Ministry of Agriculture &
Farmers Welfare

Report of the Committee on Doubling Farmers' Income

Volume XIV

"Comprehensive Policy Recommendations"

"Summation of Recommended Reforms and Implementation Items Covering Topics discussed in all Volumes of the DFI Report"

Document prepared by the Committee on Doubling Farmers' Income,
Department of Agriculture, Cooperation and Farmers' Welfare,
Ministry of Agriculture & Farmers' Welfare.

September 2018

The outcomes of deliberations of the Inter-ministerial "Committee on Doubling Farmers' Income" were put up in tranches in subject-specific draft Reports, since 2017. As advised, the Committee ensured to firm up and release several recommendations, in parallel to its continuing work over its tenure, keeping in mind the tight schedule for doubling farmers' income. All these were accepted, adopted and action initiated by the Ministry of Agriculture & Farmers' Welfare and others. The Committee hereby submits the final Report in 14 volumes, including this comprehensive compilation of recommendations to the Government.

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ON
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Terms of Reference (ToR)

(i) To study the current incomes of farmers

(ii) To measure the historical growth rate of the current incomes

(iii) To estimate the needed growth rate to double the income of farmers by 2022-23

(iv) To examine & recommend various strategies to be adopted to accomplish (iii) above

(v) To recommend an institutional mechanism to review and monitor implementation to realise the goal

(vi) To examine any other related issue and make appropriate recommendations

Acknowledgements

It has been an intense journey of more than two years, since I was asked to chair the Inter-Ministerial Committee on Doubling Farmers' Income, constituted in April 2016 by the Government in the Ministry of Agriculture and Farmers Welfare on orders of Shri Radha Mohan Singh, Hon'ble Minister. The Committee has itself undergone pulsating new learnings, in its deliberations through these 48 months. For all concerned with the Committee, it has been a sail up the positive learning curve, beginning with amorphous estimations to a more studied comprehension of farmers and the country's commodious agricultural business eco-system.

I finally sit down, pensive, to thank everyone on behalf of the Committee as also myself, for their support in this walk through dense woods, to work on the strategy for doubling farmers' income (DFI) by the time India celebrates her 75th year of Independence. The needed perspicacity, on the oceanic canvas of agriculture and complex nature of its inter-relations, came from several people cutting across their background and from all corners of the country. There have also been trans-border inputs, thanks to the interest the phrase 'DFI' kindled across the globe. It is therefore hard to distinguish wholesomely, every single person, or each of the organisations & institutions who / that have made contributions of various orders to the writing of this Report. Logically, I am impelled right at the outset, to beg apology of those who have shared valuable inputs, but may not find specific mention here. This omission would only be extemporaneous and purely attributable to me.

The Report of the DFI Committee finds its origin and purpose, from the direction set by Shri Narendra Modi, Hon'ble Prime Minister, when he first shared his vision of doubling farmers' income, at his Bareilly conference in February 2016. In fact, it was the prime minister himself who gave first shape to his vision by way of articulating 'Seven Point Approach' which came to outline the contours of the DFI strategy. The Committee is therefore grateful to the Hon'ble Prime Minister for providing the principal leadership to the nation, both through this vision and the articulation of the DFI agenda.

The responsibility of translating the Prime Minister's vision into operational strategy was that of Shri Radha Mohan Singh, Hon'ble Minister, Agriculture & Farmers Welfare. In fact, the Committee is his brainchild, and he has continuously nurtured it by providing total support, guidance and hand holding. The Committee remains obliged to him for the opportunity given and the mentorship provided.

The Ministry of Agriculture & Farmers Welfare is a large family, and logically the Committee needed support from everyone at the helm of its affairs. Such support, did come readily and profusely, from all the Hon'ble Ministers of State, namely, Shri Parshottam Rupala, Shri Gajendra Singh Shekhawat and Smt. Krishna Raj. The Committee would like to acknowledge them for their fruitful advice and consistent moral support. The Committee also thanks the erstwhile Hon'ble Ministers of State, namely, Dr. Sanjeev Kumar Baliyan, Shri Mohanbhai Kalyanjibhai Kundariya, Shri Sudharshan Bhagat and Shri S. S. Ahluwalia.

If there is one single person, who the Committee in general and me in particular, would like to thank for providing both guidance and freedom to work on this Report, it would be Dr. S. K. Pattanayak, Secretary, Department of Agriculture, Cooperation & Farmers Welfare. Knowing him personally as a friend for over 30 years, it would be difficult to keep sentiments at bay when thanking him for his leadership and personal counsel to the Committee. The Committee would also like to thank Shri S. K. Choudhary and Dr. S. Ayyappan who served as Secretaries in the Department of Animal Husbandry, Dairy & Fisheries and the Department of Agricultural Research & Education before handing over the baton to their respective successors. The Committee thanks Shri J. P. Meena, Secretary, Ministry of Food Processing Industries, Shri Tarun Shridhar, Secretary, DAHDF and Dr. Trilochan Mohapatra, Secretary, DARE & Director General, ICAR. Each of them has been a steady and purposeful supporter.

The aforementioned provided the Committee the needed shade of an umbrella all through its precarious but exciting journey. However, the actual beasts of burden were a large number of domain experts, besides those with understanding and concern for farmers and farming. The Committee having initially deliberated with various stakeholders, through several of its meetings and consultations across the country, agreed on a layout which is manifest in the 14 volumes of this Report. To work on each of these volumes, and several of their chapters, the Committee constituted various Groups drawing knowledgeable people from a spectrum representing science, academia, institutions, universities, international organisations, private sector, NGOs, professional trade bodies, banks, farmers and farmer associations, civil society, etc. More than a 100 people, associated directly and indirectly with agriculture, exercised their minds, tested their intellects, burnished their social conscience and soiled their hands, to share detailed inputs & approaches. The Committee further worked on these, to proffer contextual correlation and thematic consistency & cogency in evolving the DFI strategy. All of these contributors are acknowledged with a deep sense of gratitude for their invaluable inputs based on data & information, analytics and interpretation. Many as the contributors are, one is left with no option but to enlist all concerned by way of an Annexure hereto.

As all these busy bees worked diligently on collecting the nectar from across diverse flora, they had to be given a suitable framework by the Committee to remain in harmony with the proposed paradigm shift, from production to income, and from resource extraction to sustainability. It was the wisdom of several highly experienced and well known experts and policy makers that helped the Committee build this strategic framework, which guided all the Group members on their mission. The Committee would like to respectfully thank Dr. M. S. Swaminathan (Chairman, MSSRF), Dr. Rajiv Kumar (Vice Chairman, NITI Aayog), Prof. Ramesh Chand (Member, Agriculture, NITI Aayog), Shri Amitabh Kant (CEO, NITI Aayog), Prof. T. Haque (Chairman, Land Policy Cell, NITI Aayog) and Dr. Kirit N. Shelat [IAS (Retd.), Executive Chairman, National Council for Climate Change, Sustainable Development & Public Leadership].

The Committee needed anchors, and therefore, co-opted three institutions / organisations as Knowledge Partners (KPs). The much required inputs for initial deliberations and subsequent

robust analytics for the Report came from these three partners-in-arms, namely, National Institute of Agricultural Economic and Policy Research (ICAR-NIAP), New Delhi; National Council for Applied Economic Research (NCAER), New Delhi; and National Centre for Cold-chain Development (DAC&FW-NCCD), New Delhi. It is with emphasis, that the Committee acknowledges their intellectual and analytical support.

Able and personal support, as one puddled through the wet fields, came from distant Dharwad. I could rely upon them for any urgent research. I would like to thank personally Dr. Shobha Nagnur (Professor & Head, Community Science, UAS) and Shri Maltesh Jeevannavar (Director, CDAC, Govt. of Karnataka), for their valuable time and efforts.

The Committee would also like to thank all the States & Union Territories, Group of Secretaries who deliberated on agricultural sector, ICAR, NABARD, State Agricultural Universities, Karnataka Agricultural Price Commission, Maharashtra Agricultural Price Commission, The World Bank, ICRISAT, IFAD, World Food Programme, Bill & Melinda Gates Foundation, World Economic Forum, CII, FICCI, PHDCCI, ASSOCHAM, Philips Capital, Ernst & Young, Grant Thornton and several others. In this context, the Committee particularly thanks Shri Harsh Bhanwala, Chairman, NABARD; Dr. T. N. Prakash Kammardi of KAPC, Shri Pasha Patel of MAPC and Shri Ajay Vir Jakhar of Punjab Farmers Commission; Dr. David Bergvinson, Dr. K. V. Raju and Dr. Suhas P. Wani, all from ICRISAT; Dr. Suresh Pal of ICAR-NIAP; Dr. Purvi Mehta of BMGF, Dr. Saswati Bora of WEF, Shri Amit of E&Y, Dr. Anjali Verma of Philips Capital, Smt. Garima Kapoor of Elara Capital; and several others. A series of critical articles on agriculture by Dr. Ashok Gulati (former Chairman, CACP) and Shri Siraj Hussain (former Secretary, DAC&FW), and others, also gave the Committee useful insights.

The Committee found needed sustenance in the support from the Joint Secretaries who handled the Policy & Farmers' Welfare Division of the Department, including Shri Devesh Chaturvedi, Shri Dinesh Kumar and Smt. Chhavi Jha. Active support was also provided by Smt. Sushila Ananth, Deputy Secretary in the Division. They did research and helped bring clarity to the maze of information. Other officers who stood by were Dr. Alka Bhargava, Smt. Neerja Adidam, Dr. Ashish Bhutani, Shri P.K. Swain, Dr. B. Rajender, Shri K.S. Srinivas and Shri Ashwani Kumar, all Joint Secretaries in DAC&FW; Shri Mihir K. Singh, Shri Sagar Mehra and Shri O.P. Chaudhary, all Joint Secretaries in DAHDF; Dr. J.P. Mishra, Adviser (Agriculture), NITI Aayog; Shri Suresh K. Vashishth, Joint Secretary, DoFPD; and Smt. Anuradha Prasad, Joint Secretary, MoFPI.

I wish to record the voluntary and spirited services of Dr. Suresh Honnappagol, (Animal Husbandry Commissioner, DAHDF); Dr. Suresh Malhotra (Agriculture Commissioner, DAC&FW); and Dr. S. Bhaskar & Dr. A. Arunachalam, both ADGs from ICAR.

On behalf of the Committee, I personally thank two families who have shouldered the total responsibility and worked diligently and doggedly by treating this task as their own. Aiming at perfection or nigh perfection, one was always chasing the inimitable butterfly. Of the first family, it is Shri Pawanexh Kohli (CEO, NCCD), multi-talented, knowledgeable and of

marathon-run capacity, deserving of special mention. Two other members of this family, whom I would like to acknowledge with gratitude and regards are Dr. P. K. Ghosh (National Coordinator, NAHEP-ICAR) and Dr. Raka Saxena, (Principal Scientist, ICAR). These three have unwaveringly provided their mind and time space, in helping to stitch together a comprehensive strategy, and they deserve special appreciations and thanks.

