agriculture

The package of economic reforms launched in the early 1990s did not cover policies and regulations in the agriculture sector except some liberalisation of trade. The effect of these reforms is visible in the growth trend of agricultural output and non-agricultural output. The latter witnessed acceleration, whereas the former remained stuck at a 3% trend growth rate.

3.10.1 Reforms in Agricultural Policy and Market

Except a few states, agriculture marketing was brought under the state level APMC Acts, also known as Agriculture Produce Market Regulation Act during the 1960s and 1970s. These regulations helped in many ways. They checked rampant malpractices in transactions of farm produce, upgraded mandis, improved competitiveness, brought transparency in transactions through open auction of produce, and set up mechanism for redressal of any grievance of seller farmers.

Over time, it was felt that the system of agri marketing was not keeping pace with the growth, and did not align with the needs of the agriculture sector and open new opportunities for trade. Some weaknesses also crept in the prevailing APMC system necessitating change and improvement in regulations. Some of the states started us-

ing APMC mandis for revenue generation, which added to cost and price spread. Various types of requirements in the form of licensing, registration and so on restricted participation in mandis to local traders, and closed the door for traders and buyers from outside the APMC. This raised the possibility of collusions, exploitation and restrictive competition. Growth of APMC infrastructure fell far short of growth in marketable surplus of crop output (Chand 2012). The net result has been that more produce is transacted outside APMC mandis. Regulations also necessitated a large number of transactions between producers and consumers. This created a gap between the prices paid by consumers and the prices received by producers, and denied direct purchase from farmers and direct supply by farmers to producers that has acquired a lot of significance for high value crops and quality produce. The regulations worked against investment in agricultural marketing, infrastructure and logistics.

Thus, since long, there was a felt need to overcome the limitations and constraints of the present agricultural marketing system and to develop competitive, transparent and barrier free markets with the choices to the farmers to sell their produce in the markets and to the buyers offering a better price to them in a transparent manner. Around the year 2000, a debate started to bring reforms in agriculture, especially in agriculture marketing. Almost all experts and various high-level committees on agriculture constituted from time to time held the lack or poor progress of reforms in agriculture as a major constraint for high growth and the modernisation of agriculture. It was concluded that policy interventions at the national and state level did not address structural problem of the agricultural sector, which is the basic reason for various problems faced by the sector, farmers discontent and relatively low growth in farmers' income. Ten important reasons for reforms in agriculture were discussed by Chand (2020).

The Government of India formulated and circulated model APMC Acts and Model Contract Farming Acts for their adoption by the states. A large number of attempts were made by successive governments to persuade the states to adopt marketing reforms and reforms related to contract farming. Some of the states adopted model Acts partially, but by and large their adoption remained partial, diluted, patchy and half hearted. Series of attempts were made by the government during 2017 to 2019 to persuade the states to adopt the model Acts to bring reforms in agriculture. However, implementation of APMC and other reforms did not register any significant progress.

When states did not come on board to reform their APMC Acts, despite repeated pleas and persuasions by successive governments at the centre for 18 long years, the option left with the union government was either to ignore its responsibility to secure the future of agriculture and farmers, or use the constitutional route for pan India reforms in agricultural policy and market. Moreover, COVID-19 threw up formidable challenges to the economy, which could be addressed through bold and courageous policy decisions with a potential of converting challenges into opportunity. Based on all these developments, the union government took a historical decision to take on itself the responsibility of bringing reforms in agriculture in 2020, and three new farm acts were enacted after they were passed by the Parliament. These acts relate to (i) domestic agriculture trade, (ii) contract farming, and (iii) modification in Essential Commodities Act (1951). However, some misunderstanding and apprehensions developed about the new farm laws amongst farmers of some of the states, and they went on a long protest against the three new farm laws. Consequently, the three farm laws have been repealed. Nevertheless, it is very clear that the sector cannot move forward on a healthy trend without reforms.

3.10.2 MSP and Fair and Remunerative Prices

Some farmers groups seek more support from the government for higher and assured price of farm produce and the continuation of present regime of support policies having direct and indirect effect on agriculture. This implies a status quo for power, fertiliser and water sectors. The demand for legalising MSP has gained considerable traction during the recent farmers' agitation against the new farm laws. On the other hand, many experts contend that farmers' aspirations from agriculture will not be fulfilled without transformative changes in the sector. Nor can agriculture move to the next stage of development without an enabling environment. Both of these goals require a reimagining of agriculture. It is really a tough situation to address these issues without suitable changes in the regulatory environment.