The other, was the support that came with total commitment & loyalty, from my own staff, namely, Shri Anoop Singh Rawat, Shri Amit Sardana and Shri Vikram Pangtey, besides Smt. Shilpa Mehta, Sr. Consultant, IT. These four have literally slogged beside these years, everyday including every Saturday and even some Sundays. It is they, with enduring perseverance, who typed & retyped, and formatted & uploaded countless pages of the DFI Report. I also thank my other office staff who also worked with smile and camaraderie. With pride, I place on record their yeomen services.

Lastly, I would like to thank the several people who organised conferences, workshops & seminars on various aspects of Agriculture across the country. These provided the Committee constructive and out-of-box inputs. Two such highly fruitful interactions need special mention. The first of these two, was the National Consultation held in Delhi over five days, with representatives from across all the sub-sectors of agriculture, and these included farmers, farmer bodies, NGOs, trade and professional bodies, etc. The second one, was a two days National Conference held at Delhi by inviting more than 300 experts and experienced people from cross-domain backgrounds and geographies to deliberate upon multiple dimensions of agriculture for doubling farmers' income. Apart from these, the opinion makers, media, farmers, national & international bodies, and others with interest in farmers' issues gave their shoulder to the Committee by analysing, critiquing and suggesting needed changes on the draft volumes, that the Committee hosted on the Ministry's website from time to time. The Committee sincerely thanks all of them for participating as conscientious members of society and pushing the Committee to improve the quality of its research, examination and recommendations.

I cannot end this unarguably long acknowledgment without recognising the members of the Committee who evinced keen interest and made sharp contributions. As always happens, some official members changed, with transfers and postings. However, all of them gave able support, notwithstanding their routinely busy official engagements. The members who are closer to the farmers in the field, and possess immense knowledge on the subject are Shri Vijaypal Singh Tomar, Member of Parliament (Rajya Sabha), Dr. Mohini Mohan Mishra and Shri Pampari Narsimha Janardhan. They kept the Committee rooted to the contemporary and emerging challenges of India's agriculture and its farmers. It has been a privilege having these three committed farmers' representatives in our Committee. I once again place on record my sincere gratefulness to all the members of this Committee.

That, the direction of the Committee was in convergence with the larger national agendas, stood validated by the acceptance of several of its recommendations, and their adoption as policies

and action plans, by the Government. Hon'ble Minister Agriculture was clear, that the Committee should be making recommendations parallel to the Report under progress, keeping in mind the tight implementation schedule of 2016-17 to 2022-23.

The Committee thanks everyone else who made efforts to contribute to this task. As we submit this Report, I and the Committee, trust that the work and recommendations would be relevant and will help bring about the desired income revolution for farmers and strengthen the resurgence in India's agricultural value-system.

New Delhi
17th September, 2018

Ashok Dalwai
Chairman
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Vol. XIII	**Structural Reforms and Governance Framework** **DFI Committee**
Vol. XIV	**Comprehensive Policy Recommendations** **DFI Committee**

Abbreviations:

APEDA	Agricultural Products Exports & Development Agency
DAC&FW	Department of Agriculture, Cooperation & Farmers' Welfare
DAHDF	Department of Animal Husbandry, Dairying & Fisheries
DARE	Department of Agricultural Research & Education
DIPP	Department of Industrial Policy & Promotion
DoCA	Department of Consumer Affairs
DoFPD	Department of Food & Public Distribution
DoLR	Department of Land Resources
DoPR	Department of Panchayati Raj
DoR	Department of Revenue
DoRD	Department of Rural Development
ICAR	Indian Council of Agricultural Research
MEA	Ministry of External Affairs
MCA	Ministry of Civil Aviation
MoCF	Ministry of Chemicals and Fertilizers
MoCI/DoCI	Ministry/Department of Commerce and Industry
MoEFCC	Ministry of Environment, Forest & Climate Change
MoES	Ministry of Earth Sciences
MoF	Ministry of Finance
MoFPI	Ministry of Food Processing Industries
MoP	Ministry of Power
MoPNG	Ministry of Petroleum & Natural Gas
MoR	Ministry of Railways
MoR	Ministry of Rural Development
MoRTH	Ministry of Road Transport and Highways
MoUD	Ministry of Urban Development
MoS	Ministry of Shipping
MoTex	Ministry of Textiles
MoWR	Ministry of Water Resources
MSDE	Ministry of Skill Development & Entrepreneurship
MSME	Ministry of Micro, Small and Medium Enterprises
NCCD	National Centre for Cold-chain Development
NCDC	National Cooperative Development Corporation
NRAA	National Rainfed Area Authority

About Volume XIV

The fourteenth volume of the Report of the Committee on Doubling Farmers' Income (DFI) is a compilation of the various subject matter recommendations, which are detailed in the previous Volumes. The recommendations are presented theme-wise where possible, with timelines indicated, to guide the implementing parties. The agencies responsible would further detail their action plans accordingly. The other departments and ministries, which are not traditionally or directly linked with agriculture, may hitherto have not been in the thick of action, but they should now see this as a national agenda and adopt the relevant aspects in their future action plans.

Agricultural sector is both elephantine in size and complex in nature, that cuts across domains and all socio-economic backdrops, and therefore, the approach to it cannot remain in a narrow prism of a traditional farmers' discipline, nor boundaried to the size of a farm. The DFI Committee therefore, opted to incorporate cross-disciplined approach, and provide as much evidence and background as possible, when developing its strategies. The attempt has been to always adopt *a priori* approach, so that one is free to challenge the interpretations and conclusions made, and suggest amendments where felt necessary. This, naturally required correspondingly commodious deliberations, the context linked re-defining of concepts, and a multitude of cross-domain recommendations. However capacious and overwhelming, the output of the DFI Committee may seem, there is much that may have been missed, in bringing a holistic and long lasting strategy to the agricultural domain, led by the agenda of doubling of farmers income. This call, by the Hon'ble Prime Minister, has effectively given direction that farming must be treated as an enterprise, and that future agricultural development will have the returns and not just the output from the farms as its prime objective.

Agriculture, especially in India, is a domain which not only touches a very large number of lives directly, but can also impact the strategic geo-political significance of the country, to shape its global character in the coming decades. Agrarian societies, are a source of agricultural raw material that can feed humans, animals and industries on a sustainable basis. Hence, these societies will find renewed global predominance, as the world faces growing populations & industrial demands, and this will happen in the backdrop of climate change. Communities will not merely think global to act local, but will think global and also act global, as inter-linkages across the continents get strengthened.

The secondary and tertiary sectors - industries and services need sustenance, by way of food and other raw materials, which will require building greater empathy, collaboration and coordination with the source of such goods - the farmers. India has already commenced on this path, by redefining agriculture, and approaching this important sector from the perspective of its primary actors, the farmers.

Various recommendations presented in this volume are in the perspective supra.

Ashok Dalwai

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Doubling Farmers' Income

Volume XIV

"Comprehensive Policy Recommendations"

Index

Chapter 1
Introduction

1.1 The Context

The Inter-Ministerial Committee on Doubling Farmers' Income (DFI) recognises agriculture as a value led enterprise and suggests empowering farmers with "improved market linkages" and enabling "self-sustainable models" as the basis for continued productivity-production and income growth for farmers. This builds the basic strategy direction for five primary concerns: optimal monetisation of farmers' produce, sustainability of production, improved resource use efficiency, re-strengthening of extension and knowledge based services and risk management.

The Committee identifies and focuses on seven major sources of growth (Volume II), operating within (6) and outside (1) the agriculture sector. The priority assigned to each will vary depending on the status of agricultural development in States and Union Territories. These sources are:

Within the agriculture domain

- Improvement in crop productivity.
- Improvement in livestock productivity.
- Resource use efficiency or saving in cost of production.
- Increase in cropping intensity.
- Diversification towards high value crops.
- Improvement in real prices received by farmers.

Outside the agriculture domain

- Shift from farm to non-farm occupations.

In Volume-I, the growth of agriculture over the past 7 decades are analysed, current status examined and an appropriate context set for a comprehensive understanding of the pathway followed, the results and needed directional change, if farmers' income is to be the basis of agriculture in place of production as of now.

In Volume-II of its Report, the DFI Committee tables the "growth targets" for doubling farmer's real income while improving the ratio between farm and non-farm income from *60*:*40* as of now, to *70*:*30* by 2022-23. It suggests the following strategy:

a) Adopting a "demand-driven approach" for efficient monetisation of farm produce and to synchronise the production activities in Agriculture & Allied Sectors.

b) Improving and optimising input delivery mechanism and overall input efficiency [technologies, irrigation methods, mechanisation, Integrated Pest Management (IPM),

Integrated Nutrient Management (INM), farm extension services, adaptation to climate change, integrated agri-logistics systems, Integrated Farming Systems Approach, etc.].

c) Offering institutional credit support at the individual farmer and cluster levels.

d) Strengthening linkages with MSMEs (micro, small and medium enterprises), so as to accelerate growth in both farm as well as non-farm incomes along with employment creation.

Farmers' income is directly related to cost of agricultural production (including input costs) and profitable monetisation of the agricultural produce, through effective market linkages. The DFI Committee Report, in Volumes III–XIII, deliberates upon specific economic activities and topics that have a durable impact on increasing farmers' income. Some of these are categorised as follows:

i. **Demand Driven Agricultural Logistics System** for post-production operations such as produce aggregation, transportation, warehousing, etc.

ii. **Agricultural Value System** (AVS) as an integration of the supply chain and to drive market led value system – District level, State level and National Level Value-System Platforms to promote individual value chains to collaborate and integrate into a sector-wide supply chain.

iii. **Farmer-centric National Agricultural Marketing System** by restructuring for a new market architecture, consisting of Primary Retail Agriculture Markets (PRAMs/GrAMs numbering 22,000) and Primary Wholesale Agricultural Markets (APMCs/APLMs-other markets numbering around 10,000), as also secondary & tertiary agricultural markets, all of which are networked by online platforms to facilitate a pan-India market access; as also integrating the domestic market with export market by considering the latter as a targeted market activity and not just an add-on.

iv. **Developing Hub and Spoke System** at back-end as well as front-end to facilitate and promote an Agri-Value System (AVS) (which includes a combination of input providers, farmers, transporters, warehousing, wholesalers, food and agro-processors, retailers, etc).

v. **Marketing Intelligence System** to provide demand led decision making support system - forecasting system for agricultural produce demand and supply, and crop area estimation to aid price stabilisation and risk management.

vi. **Promoting Sustainable Agriculture** – Climate Resilient Agriculture, Rainfed Agriculture, Conservation Agriculture, Ecology Farming, Watershed Management System, Integrated Farming System, Organic Farming, Agro-Climatic Regional Planning, Agricultural Resources Management and Micro-Level Planning, etc.

While the above alternate systems are to be adopted & scaled up, with due validation of the protocols & outcomes by NARS (National Agricultural Research System), the modern agro-chemical based cultivation practices shall be promoted based on the principle of evidence based, minimal/integrated and efficiency targeting resource use (eg., Soil Health Card recommendations as the basis for soil nutrient management). It is essential that sustainable agriculture is not limited to the practice of alternate production systems in certain geographies alone, but goes beyond into larger cultivation practices by incorporating evidence based and good agricultural practices.

vii. **Effective Input Management** achieving Resource-Use-Efficiency (RUE) and Total Factor Productivity (TFP) – Water, soil, fertilisers, seeds, labour-farm mechanisation, credit and precision farming, so as to reduce farm losses, while ensuring sustainable and eco-friendly practices.

viii. **Enhancing Production through Productivity**– to achieve & sustain higher production out of less and release land and water resources to diversify into higher value farming for enhanced income.

ix. **Farm Linked Activities** including secondary and tertiary sector activities of KVIC (Khadi and Village Industries Commission) and MSME (Micro, Small and Medium Enterprises) scales, for promoting near-farm and off-farm income generating opportunities as well as to facilitate more of the produce capturing more of the market value.

x. **Agricultural Risk Assessment and Management** including drought management, demand & price forecast, weather forecast, management of biotic stress including vertebrate pests, access to credit among farmers for farming operations; providing long term credit, post-production finance to preventing distress sale by farmers, and crop & animal risk management through insurance.

xi. **Empowering Farmers** through Agricultural Extension, Knowledge Diffusion and Skill Development.

xii. **Research & Development and ICT** designed to support the Doubling of Farmers' Income strategy in the short run, and help accelerate the pace of income enhancement on a sustainable basis in the long run.

xiii. **Structural and Governance Reforms in Agriculture,** including building a database of farmers, facilitating farmer & produce mobilisation, institutional mechanism at district, state & national levels for coordination & convergence, digital monitoring dashboard at district, state & national level for seamless & real-time monitoring of field delivery, utilising Panchayat Raj Institutions, and farm income measurement as key delivery channels for transparent and inclusive development.

It also calls for paying special attention to non-timber forest produce (NTFP) to support tribal farming communities to capture higher value and non-farm incomes therefrom.

1.2 Sustaining Income Growth – Five Pillars

The recommendations that emanate from the preceding 13 different volumes, delineated under different themes, strive to align with one or more of the five pillars, that the DFI Committee identifies, as essential to doubling farmers' income, and sustaining a steady income growth in the long run. These include:

i. Increasing productivity as a route to higher production.
ii. Reduced cost of production / cultivation.
iii. Optimal monetisation of the produce.
iv. Sustainable production technology.
v. Risk negotiation all along the agricultural value chain.

1.3 Layout of the Recommendations

The individual volumes of the Report of the Committee on Doubling of Farmers' Income, communicate about a specific subject, to first prepare the context and deliberate on the logic, before leading to the concluding recommendations for the selected subject.

The recommendations put forth in the first thirteen volumes, are both specific and generic, and will be germane to policy makers, implementing agencies, farmers and farmers bodies, farmer-centric opinion makers, NGOs, public and private sector entrepreneurs and investors, subject matter experts and students, as also international bodies interested in Indian agriculture. They would be able to engage themselves in review, interpretation, extraction and drawl of recommendations which may be much more meaningful and comprehensive than what has been done by the Committee.

It is not possible to capture all the recommendations and lay them in relevant flow and framework, without adding to the bulk and being repetitive. There is also a fear of being out of context and therefore out of step with the logic adopted in each of the volumes, while making an effort to articulate them concisely in this final volume. Hence, in compiling the comprehensive recommendations vide this volume, certain thematic lines have been adopted. In this bargain, only a few of the recommendations have been delineated and the readers would benefit more from referring to the respective chapters and volumes as per their requirement.

The recommendations have been assigned a period, short term and/or long term. These terms indicate the opinion of the Committee on the time period required for initiation of action and when its outcome would be realised. Short term indicates a period of maximum of 3 years and long term refers to a period beyond that. While short term activities should be initiated at the earliest, the long term initiatives may take some more time, but should preferably be rolled out as early as feasible so that rise in farmers' income can be sustained even beyond 2022-23.

As regards the responsibilities for the initiatives, the name of the department(s)and/or ministry(ies)has/have been indicated at a generic level, to allow them to decide on the specific division/organisation to own it up. The Committee is also conscious that there could be several

other department(s) and/or ministry(ies) or even organisations in Public/Private/NGO sectors who may also find it useful to act upon the recommendations in their own way. This will bring in greater synergy and spread at the field level.

1.4 The Watchword – Efficiency for Sustainability

The underlying theme of the DFI Report is to promote agriculture as an enterprise and farmer as an entrepreneur necessitating adoption of business principles for positive net returns.

Further, agriculture sector as a profession will become wholesome, when transition happens from, food security to nutrition security for the consumers, extractive production system to sustainable production system for the ecology, and from a mere Green Revolution to a Farmers' Income Revolution or Income Revolution for the farmers – Good for the Farmer, Good for the Consumer and Good for the Planet.

The final word, or rather the first advice well worth adoption is, that efficiency alone can enable growth of agriculture and rise of farm incomes on a sustainable basis.

Chapter 2
Income Growth Rates and Investment Targets

The march of India's agriculture since 1947 to date has been impressive. It has been cataclysmic since 1965, with the adoption of green revolution technologies. Indian farmers now produce more than 1.1 billion tonnes of agricultural commodities every year, which is accounted for by, more than 80 species across the sub-sectors.

The strategy for doubling farmers' income, entails monetising of all commodities appropriately. Simultaneously, the potential of each commodity to contribute in terms of value varies. Currently, cereals dominate the agricultural landscape, occupying more than 50 per cent of the area but adding only 22 per cent to the value of output. This has been the outcome of a food deficit economy till the late 1960s, compelling the policy to focus on food security.

Given the current comfort factor vis-à-vis food requirement of the population, and the glaring challenge of income deficiencies of the farmers, the agricultural development strategy calls for appropriate retailoring. In order to put this paradigm shift on a foundational basis, the mandate of agriculture deserves to be redefined. The DFI Committee proposes that the mandate of the redefined Agriculture is:

> *"to generate both food and raw material, to meet the requirement of modern society for feed, fibre, fuel and other industrial uses, and in a manner that is sustainable and aims to bring economic growth to farmers."*

The following recommendations flow against this backdrop -

1

Impart a more robust and comprehensive mandate to the agriculture as suggested below-

a. Agriculture has the moral responsibility of meeting food and nutritional security of the country in consonance with the agro-ecological backdrop.
b. It has to generate gainful employment resulting in income gains to make the farmers more economically secure.
c. It has to generate raw material that will directly support agro-processing of food and non-food products to support secondary agriculture.
d. It has to support agro-processing industry to produce primary and intermediate goods, which will feed the manufacturing sector.
e. Agricultural practices need to be on a sustainable basis.

	Responsibility: DAC&FW supported by DAHDF, DARE, NITI Aayog
	Timeline: Short term
	Refer Volume: I

2

Maintaining food and nutritional security of the growing population of the country, as an unalterable requirement, re-configure the crop geometry and production matrix of the agricultural system (inclusive of all sub-systems), in order to enable the farmers to gain greater value.

In this context, achieve higher productivity in case of staple crops and release the extra land for high value activities. A sharp policy with concomitant support system be provided to engines of high growth – horticulture, dairying, livestock, poultry and fisheries.

Responsibility: DAC&FW, DAHDF, DARE
Timeline: Short term
Refer Volume: I, VIII

3

Analyse and recognise, the changing pattern of consumption expenditure. Between the food and non-food expenditures, a visible shift to the latter, is discernible and it is as high as 15 per cent. However, with increases in absolute levels of income the consumption expenditure on food remains substantive, and therefore demand for food will continue but with emphasis on nutrition, safety and quality. Within the food sector there is a growing demand for proteins, fruits, vegetables, meats, fish, milk, etc. with a substantive transition from the cereal base.

Responsibility: DAC&FW, DAHDF, DARE
Timeline: Short term
Refer Volume: I

4

From the farmers' income perspective, agriculture in consonance with its redefined mandate will have to produce greater ratio of non-food article, namely feed, fibre, fuel and others to feed into industrial uses. Apportion a proportionate area for these non-food crop systems.

Responsibility: DAC&FW, DAHDF, ICAR, NITI Aayog MSME, MoTex, MoPNG
Timeline: Short term
Refer Volume: I

5

For the triennium ending (TE) 2014-15, the composition of the agricultural output was 6.31 per cent in crops including horticulture, and 27, 4.5 and 7.4 per cent in livestock, fisheries and forestry respectively. In the last decade, the growth rates have been higher in case of livestock and fisheries sectors, relative to the crop sector. Within the crop sector, horticulture growth has however been more robust. Hence, the strategy for DFI should capitalise the potential of high growth sectors by providing a facilitating environment.

Responsibility: DAC&FW, DAHDF, ICAR, MoEFCC
Timeline: Short term
Refer Volume: I

6

The changes in agriculture are currently measured in terms of annual GDP/GVA. This measure does not capture the changes in the life in the farmer, who is central to agriculture. Now that the vision and goal are one of enhancing the farmers' income it would be necessary to adopt a suitable income measurement mechanism.

Hence, the government should adopt a framework for annual estimation of farmers' income (farm and non-farm income).

Responsibility: DAC&FW, NITI Aayog, MoSPI
Timeline: Short term
Refer Volume: I, II

7

NSSO had conducted a Situation Assessment Survey (SAS) of farmers in 2002-03 and conducted SAS of Agricultural Households in 2012-13. it. The host of data and information is highly useful to understand the status of Indian agriculture. It is recommended to ensure that standardised definitions and framework are adopted to enable temporal comparisons.

The frequency of this survey needs to be reduced to five years from current 10 years

Responsibility: DAC&FW, NITI Aayog, MoSPI
Timeline: Long term
Refer Volume: I, II

8

There are 29 districts in the country which are highly vulnerable and disadvantaged in terms of double stress created from low income and high climate variability.

Special programmes need to be designed to support these double stressed districts. A Mission mode approach is required for implementing a set of comprehensive and time-bound interventions to effect a visible change.

Responsibility: DAC&FW, DAHDF, DARE
Timeline: Short & Long terms
Refer Volume: I

9

The time frame for achieving the target of doubling farmers' income shall be from 2016-17 to 2022-23, with the year 2015-16 as the base year.

Responsibility: DAC&FW, DAHDF, DARE
Timeline: Short term
Refer Volume: II

10

The doubling of farmers' income as per timeframe, shall be in real terms and not merely in nominal terms. Hence, all growth projections be guided by this factor.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: II

11

The average annual income of the farmer at the national level in the base year 2015-16 be taken as Rs. 96,703, which is an extrapolation of the 2012-13 NSSO estimates. The targeted farmers' income at national level, in 2022-23, shall be Rs. 192,694 (at 2015-16 constant prices) or Rs. 271,378 at current prices. (Note that these figures for both farm and non-farm incomes, together constituting the farmers' income are under see volume II for details on business as usual vs. accelerated growth) situation of accelerated growth.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: II

12

The states are advised to adopt their respective base year and target year average incomes as shown in table below. It may be noted that while the indicated farm income in target year is

under accelerated conditions, those for non-farm income is for business as usual. The states may choose to accelerate non-farm income growth rates, as per local conditions.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: II

Farmers' Income in Base and Target Year (Rs.)