There are three ways to enable farmers to get fair and remunerative prices: one, by creating an enabling environment for a fair, competitive and remunerative prices through market mechanism, two, by public intervention to keep prices remunerative through procurement or other means, and, three, by a combination of the above two. The NDA government which came to power in 2014 followed the third route. It first changed the norm for fixing MSP in 2018 to increase margin for producers to 50%

or more over the average cost of crop production. Simultaneously, the government at the centre circulated Model Acts ‘The Agricultural Produce and Livestock Marketing (Promotion and Facilitation) Act (2017)’ and ‘The Agricultural Produce & Livestock Contract Farming and Services (Promotion and Facilitation) Act, 2018’ for adoption by the states. The third initiative taken by the government included two components of public intervention: (i) expansion in procurement of pulses and oilseeds by central agencies, and (ii) the states were given three options to keep farm prices at or above MSP. These were covered under the scheme PMASHA which include procurement under (i) Price Support Scheme (PSS), (ii) Price Deficiency Payment (PDP), and (iii) Private Procurement and Stockists Scheme as a Pilot Scheme.

States were offered central assistance to procure up to 25% of the produce and to meet up to 25% price deficiency under PDP scheme. The rationale behind the PSS was that once 25% produce is purchased by public agencies, it will result in an increase in open market prices to the level of MSP. This was same as the intervention in rice and wheat until a few years back. At the same time, attempts were made by the centre to persuade states to adopt model marketing act and Contract Farming Acts, but these attempts were met with lukewarm response from the states. The centre then brought comprehensive reforms in agriculture through three farm laws to create a competitive market environment and other options like direct marketing and contract farming for better price realisation by the farmers. But the new laws now stand repealed. The concern now is how to ensure remunerative prices to farmers and to help them to get higher incomes.

Some farmers’ groups demand legalising of MSP as a solution to low market prices. Suggestions are also made to adopt mechanism like PDP, if procurement at MSP is not feasible. Both these suggestions have far-reaching implications for the economy, especially the fiscal health, private sector, crop pattern, diversification, entrepreneurial skills of farmers and exports. Legal MSP cannot work if not supported by demand and supply side factors. At best, it can work only when trade pays a lower price to farmers as compared to a competitive market price. But if MSP itself is above the price dictated by demand and supply, then even competitive markets will not support MSP. Thus, legal MSP can work if it is based on what would be open market price or market clearance price. If MSP is anchored to a fixated formula of cost plus, which happens to be above the price supported by demand, then the private players

will not have any incentive to buy the produce. Price data shows that after adoption of the new formula for MSP in 2018, MSP remained higher than open market prices and international prices of most of the crops. In such a situation, neither will the private sector buy the produce, nor can the produce be exported without subsidising it. Thus, if we want to protect the farmers against unremunerative or uncompetitive prices through legal MSP, we should be guided by the price recommended by institutions like CACP considering the demand side factors and possible open market price. Making MSP legal by itself will not ensure market prices moving to MSP.

When private sector does not buy at legal MSP, all that is offered for sale will not be purchased and market clearance will not happen leading to a chaotic situation. Thus, the government will be called to buy the produce. This amounts to taking over agriculture trade by government, and has its own serious implications. Nowhere in the world, not even in the socialist countries, this kind of mechanism is working. It should also be kept in mind that non-MSP crops and products like fruits, vegetables, milk, egg and fish are showing a much higher growth rate than MSP crops in the country. A demand driven production can be much more remunerative for farmers than production fixated to MSP.

Another suggestion to ensure legal MSP for farmers without distorting prices is to pay the difference between legal MSP and market price received by farmers. A mechanism similar to this is followed in United States of America (USA) and China to pay the farmers the difference between target or guaranteed price and actual market price. The question is when USA and China are doing it, why India cannot do it? To understand this, the system prevailing in USA and China need to be understood clearly. China has faced same situation which India is now facing in the case of surplus of rice and sugar, and changed policy support mechanism for agriculture from procurement and stocking to payment of price difference on a selective basis.

Agricultural economists and experts need to debate the following issues to bring clarity to future policy for transformation of agriculture, price assurance and better farm incomes:

1. What is the best way to support farmers in raising their income?
2. What are the learnings for India from the experience of other countries that provide price support to their farmers?

3. What are the implications of legalising MSP? What are other options to ensure remunerative prices to farmers?
4. What should be the norm for MSP if it has to serve as a price guarantee?
5. Should the responsibility for price assurance rest entirely with the centre? Should it be shared between the centre and the states? The China model can be useful in this case.
6. Should India move from price support and input subsidies to income support for farmers?

A scholarly and widespread debate is required on the above issues to steer clear the policy roadmap for reimagining agriculture and its role in the future development of the country.

4. Conclusion

A significant and sustained increase in farmers' income and the transformation of agriculture require a paradigm shift in the entire approach towards agriculture sector. Changes in archaic regulations and liberalisation of the sector are a must for creating an enabling environment for a modern and vibrant agriculture. Advancement in science led technology, an enhanced role of private sector in both pre and postharvest phases, liberalised output market, active land lease market and emphasis on efficiency will equip agriculture to address the challenges of 21st century and contribute towards the goal of a new India. A well-coordinated action and strategy between the centre and the states is needed to ensure that agriculture marches to the next stage of development along with the other sectors.

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