States/UTs	Base Year: 2015-16 (at 2015-16 Prices)			Target Year: 2022-23 (at 2015-16 Prices)			Target Year: 2022-23 (at Current Prices)		
	Farm	Non-Farm	Total	Farm	Non-Farm	Total	Farm	Non-Farm	Total
Andhra Pradesh	54,135	49,957	104,092	105,768	70,295	176,063	148,827	98,912	246,707
Arunachal Pradesh	124,461	51,691	176,152	235,803	72,735	308,538	331,798	102,345	435,240
Assam	64,300	21,662	85,962	131,406	30,481	161,887	184,901	42,890	22,7791
Bihar	26,116	19,201	45,317	49,256	27,018	76,274	69,307	38,017	104,307
Chhattisgarh	46,172	24,892	71,064	102,941	37,381	140,321	144,848	52,598	194,654
Goa	41,581	76,829	118,410	93,654	108,106	201,760	131,781	152,116	263,595
Gujarat	72,969	45,074	118,043	148,142	66,101	214,243	208,451	93,011	296,994
Haryana	136,622	50,603	187,225	272,381	71,204	343,585	383,268	100,191	471,797
Himachal Pradesh	51,933	62,943	114,876	104,340	88,567	192,907	146,817	124,623	258,787
Jammu & Kashmir	53,391	118,825	172,216	115,272	167,198	282,470	162,199	235,265	363,661
Jharkhand	49,060	35,760	84,820	102,283	56,926	159,210	143,923	80,101	219,802
Karnataka	97,547	56,852	154,399	204,891	79,997	284,888	288,303	112,564	386,045
Kerala	54,452	101,336	155,788	105,092	142,590	247,682	147,874	200,639	327,708
Madhya Pradesh	89,434	27,354	116,788	201,813	48,309	250,122	283,972	67,975	342,626
Maharashtra	60,885	39,148	100,033	119,069	55,085	174,153	167,541	77,510	242,736
Manipur	61,973	60,916	122,889	114,052	85,715	199,767	160,483	120,609	271,193
Meghalaya	109,707	70,677	180,384	218,237	99,450	317,687	307,081	139,936	434,666
Mizoram	76,612	51,882	128,494	168,688	73,002	241,690	237,360	102,722	337,359
Nagaland	58,666	78,473	137,139	110,467	110,419	220,886	155,438	155,371	303,799
Odisha	34,463	28,822	63,285	78,192	40,556	118,747	110,023	57,066	157,018
Punjab	160,683	70,222	230,905	343,236	98,809	442,045	482,968	139,035	555,958
Rajasthan	52,270	40,644	92,914	103,885	57,190	161,075	146,176	80,472	225,014
Sikkim	49,129	71,504	120,633	91,766	120,172	211,938	129,124	169,094	293,824
Tamil Nadu	57,511	76,057	133,568	125,486	107,019	232,505	176,571	150,587	318,223
Telangana	63,492	22,799	86,291	117,931	32,081	150,012	165,941	45,141	214,332
Tripura	54,642	24,320	78,962	122,575	40,501	163,076	172,475	56,989	223,875
Uttar Pradesh	56,785	22,188	78,973	104,906	31,221	136,127	147,613	43,932	189,452
Uttarakhand	18,862	42,971	61,833	34,946	60,465	95,411	49,173	85,080	125,978
West Bengal	24,441	54,267	78,708	45,164	76,359	121,523	63,550	107,444	160,269
And. & Nic. Ils	57,417	94,895	152,312	135,448	133,526	268,975	190,590	187,885	354,670
Chandigarh	31,571	306,791	338,362	59,822	431,686	491,508	84,175	607,426	623,686
Dadra & Nagar H.	8,806	100,196	109,002	18,757	140,986	159,743	26,393	198,381	202,084
Daman & Diu	24,665	84,402	109,067	52,639	118,762	171,400	74,068	167,110	219,375
Delhi	13,204	262,822	276,026	32,685	369,817	402,503	45,992	520,370	506,306
Lakshadweep	66,496	173,899	240,395	125,418	244,693	370,111	176,475	344,307	485,360
Puducherry	62,431	41,221	103,652	144,613	68,128	212,741	203,485	95,863	290,144
All India	**58,246**	**38,457**	**96,703**	**116,165**	**56,529**	**172,694**	**163,456**	**79,543**	**242,998**

13

The prescribed timeframe for doubling the farmers' income, being seven (7) years, it requires that accelerated growth rates are targeted since, business as usual would not make it possible. Hence, target a farm income growth rate of 10.4 per cent per for the nation. The states may adopt likewise accelerated growth rate of farm income as shown below.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: II

Targeted Real Annual Growth Rate in Income (%)

States/UTs	Farm Income Growth	Non-Farm Income Growth	Total Income Growth
Andhra Pradesh	10.04	5.00	7.80
Arunachal Pradesh	9.56	5.00	8.34
Assam	10.75	5.00	9.47
Bihar	9.49	5.00	7.72
Chhattisgarh	12.14	5.98	10.21
Goa	12.30	5.00	7.91
Gujarat	10.65	5.62	8.89
Haryana	10.36	5.00	9.06
Himachal Pradesh	10.48	5.00	7.69
Jammu & Kashmir	11.62	5.00	7.32
Jharkhand	11.07	6.87	9.41
Karnataka	11.18	5.00	9.15
Kerala	9.85	5.00	6.85
Madhya Pradesh	12.33	8.46	11.49
Maharashtra	10.06	5.00	8.24
Manipur	9.10	5.00	7.19
Meghalaya	10.32	5.00	8.42
Mizoram	11.94	5.00	9.45
Nagaland	9.46	5.00	7.05
Odisha	12.42	5.00	9.41
Punjab	11.45	5.00	9.72
Rajasthan	10.31	5.00	8.18
Sikkim	9.34	7.70	8.38
Tamil Nadu	11.79	5.00	8.24
Telangana	9.25	5.00	8.22
Tripura	12.23	7.56	10.92
Uttar Pradesh	9.16	5.00	8.09
Uttarakhand	9.21	5.00	6.39
West Bengal	9.17	5.00	6.40
Andaman & Nicobar Islands	13.04	5.00	8.46
Chandigarh	9.56	5.00	5.48
Dadra & Nagar Haveli	11.41	5.00	5.61
Daman & Diu	11.44	5.00	6.67
Delhi	13.82	5.00	5.54
Lakshadweep	9.49	5.00	6.36
Puducherry	12.75	7.44	10.82
All India	**10.36**	**5.66**	**8.64**

14

A farmer's average income as per SAS 2012-13 comprises both farm and non-farm incomes. The strategy for doubling farmers' income, though calls for interventions in respect of both

these components, the agricultural machinery of the government (centre and states) is advised to focus on farm income strategy as it is their direct domain. In respect of non-farm income, which is catered to by several other ministries and departments, the contributions would depend on the pace at which the general economy of the state and nation will grow (may note that growth rates of non-farm sector have been shown under business as usual approach).

Responsibility: DAC&FW, DAHDF, ICAR, NITI Aayog MSME, MoTex, MoPNG
Timeline: Short term
Refer Volume: II

15

While the DFI strategy focuses on doubling the farmers' income, all concerned at central and state levels must take care to disaggregate the interventions to achieve higher share of farm income in the farmers' cumulative income. Hence, target to change the ratio of farm to non-farm income from the existing 60:40 (in 2015-16) to 70:30 (by 2022-23). This will impart greater viability to farming.

Since income approach basically aims at addressing the farm level socio-economic challenges (as described by high incidence of poverty and under employment in farm sector), the interventions must take care to achieve equitability at regional level and across land-holding classes.

Responsibility: DAC&FW supported by DAHDF, DARE
Timeline: Short term
Refer Volume: II

16

The DFI Committee has identified the following seven major sources of growth that will contribute to doubling the farmers' income.

i. Improvement in crop productivity
ii. Improvement in livestock productivity
iii. Resource use efficiency or saving in cost of production
iv. Increase in cropping intensity
v. Diversification towards high value crops
vi. Improvement in real prices received by farmers
vii. Shift from farm to non-farm occupations.

The states may like to be guided by, and target to achieve, the source-wise growth rates indicated for each of them vide Tables in Chapter 6 of Volume II of this Report.

Note: The growth source at vii above is predicated upon the robustness of growth of the industry and service sectors, and hence outside the purview of farm income strategy

Responsibility: DAC&FW, DAHDF, DARE
Timeline: Short term
Refer Volume: II

17

Recognise that there exists a direct correlation between capital investments in agriculture and its growth rate. Further, capital investments related to agricultural growth are of two categories

- Capital investments 'in' agriculture – land development, irrigation, markets, etc.
- Capital investments 'for' agriculture – road, power, transport, etc.

Hence there should be a focused and targeted approach to ensure Gross Capital Formation (GCF) in both the investment categories as above.

Responsibility: DAC&FW, DAHDF, DoRD, MoWR
Timeline: Short & Long terms
Refer Volume: II

18

In order to achieve the required 10.4 per cent income growth rate in farm sector over the period of 2016-17 to 2022-23, the annual growth rate in investment required; 'in' agriculture is 12.5 per cent; and 'for' agriculture it is 16.8 per cent. The respective growth rates in 2015-16 are 9.15 (2002 to 2012) and 12.45 (2000 to 2013) per cent.

Efforts must be made to ensure consistent annual growth rates as indicated. Further, it may be noted that in case of 'in' agriculture, the investments will largely come from private investments and that in case of 'for' agriculture will come from public investment. Accordingly, a differentiated focus must be brought to bear upon each category.

The targets and the translation in absolute figures may be seen in table below.

Responsibility: DAC&FW, DAHDF, DARE
Timeline: Long term
Refer Volume: II

Future Public and Private Investments
(Rs. billion) and required annual rate of growth (%)

	Private Investment in Agriculture			**Public Investment 'for' Agriculture**		
	2015-16 (Base year - current investment)	**2016-17 to 2022-23** (additional over 7 years)	**Total Investment** (base year plus additional)	**2015-16** (Base year - current investment)	**2016-17 to 2022-23** (additional over 7 years)	**Total Investment** (base year plus additional)
At 2015-16 prices	**Rs. 610** (61,000 crore)	**Rs. 780** (78,424 crore)	**Rs. 1394** (1,39,424 crore)	**Rs. 1171** (1,17,100 crore)	**Rs. 2300** (2,29,904 crore)	**Rs. 3471** (3,47,004 crore)
At 2004-05 prices	**Rs. 296** (29,559 crore)	**Rs. 463** (46,298 crore)	**Rs. 759** (75,857 crore)	**Rs. 640** (64,022 crore)	**Rs. 1023** (1,02,269 crore)	**Rs. 1663** (1,66,300 crore)
Annual growth rate	9.15% (2002 to 2012)	12.5%	--	12.45% (2000 to 2013)	16.8%	--

Note: Private investment by farmers, estimated at all India level; Public investment estimated for 20 select states; Public investment 'for' agriculture is sum total of agriculture, irrigation, rural road-transport and energy heads.

19

The 'in' agriculture private investments be accelerated by targeting individual farm households and the private corporate sector. In case of individual farmers, higher investments will come from providing them higher access to institutional credit (investment loans at concessional rates of interest) and inculcating in them the habit of savings and investment. Special drive will be required to elicit greater participation of the private corporate sector

whose investment rates are currently as low as 2 to 3 per cent in agriculture. Private corporate investments need to be crowded in by offering an appropriate policy framework along the entire agricultural value system.

As regards investments 'for' agriculture, to be largely made by the public sector, the resource mobilisation should come through budgetary and non-budgetary (creation of corpus funds) channels; convergence of funds from different ministries and departments, etc. This warrants close inter-ministerial coordination and monitoring at all levels (national, state and district).

	Responsibility: DAC&FW, DAHDF, NITI Aayog
	Timeline: Short term
	Refer Volume: II

20

One of the major source of public investments realisable through convergence is MGNREGA. The annual investments under this Employment Guarantee Scheme are massive. Several activities, that benefit agriculture are already being undertaken under this scheme. It may be more useful to reserve a certain percentage of minimum spend for all sectors of agriculture, largely supporting pre-sowing and post-harvest activities, besides production activities like protective irrigation, agro-forestry etc. However, this will have to be done without any compromise on the principle scheme objective of providing guaranteed employment to those seeking the same.

An illustrative list of activities/infrastructure that will support interventions for doubling farmers' income may be prepared jointly by a team of officials from the Departments under Ministry of Agriculture and the Ministry of Rural Development.

	Responsibility: DAC&FW, DAHDF, DARE, MoRD, MoF
	Timeline: Short & Long terms
	Refer Volume: II

21

While the required investment growth rates are not very difficult to achieve, the priority attention required is on efficient use on investments and not just on scaling up the investments. Higher capital use efficiency brought in by introduction of holistic planning, rigorous scrutiny & monitoring and application of information technology would make up for possible slip-ups in investments or result in higher achievements.

	Responsibility: DAC&FW, DAHDF, DARE, MoRD, MoF
	Timeline: Short & Long terms
	Refer Volume: II

22

The RKVY-RAFTAAR guidelines may be modified for apportioning a higher percentage share for developing infrastructure (both production and post-production, with a bias in favour of later); reserving a certain percentage for enterprise development and incubation systems.

	Responsibility: DAC&FW
	Timeline: Short term
	Refer Volume: II

23

Restructure the RKVY-RAFTAAR Division in DAC&FW with an added role as the Division of Agri-investments and Enterprise Development. An important mandate of this Division should include collecting and compiling investment information from different ministries and sources, analysing it and offering appropriate advice.

The Division may also coordinate on triggering the immediate policy framework to crowd in higher investment including from private sector. Similar Divisions may also be created in DAHDF and DARE.

Responsibility: DAC&FW, DAHDF, DARE
Timeline: Short term
Refer Volume: II

For full context and other details, the linked domain specific Volumes of the DFI Report may be referred to.

Chapter 3
Structural Reforms and Governance Framework

The objective of the green revolution was to secure the basic food requirements post-Independence, and now after seven decades, the current day needs of the nation have undergone a change. It is clear that the erstwhile production-centric approach to farming, that largely rooted the policies in intensive agriculture, has run its course successfully. The new approach towards agriculture, is to develop it beyond mere cultivation, rearing or harvesting of the produce, and to encompass an enterprise approach, that will secure optimal returns to these enterprises. The focus on farmers' income brings about this much needed shift and this must lead to certain vital structural reforms and transform the way agriculture is governed.

The country and its agriculturists have witnessed great progress since independence, in terms of infrastructural development, liberalisation in other economic sectors, education and communication systems, and changes in demand patterns for food and other agricultural raw material. Such development has garnered accelerated pace in recent years, and it is necessary that associated changes must come into agricultural systems, to remain contextual and take advantage of developments in non-agricultural spheres. While other countries profess a pattern to their agricultural progress, it is their experiences over the past half a century, including the type of industrialisation that have guided them.

In case of India, the situation is varied, and the current day technologies coupled with its agricultural strengths, place it in a position that allows it to map a different roadmap. The next decades will require more connected agricultural output, for food and raw material, and the future world requires an agricultural powerhouse. India is at a tipping point to be that powerhouse, provided agriculture is managed in a more holistic and inclusive manner, and functions with the purpose of optimal economic gain, and not merely to build stocks to mitigate food insecurity concerns. Necessary reforms will be needed now, and again, as the country progresses on a path that takes agriculture in a direction to achieve its economic potential.

As per constitutional arrangements, agriculture is a state subject and hence, both production and marketing are primarily viewed as the responsibilities of a state machinery. The world has always recognised the importance of a vast market, thereby the globalisation being experienced. India with its enviable geographical expanse, facilitative agro-climatic basket and elephantine consumer base should not fail to recognise the advantage of pan-India production and marketing design, and fritter away by not enabling by adopting suitable governance architecture. After all, there always is an inter-play of several vectors across the states, as also across the nations influencing overall growth and development.

This entails a continuum of planning, implementation, review and monitoring between the Gram Panchayat and Krishi Bhawan, via the District and State headquarters. This is not to suggest, that agriculture should be moved out from the state jurisdiction, but only to emphasise that dismantling of state-bound mind-set in production planning and boundaries in marketing

would help the farmers take a more rational decision vis-à-vis both production plans and market access.

The target of doubling farmers' income by 2022-23 is only a first radical step that engenders a fundamental shift, to the way agriculture has so far been perceived and practiced in India. If the agriculture sector is to respond suitably, to a redefined mandate (Volume I), it will require continuous transformation, so that it acquires the characteristics of an agri-enterprise, whereby farmers take to agriculture as a chosen option, and are able to earn their livelihood as entrepreneurs and simultaneously cater to the country's strategic requirements and global food and nutrition security.

Structural Reforms

1

In modern day context, it is absolutely necessary to expand on the existing narrow production-centric mandate that defines agriculture. It is recommended to adopt a new definition, that goes beyond the conventional terms of food security and ensure that this includes not merely such quantity, but also quality of nutrition and quality of production system. The demand from agriculture is to generate both food and raw material to meet the requirement of modern society for feed, fibre, fuel and other industrial uses, and in a manner that is sustainable.

Adopt the redefined mandate of agriculture:

i. Agriculture has the moral responsibility of meeting food and nutritional security in consonance with the agro ecological backdrop.
ii. It has to generate gainful employment resulting in income gains to make the farmers economically more secure.
iii. It has to generate raw material that will directly aid agro-processing of food and non-food products to support secondary agriculture.
iv. It has to support agro-processing industry to produce primary and intermediate goods, which will feed the manufacturing sector.
v. Agricultural practices need to be on a sustainable basis.

Responsibility: DAC&FW supported by DAHDF, DARE-ICAR, NITI Aayog
Timeline: Short term
Refer Volume: I, VIII, XIII

2

Productivity must be defined as a measure of gainful income (the outcome) and not only as a measure of production per unit of asset (the output). Therefore, the yield computation should incorporate economic yield and not merely physical yield. The shift in production and income curves should be strategically addressed, so as to result in doubling of farmers' income.

Responsibility: DAC&FW supported by NITI Aayog, MoSPI
Timeline: Short term
Refer Volume: XIII, III, IV

3

Besides land, labour and capital as universal factors of production in all industry, experience in case of agriculture, multiple inherent constraints arising from its complex biological nature, exposure to uncontrolled variables linked to weather and climate, as well as the fact that the marketing system structurally delinks farmers from the dynamics of market demand. Strategic focus needs to be brought about on the controllable factors on priority. This includes adopting recommendation of this Committee regarding the restructuring of market architecture, implementing market reforms, building a market intelligence system and adopting a market linked 'fork-to-farm' agricultural production system.

Responsibility: DAC&FW, DARE-ICAR
Timeline: Short term
Refer Volume: III, IV, XIII

4

The net returns from the operational efficiency of farms is influenced by the size of land holding. It is difficult operationally, to harvest individually the scales of economy at both production and post-production stages. Against this backdrop, there exists a strong case for designing alternate ways of land pooling, without breaching the spirit of equitability of asset ownership at the societal level, and without compromising the deed of right, title and ownership at individual level.

The States are recommended to legislate the Model Agricultural Land Leasing Act, 2016 (brought out by NITI Aayog), to incentivise and promote pooling of agricultural land. Further, the Model Act itself may be amended to incorporate the provisions of the suggested Land Cultivators License Act, (the Andhra Pradesh model) so that Bankers recognise lease/license vis-a-vis land and extend institutional credit.

Responsibility: DAC&FW, DoLR, NITI Aayog
Timeline: Short term
Refer Volume: XIII

5

The Government may prepare a suitable Model Contract Farming and Services Act and frame Rules thereunder to facilitate the adoption by the States and Union Territories. The model should incorporate a synergistic sharing of windfall gains by sponsoring company with farmers and sacrifice of small percentage by farmers if sponsor suffers unsustainable loss. The Act should also provide flexibility so that States/UTs can suitably attract both sponsors and small & marginal farmers, and place an empowered authority to counsel, supervise and monitor the contract farming and services. However, such an authority should be facilitative and not regulatory in nature, and therefore needs to be designated in an appropriately soft name, like for example 'Board' and not 'Authority'.

Responsibility: DAC&FW supported by DAHDF
Timeline: Short term
Refer Volume: IV, VIII, XIII

6

Realising certain challenges and weaknesses of a cooperative FPO, there has been effort since 2012 to promote farmer producer companies (FPCs) registered under the Company's Act. Farmer producer companies may be given priority for cultivation on pooled land and for allied infrastructure development to harvest the desired economy of scale in operations. In the view of this Committee, a minimum of 7,000 FPOs & VPOs should be targeted by 2022-23 and

double that number in the six years thereafter. At an average of 1000 hectares of cultivated land and minimum 1000 farmers per FPO / VPO, the organised number of farmers would be at least 7 million and resulting pooled land be 7 million hectares by 2022-23. This will scale to an additional 14 million farmers and 14 million hectares by 2029-2030 and will to some extent address the structural weakness of small and marginal farm holdings.

Responsibility: DAC&FW, DAHDF, MoFPI
Timeline: Short term
Refer Volume: III, IV, VIII, XIII

7

Undertake comprehensive digitisation of land records including geo-tagged and location agnostic online registration of land transactions, to generate seamless and updated record of farm land ownership. This exercise can be carried out in Public-Private-Partnership mode. The linked interventions are online and location agnostic registration of land transactions; and automatic & continuous mutation of land records that reflects an updated ownership status.

More than 55 per cent of the civil disputes across the country are related to land. Developing accurate and approved land ownership records with GPS (global positioning system) and revenue department certification would drastically reduce the profitability of civil disputes and also the huge amounts of expenditure incurred by the farmers on court cases. The spin off benefit for the farmers is a huge saving of time now wasted on court sojourns.

Responsibility: DoR, DoLR, DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XIII

8

Land is a major asset of the farmer, and the exercise of buying and selling of farm-land is carried out through non-transparent land agents, with resultant price differentials to the detriment of the land owner. An online platform may be developed, to function as a land market for farmers. This will also induce the land sellers to get their land size and title digitally geo-tagged.

Based on guidelines of the Department of Revenue, a digitally signed and geo-tagged certificate should be issued to the actual plot owner, which an owner desirous of making a sale can display in the land market.

Responsibility: DAC&FW, DoLR
Timeline: Short term
Refer Volume: XIII

9

To all intents and purposes, a farmer is one who owns land and possesses a revenue record that establishes his right, title and ownership. This record of right (RoR) is the 'certificate' that offers him a right to access all benefits – material or otherwise, that the government provides through large number of its schemes, programmes and missions. Currently, this tends to exclude the landless cultivator, fisher, nomadic livestock rearer, etc. Purely from the perspective of developing agriculture and ameliorating the condition of the farmers, they also must be recognised as farmers and rendered eligible to all the benefits under various schemes / programmes / missions, as also institutional credit and relief measures.

The definition of 'Farmer' should be liberalised, based on norms that include cultivators, lessee sharecropper, etc. This will enable the actual cultivators and agriculturists to access the support-system intended to buttress those pursuing an agricultural enterprise.

Responsibility: DAC&FW supported by DAHDF
Timeline: Short term
Refer Volume: XIII

10

A harmonised online portal, with annually authenticated database may be developed to identify all categories of farmers, to render him/her eligible to avail agriculture related support-system. In this context, it is suggested that the list of farmers be kept dynamic, which means that there can be both entry and exit options, based on the actual status of ownership and / or cultivation. Some of the norms suggested are:

i. Ownership of land and/or actual cultivation.
ii. Agreement with the land owner to the effect that he/she is a lessee/sharecropper, etc.
iii. Eligibility for the period of agreement of lease, etc. with the land owner.
iv. Gender of farmer.

A portal may be developed to enable the owner and lessee, etc. to post their status, accompanied by relevant document(s). The database can be maintained by the local Revenue Officer or Gram Panchayat or the local Agriculture Officer. An annually authenticated village-wise database can be made accessible to the officers of the Departments of Agriculture, Horticulture, Animal Husbandry, Fisheries, Banks, Cooperatives, Relief, etc. who are then free to offer eligible benefits to newly defined farmers.

Responsibility: DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XI, XIII

11

It is recommended that the Directorate of Marketing & Inspection be restructured into Directorate of Marketing and Intelligence to take responsibility for Market Intelligence in particular, and provide technical backstopping to an institutional mechanism for undertaking (i) demand & price forecasting; and (ii) import-export duty recommendations.

Responsibility: DAC&FW
Timeline: Short & Long terms
Refer Volume: III, IV, XIII

12

Develop a crop coverage area portal, to allow farmers and other stakeholders to upload data to supplement the cropped area and production estimates. Area and production estimations must be modernised, using geo-spatial tools and to phase out inaccuracies from eye estimates.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: XII, XIII

13

Undertake suitable orientation of District level planners, to use the information from crop coverage data and demand data, to take incisive decisions on selecting and planning cultivation and other farming activities to be carried forward through the agricultural extension system.

Responsibility: DAC&FW, DAHDF, ICAR
Timeline: Short term
Refer Volume: VIII, XIII

14

Implement comprehensive climate-proofing of the 151 districts identified as highly vulnerable, in a time-bound manner. This delineation by ICAR-NICRA based on IPCC's Assessment Report (AR) 4 may undergo a change, when AR 5 framework is deployed to determine vulnerability of the districts.

Additional districts, if any, as a result must also be brought into the fold of drought-proofing. This would include developing timelines for the adoption of varieties, technologies and practices that will promote resistance / tolerance to risk factors (drought, flood, etc.), and the rolling out sustainable production system on the principles of rainfed agriculture, watershed management, integrated farming system, etc.

Responsibility: DAC&FW, DARE-ICAR, DoRD, DoLR, MoEFCC, NRAA
Timeline: Short & Long terms
Refer Volume: VI, XIII

15

Special emphasis is needed to develop agricultural production systems in accordance with the agro-ecological situation. Widespread adoption of sensor based technologies in water and soil health management, etc. to make the activities more resource efficient is required.

States must deploy sensor based technologies, including in combination with robotics and analytics to build a robust IOT platform, to improve overall resource use efficiency.

Responsibility: DARE-ICAR, DAC&FW
Timeline: Long term
Refer Volume: VII, VIII, XII, XIII

16

Agricultural supply chains are under fragmented and shifting ownership, and the farmer user has little recourse to relevant information. The entire agri-supply chain needs to be empowered by supporting the deployment of ICT, so as to facilitate the public sharing of data related to production, pests, weather, transport, markets, etc., and to allow farmers to make information based and reasoned decisions in response to changed dynamics.

Responsibility: DAC&FW, DAHDF, DARE-ICAR
Timeline: Long term
Refer Volume: XI, XII, XIII

17

A strong system of connect between production and consumption centres needs to be developed in the form of pack-houses at village level, dry and cold storages, with multimodal transportation. There is need for farmers to precondition, transport and store their produce, of their own volition, in safe and secure manner to markets of choice and at a time of choice.

Those market and agri-logistics components, identified to be of critical importance, may be given special capital interest subvention to motivate investment and offset shortfall.

Responsibility: MoFPI, MSME, DoRD, DAC&FW, DAHDF
Timeline: Short term
Refer Volume: III, IV, XIII

18

Processing facilities, both small and large scale, can further help the farmers in realising better value on the surpluses that cannot be consumed in fresh form in both near and far markets. It is, therefore, necessary to strengthen agro-processing (food & non-food processing). Such industries, typically hold and stock inventories for their processing needs, and can be developed as a channel to facilitate post-harvest pledge loans to farmers.

Responsibility: DAC&FW, DAHDF, MoFPI, DIPP, MoTex
Timeline: Long term
Refer Volume: III, IX, XIII

19

An institutional mechanism is recommended for formulating a long-term Agricultural Trade Policy, vide a permanent inter-ministerial Committee. Long term international market relations are put at risk when trade policy is varied in the short term and is unstructured in nature. Agricultural Trade Policy should aim to promote a stable trade regime, facilitate ease in doing business, rather than be disruptive to business planning and aggressively promote trade in both produce and products of agriculture.

Responsibility: DAC&FW, DAHDF, DARE, DoCI, DoCA
Timeline: Short term
Refer Volume: III, IV, XIII

20

The Committee recommends an aggressive strategy for developing international agricultural trade with the aim to achieve a target of USD 100 billion in value of agricultural exports and aim to at least double the volume of agricultural commodities and/or products exported. It is also recommended to strengthen the India Embassy system to orient towards enabling increased agriculture exports.

Responsibility: DAC&FW, DAHDF, DoCI, MEA, MoFPI
Timeline: Short term
Refer Volume: IV, XIII

21

It is recommended that the India Embassy system be strengthened to orient with the aggressive agri-trade targets. The post of Advisor (Agri-trade), initially in ten selected export markets, may be created in embassies to focus on developing trade in all kinds of agricultural goods. A short supply chain having direct linkage with farmer groups should be the preferred option for such trade. Further the basket of commodities exported should be broad-based and reach beyond cereals and meat, which today account for the bulk of the exports.

Responsibility: DAC&FW, DAHDF, MEA
Timeline: Short & Long terms
Refer Volume: IV, XIII

22

The Agri-Trade and International Cooperation (IC) Divisions in DAC&FW and DAHDF should interact proactively with the Indian Heads of Missions across the globe, with the primary focus to expand export destinations.

Responsibility: DAC&FW, DAHDF, MEA
Timeline: Short term
Refer Volume: IV, XIII

23

Various reforms are suggested in the critical area of inputs (seeds, fertilizers and pesticides) to alleviate structural bottlenecks. Chapter 6 of Volume XIII may be referred for details, which examines important issues relating to legislations on Seed, Pest Management and Fertilizers.

The Seed chain, from production to supply, including development of new varieties can be liberalised to tap the vast scope in enterprise based models from private sector.

Responsibility: DAC&FW, DARE-ICAR
Timeline: Short term
Refer Volume: XIII

24

Achieving higher levels of Seed and Varietal Replacement Rates, re-structuring and revamping the public sector seed producing undertakings, facilitating Intellectual Property Rights and PPP in R&D for seeds is recommended.

Responsibility: DAC&FW, ICAR
Timeline: Long term
Refer Volume: VII, XIII

25

The government to develop a Model Guideline & Procedures for States to harmonise the seed licensing system, practiced under Seeds (Control) Order 1983.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VI, XIII

26

The fertilizer sector policies were framed at the time of intensive farming. In light of changed circumstances with new initiatives such as soil health management and sustainable farming, there is need to promote customised fertilizers, linked to the Soil Health Card scheme.

Responsibility: DAC&FW supported by MoCF
Timeline: Short term
Refer Volume: VIII, XIII

27

The stipulated time for testing of fertilizer samples under Fertilizer Control Order (FCO) can be reduced to 25 days from 57 days.

Responsibility: DAC&FW supported by MoCF
Timeline: Short term
Refer Volume: VIII, XIII

28

The fertilizer subsidy policy should be rationalised such as to encourage balanced use of primary, secondary and micro-nutrients, and to promote development of innovative new products. The policy should help transition from general fertilizers to specific fertilizers.

Responsibility: DAC&FW, MoCF
Timeline: Short term
Refer Volume: VIII, XIII

29

The pesticide regulations need to be rationalised, including the need for checks and balance of Inspectors and to reduce time lines to register new molecules. The proposed Pesticide Management Bill should incorporate aspects that promote competition in quality, safety and effectiveness, while facilitating access to new molecules.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII, XIII

30

The states need to modernise their agricultural market architecture and legislate the Model APLM Act 2017, so as to liberalise the output market environment and simultaneously invite large number of private sector participants.

States may also broaden the scope of the APLM Act to cater to marketing of non-timber forest produce (NTFP) or in the alternate enact Minor Forest Produce (MEP) Marketing (Promotion & Facilitation) Act, as an independent piece of legislation.

Responsibility: DAC&FW supported by DAHDF & NITI Aayog
Timeline: Short term
Refer Volume: III, IV, XIII

31

It is recommended to take advantage of the premises of existing 22,000 (approx) *haats* across States, to co-host aggregation market platforms under private and public sector organisations, as also by adopting PPP models. The *haats* may be upgraded into rural level agri-market platforms, and be kept outside the ambit of State Marketing Act, so as to enable them to directly link the farm gate with wholesale terminal markets, national and international. These would also support local retail between farmers and consumers, and direct marketing to supply retail requirements at terminal markets.

Government may allocate appropriate funds for upgrading the periodic *haats*, into primary rural (grameen) agri-markets (PRAM/GrAM), and take this up as a priority action to organise the first mile of the supply chain.

To give appropriate focus on developing such rural retail market platforms, the government may initiate guidelines to facilitate the development of PRAM/GrAMs. Subsequently, a separate model Act should be formulated, to remove any amorphousness between retail and wholesale markets and to facilitate the States in this course of action.

Responsibility: DAC&FW supported by DoRD
Timeline: Short term
Refer Volume: III, IV, XIII

32

Structurally, the regulated markets are placed under agriculture marketing in states, which typically does not concern with marketing needs of allied domains of horticulture and livestock. Since the DFI strategy looks for integration in the agricultural sector, it is recommended that the proposed PRAM/GrAM be placed under the Directorate of Agriculture, so that the focus includes output of traditional agriculture, horticulture, livestock and fisheries. The Directorate should assign a suitable strength of field functionaries to develop the GrAMs and promote a market led approach to production and post-production activities, across all the sub-sectors in agriculture.

Responsibility: DAC&FW, DAHDF
Timeline: Short term
Refer Volume: IV, XIII

33

A special Task Force be constituted to evaluate appropriate business models with liberalised stock limits, such that it will relieve market distress of farmers, while promoting various opportunities to capture a larger share of the global demand.

A structural limitation arises when stock limits disallow wholehearted inclusion of the private sector in agricultural trade. It is recommended that conditional exemption from stock limits be optioned to private organisations that procure stock at MSP rates directly from farmers, along with exemption from variable export limitations. This will not only ensure bigger reach of MSP benefit to more regions and farmers, but also bring private sector efficiencies and develop long-term markets for such commodities outside India, thereby provisioning an economic case to enhance farm productivity and production.

Responsibility: DAC&FW, DoFPD
Timeline: Short term
Refer Volume: IV, XIII

34

Long term shift in weather patterns, or climate change, will also bring about a shift in pathogen and pest populations & infestation zones, a changed situation in water availability and various other associated biological variations. The previous categorisations of agro-climatic zones will change (in fact some changes are already visible) and entire agricultural economies will undergo a transition which has to be planned for. Impacts from climate change are not well mapped and are at times in an unexpected direction, forcing a mirror on past strategies.

The strategy and components of the National Mission on Sustainable Agriculture (NMSA) may be reviewed with an option to revise every two years, to maintain appropriate relevance with newly developed scientific knowledge and technologies in regards to climate change.

Responsibility: DAC&FW, DARE-ICAR
Timeline: Short term
Refer Volume: V, VI, XIII

35

In view of climate change and other ecologically diverse changes that have occurred there is a need to revisit and map anew the climatic zones and agro-ecological regions in the country. This will help provide fresh direction in respect of all other sustainable strategies and practices.

Science can play a big role in mitigating the effects of climate change and greater focus needs to be laid to develop technologies, such as biotic stress resilient crops varieties and livestock breeds.

Widespread dissemination of climate change concerns and economic impact including the expected transition in cropping system, crop selection, livestock care and adoption of new technologies has to be undertaken in participation with KVKs and the ATMA network.

Responsibility: DAC&FW, DAHDF, DARE-ICAR
Timeline: Short & Long terms
Refer Volume: V, VI, XIII

Governance Framework

36

In a socialist country like India, the welfare of any individual or a class of people, including that of the farmers, is catered to by governments through various schemes that offer direct support besides creating or facilitating generation of job opportunities. These include employment guarantee schemes (MGNREGA), pension schemes (old age pension, widow pension, etc.), free education upto a certain stage, food subsidy under public distribution system, welfare of children and mothers under ICDS, free primary health services, developmental schemes under different departments (including agriculture), life and non-life insurance (crop insurance under PMFBY is a good illustration). The implication is that both personal incomes and governmental support determine the intensity and extent of welfare that is available to the people of India.

It is important that the term "Farmers' Welfare" is well defined and a set of comprehensive support systems adopted, that would guarantee the specific well-being and meet the needs that are unique to farmers. In light of this, the Committee recommends that farmer's welfare be indicated in the following terms-

- both absolute and relative average income;
- availability and accessibility to social security system – education, health, etc.;
- facilitating the farmer in moving up Maslow's need hierarchy beyond social security.

Responsibility: DAC&FW, DAHDF, MoSPI
Timeline: Short term
Refer Volume: I, XIII

37

A comprehensive parametric based scale be developed, to evaluate and monitor farmers' income and welfare, measured annually by sample surveys and in five yearly intervals based on universal survey. See chapter 9 of Volume XIII for suggested indicators.

The approach to farmers' welfare should broadly cover, a) income enhancement; b) social security cover; c) access to institutional credit; d) risk cover; e) access to knowledge.

Responsibility: DAC&FW, DAHDF, MoSPI
Timeline: Short term
Refer Volume: I, II, XIII

38

The governance mechanism also requires a paradigm shift in the approach towards planning, reviewing and monitoring of the new agricultural strategy, aimed at doubling farmers income in the short term and long-term well-being of farmers. Against this understanding, specific institutional systems are suggested – one led by the political-executive leadership, another by the bureaucratic-executive and the third as a domain authority.

Responsibility: DAC&FW and DAHDF supported by NITI Aayog
Timeline: Short term
Refer Volume: XIII

39

Create a three-tier institutional arrangement headed by political-executive leadership, that includes both the state and central machinery, to strengthen planning, review and monitoring mechanism that exists between Gram Panchayat, District & State headquarters and Krishi Bhawan. The objectives, composition and terms of reference are proposed in Chapter 10 of Volume XIII of this Report.

Responsibility: DAC&FW supported by NITI Aayog
Timeline: Short term
Refer Volume: XIII

40

Create a four-tier arrangement headed by the bureaucratic-executive for coordination and convergence in implementation, which includes Block level to include a bottom-up approach.

This will follow, in harmony with the decisions of the three-tier institutional mechanism as discussed above. A robust system for ensuring effective coordination in implementation is necessary at all appropriate levels. The objectives, composition and terms of reference are proposed in Chapter 10 of Volume XIII of this Report.

Responsibility: DAC&FW supported by NITI Aayog
Timeline: Short term
Refer Volume: XIII

41

The government may consider to establish an omnibus and quasi-judicial agricultural authority to fast track resolution of disputes relating to contract farming, land lease, crop insurance and other implementation disputes. This will offer an alternative to dispute resolution in various areas that affect the farmers' economic activities and hence, do away with the need for individual and multiple authorities that are generally suggested in dealing with different aspects of agriculture.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XIII

42

Despite a plethora of formal and informal institutions, organisations and platforms, a large majority of the farmers feel that they are not well represented in decision making and that their interests are not well protected. Therefore, for a more inclusive grassroots level participation of farmers, it is both appropriate and important, to make Gram Panchayats (GPs) responsible for agricultural development encompassing planning and execution.

The village level action plan should be prepared at GP level and integrated into Block Action Plan (BAP). Gram Panchayats can be developed as robust and active delivery institutions, to serve as Centres of Agricultural Planning and Execution and for the delivery of extension services.

Responsibility: DAC&FW, DoPR
Timeline: Short & Long terms
Refer Volume: XIII

43

The above proposed Gram Panchayat Centres are also optimally placed to monitor welfare and transition management. There is need to ensure coverage under social welfare schemes such as old age pension, widow pension, girl child benefits, insurance, etc., at village level.

The GPs can be given responsibilities and facilitated as centres of welfare, and their activities would include maintenance of farmers' database, coverage under welfare schemes, counselling for stress management and for transition management in case when members of the community migrate for jobs. See further explanations in chapter 11 of Volume XIII.

Responsibility: DoPR supported by DAC&FW, DAHDF
Timeline: Short & Long terms
Refer Volume: XII, XIII

44

It is important to take advantage of technology, that bears the capacity to neutralise hierarchy, break down barriers, jump decision making stages and create a friendlier & hassle-free partnership. Farmers must be facilitated to take advantage of IT network, to break bottleneck of hierarchy and to allow a more user-friendly and horizontal partnership with governmental agencies at different levels.

For decentralised decision making, the Gram Sabhas provide a platform for deliberations that include direct participation of farmers. Such participation can be expanded and made location agnostic through greater deployment of portals, IVR and video conferencing facilities.

Responsibility: MEITY supported by DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XIII

45

Farmer Producer Organisation (FPOs) in their various formats, can be federated into larger regional entities so as to engage the farmers with common interests in participative governance, especially in commercial matters.

Responsibility: DAC&FW, DAHDF
Timeline: Long term
Refer Volume: XIII

46

As a large percentage of agriculture in the country continues to be monsoon-dependent, many of the states which are largely rainfed are seen to have diverted a significant proportion of their expenditure in strengthening and expanding irrigation coverage. The growth rate of private investment in agriculture has also been substantive in the rainfed states during the recent period.

Effective public-private inter-linkages to deepen capital formation in agriculture, can be replicated in all the states as well. Such public–private coordination for investment in agriculture is particularly important in those states which are largely rainfed, where the critical need is to increase coverage of area under irrigation and water use efficiency.

Responsibility: DAC&FW, NRAA
Timeline: Short term
Refer Volume: XIII

47

In contrast to capital investments that go towards infrastructure build up, the subsidies are in the nature of production support. The subsidies on inputs like fertilizers, water, power, and MSP-linked procurements have increased substantively from Rs. 12,158 crore in 1990-91 to Rs. 2,43,811 crore in 2015-16. However, the green revolution technology, conditional upon input guzzling crops and varieties has channelled a major part of the subsidies into irrigated belts, and majorly around a few crops. This has restricted growth to a few regions and farmers.

It is recommended, that for purposes of inclusion across regions and categories of farmers, the subsidy including the MSP-linked procurement be strategically rationalised in spread, to reach more farmers and promote income growth in erstwhile ignored areas. As such, the share of crops procured by the government be reassessed, and/or provision for incentives or conditional exemption to induce the private sector to manifest such a spread in support.

Responsibility: DAC&FW and DoFPD supported by NITI Aayog
Timeline: Short & Long terms
Refer Volume: XIII

48

Food inflation concerns originate from aspects of imbalanced demand and supply. Each aspect that is the root cause of such concerns, requires to be resolved. Currently, food inflation is countered from the perspective of consumer alone, intended to suppress the prices by intervening in the total flow of specific commodities to markets. But the current times when India's farmers are generating food surpluses, the challenge is also one of ensuring remunerative prices on their produce.

In this context, balancing the inflation and the need for ensuring fair & remunerative prices on the farmers' produce is a challenge. This needs to be addressed on priority for sustaining higher production. Such a balance will come from increasing the market network, improved crop planning, reducing production where markets are depressed and shifting towards high value commodities.

Responsibility: DAC&FW, DAHDF, ICAR
Timeline: Long term
Refer Volume: XIII

49

DAC&FW may constitute an inter-ministerial committee to study and suggest ways to harmonise the various product standards and grading parameters adopted by different agencies (BIS, APEDA, FSSAI, Agmark, etc.). This is a pre-requisite to continued success of a national agricultural market (NAM) which works on the online platform.

Responsibility: DAC&FW, DAHDF, BIS, APEDA, FSSAI
Timeline: Short term
Refer Volume: IV

50

It is necessary to recognize non-timber forest products (NTFPs) as a source of income at par with agriculture in case of the tribal communities and facilitate them to improve the practices of gathering minor forest produces (MFP).

There is the need to promote self-help groups (SHGs) of the gatherers and provide them with a well-appointed place (drying yard, storage, primary processing support etc.) so that the small lots can be aggregated and traded more efficiently.

Responsibility: DAC&FW, MoEFCC
Timeline: Short term
Refer Volume: XIII

51

The trading of MFPs can also be integrated with online agriculture trade platforms like e-NAM by developing needed standards, rates etc. and developing assaying labs. The provision for trading in MFPs including online trading can become part of the State Marketing Act (APLM), or if the states feel necessary they may enact a separate Act on similar lines as that of Agricultural Marketing. The Act can be called as Minor Forest Produce Marketing (Promotion & Facilitation) Act.

The Ministry of Tribal Welfare can develop and share a Model Act and Rules with the states for adoption.

Responsibility: MoTW, DAC&FW
Timeline: Short term
Refer Volume: XIII

52

There is a considerable range of non-timber forest products (NTFP), encompassing tree/bush borne oilseeds, fruits, flowers, roots, shoots, leaves, bark and herbs. Over the civilizational times, they were the source of food and medicine, apart from constituting the ecology. Comprehensive development of the NTFPs may be taken up and funds available under various ongoing schemes like MGNREGA, Tribal sub-plans etc. can be used.

Responsibility: DAC&FW, MoTW
Timeline: Long term
Refer Volume: XIII

53

It is recommended to set up a body with members drawn from DAC&FW, ICAR, SAU and State Governments, etc. that will prepare advance guidance value for major crops, particularly tomato, onion and potato every season, so that the response will be quick and state governments can promptly start the procurement process.

This is necessary to improve the efficiency and effectiveness of 'Market Intervention Scheme (MIS)', a price support scheme in operation for the perishable commodities.

Responsibility: DAC&FW, DARE-ICAR
Timeline: Short & Long terms
Refer Volume: VIII

54

In order to enhance the case of institutional credit to the agriculture sector by addressing the risk perceived by the Banks and other Financial Institutions an 'Agricultural Credit Guarantee Trust Fund' may be created.

Responsibility: DAC&FW, MoF
Timeline: Short term
Refer Volume: VIII

55

A wholesome and accurate approach to monitoring of farmers' income, calls for adopting a standardised methodology. At the moment, farmers' income and sources of income are not systemically measured. A harmonised methodology should be formulated and implemented on a priority basis, so as to help develop appropriate system to monitor the progress of interventions and the outcomes.

Responsibility: DAC&FW, DAHDF, DARE-ICAR, MoSPI
Timeline: Short term
Refer Volume: XIII

56

There is the need to develop a Management Information System (MIS) system, inter-operable with harmonised inputs, which will output a centralised dashboard for use across ministries and departments. In the current situation, there is surfeit of data collected at various hierarchical and horizontal levels by different divisions & organisations within the department / ministry, as also across the departments / ministries and unfortunately, the data structure is not uniform. The data structure is isolated or duplicated and not standardised, resulting in inefficient data collection and non-harmonised interpretation of the results.

An appropriately designed MIS, operated via dashboard, will serve as a command and control system. When installed on need to know basis, at various hierarchies – Gram Panchayat - Block/Taluk – District – State - National levels, it will provide for seamless sharing of data and information, and interpreted in a harmonised language and format. It is then possible to work for a shared vision, common mission and for universally accepted objectives & targets.

Responsibility: DAC&FW, DAHDF, ICAR
Timeline: Short & Long terms
Refer Volume: XIII

57

In response to specific needs arising from time to time, several organisations have come up over the years, within an individual department or ministry or outside. These organisations are generally in the nature of autonomous bodies, attached offices, corporations, boards and directorates. There are overlaps in mandates across these, leading to not just duplication, but at times also resulting in cross-purpose effort or differing messaging. This is in addition to the avoidable establishment costs on men and material.

On the other hand, the priority of the day is trade, marketing, agri-logistics, capital investments, risk management etc. wherein there are suitable resources, but the focus as required is wanting. A diligent exercise by the Departments will help in positioning their existing Divisions to meet the new requirements arising from income based approach to agriculture.

There is the need to undertake reorganisation of the Divisions within DAC&FW, to bring suitable focus on marketing & agri-logistics, investments & enterprise for addressing the gaps identified in the agricultural value system.

Similar organisations are needed in DAHDF too. The Policy Divsions of all the three Departments within the Ministry of Agriculture, may be strengthened with experts to enable the Divison to undertake cross-disciplined comparisons of policies and programmes to achieve synergy and alignment.

Responsibility: DAC&FW, DAHD&F, DARE-ICAR
Timeline: Short & Long terms
Refer Volume: XIII

58

Create a new Division of Agri-logistics, within the Department of Agriculture, Cooperation and Farmers' Welfare. For effective promotion of a restructured market linked system of agri-logistics, the above mentioned Division needs to be mandated with responsibility for policy formulation and coordination, even when the implementation of individual infrastructure components are the subject domains of other Divisions or agencies within the Deptt. Autonomous bodies or other agencies deployed or more that may be deployed by the Ministry/Department with specific focus on agri-logistics systems may be postioned to work closely with the proposed new Division on Agri-logistcs.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XIII

59

The Division of Crops in DAC&FW majorly focuses on production activities. Considering the need for capturing the value from agri-commodities, the Division may be restructured as the "Division of Crops and Primary Processing", to bring focus on primary processing of the harvested produce at farm gate level.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XIII

60

The DMI (Directorate of Marketing and Inspection), an attached office of the DACFW, should be reorganised to take on the function of Market Intelligence. There is an urgent need to provide demand and price forecasts, to help make appropriate pre-production and post production plans and decisions.

The DMI may be renamed into the Directorate of Marketing Intelligence and its mandate may be upgraded accordingly.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XIII

61

It is suggested that the Division of RKVY-RAFTAAR is upgraded as the 'Division of Investment and Secondary Agriculture'. It may be mandated to draw up policies for promoting Gross Capital Formation (GCF) in agriculture, and coordinate with different Divisions and

various Departments and Ministries, so as to deliver convergence where needed and optimisation of investments. This Division may also look after promotion of enterprises linked to agriculture, i.e. secondary agriculture.

A similar Division may be created in DAHDF, given the unique and fast growing needs of dairying, livestock and fisheries, each if which is growth driver for farmers income.

Responsibility: DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XIII

62

There are 68 Public Extension Service providers under different departments and ministries of Government of India alone. In addition, there are at least 22 number of inter-governmental institutions; and many at the state level too. The challenge of governance, therefore, is to effect much needed coordination and convergence among them in optimal service of Indian agriculture. Re-mandating some of these organisations to meet the current challenges is useful.

A Group may be formed under the Ministry of Agriculture to study and make suitable recommendations to,

i) Build a conduit among various institutions, to reconcile their services and optimise delivery at the level of department, farmers and other stakeholders;

ii) Identify institutions that need to be strengthened or restructured, reorganised, re-mandated and relocated;

iii) Promote single window services.

Responsibility: DAC&FW supported by DAHDF and DARE
Timeline: Long term
Refer Volume: XIII

63

Develop and implement a State and UT ranking system on "Ease of doing Agri-business". The assessment and ranking may be undertaken on an annual basis.

Ranking should be quantified on parameters that indicate speed in adopting reforms that simplify procedures and bring transparency to carrying out agri-business. Explanation and more suggestions in regards to the objectives from such ranking on ease of doing agri-business is in Chapter 15 of Volume XIII.

Responsibility: NITI Aayog, DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XIII

64

The Prime Minister of India, in sharing a new vision for the farmers of the country, has effectively set a new course for agriculture in India. The strategies recommended on this voluminous subject, are many and yet they are correlated under a common objective. The implementation will happen through different States/UTs, ministries and departments, and there is always a probability of losing both focus and direction in this mission to transform the way agriculture is treated.

It is recommended to set up an Empowered Body, headed by an appropriately senior officer, of appropriate seniority within the Ministry of Agriculture & Farmers Welfare, to monitor the new set of activities, as they are operationalised.

This Empowered Body or Authority, can also be mandated to develop guidelines, based on an implementation framework, and provide the needed support system to the principle stakeholders, namely DAC&FW, DAHDF, DARE, other Departments and Ministries. The suggested role of such an Empowered Body is listed in the final chapter of Volume XIII of this Report.

	Responsibility: DAC&FW
	Timeline: Short term
	Refer Volume: IV, XIII

For full context and other details, the linked domain specific Volumes of the DFI Report may be referred to.

Chapter 4
Monetisation and Optimising Returns

From the perspective of this Doubling Farmers' Income Report (DFI), the agricultural produce is a unit of value, which via a liquidity event (sale transaction) is converted into currency. Farmers' produce undergoes the process of monetisation, via various market channels. The total value monetised is also dependent on the extent of food loss mitigated and the magnitude of value captured from every grain, every drop and every ounce produced. The process is expected to be transparent, equitable and also be able to assign the most appropriate price to the unit of value (produce). This is enabled better, by gaining access to a choice in markets, balancing supply with demand and by appropriate governance mechanisms.

DFI Committee expands the post-production value capture activities by going beyond 'marketing' and advocating 'monetisation'. On the lines of the well-known 'marketing efficiency', the Committee adopts 'monetisation efficiency' as the right measure of value capture and defines it as:

> *"It is the ability of the system to enable the farmer to capture and accrue the best possible value out of all that is produced, supported by both marketing and non-marketing sub-systems that operate at different stages of the integrated value chain."*

The purpose of monetisation is to capture the best possible value of the produce for the farmer, once harvested. While market is a place where value is assigned a price, discovered when the produce is offered for sale, the share of the farmer in the end-consumer's spend is predicated upon the market structure. It would, therefore, be necessary to not only maximise the price discovery through an efficient marketing system, but also enable the farmer to benefit from as large a share as possible in the end consumer's rupee.

Agri-logistics is the backbone of agri-business, as it ensures that the desired liquidation event or monetisation of produce is fulfilled with physical delivery. The entire agricultural produce consisting of every grain, every ounce and every drop must be delivered safely to reach gainful end-use. Agricultural marketing is the brain behind the back-bone, intelligently directing the flow of traffic to the most optimal transaction. Marketing is therefore, redefined as a function and a service and not an omnibus term for all supply chain activities. Agricultural marketing as a system has the main objective to catalyse and support the monetary exchange from farm produce, to organise the commerce that a farmer initiates, starting from when the farmer plans to sow the first seed or plant the first sapling. Demand-driven production of agricultural produce, rather than production-propelled marketing, is the need of the day and a function of marketing.

The markets themselves, are infrastructure platforms to facilitate the monetisation event, for crops, livestock or other produce of agriculture. At near farm locations, the market nodes not only facilitate transactions within their premises, but are also expected to service the delivery for transactions that happen at other markets, i.e. online markets, export markets, distant terminal markets, etc. Therefore, a physical market will also require service enabling logistics infrastructure.

The capacity of a market to fulfil its functions, promptly, transparently and equitably is enabled by the policies, rules and regulations. From a farmer's perspective, a market is where the

production in his custody undergoes monetisation, i.e. traditionally, the periodic retail market, primary wholesale market, government procurement, processor, warehouse, etc. The opportunity exists to break from tradition and allow the farmers to directly link with export markets, terminal markets and even to undertake some of the post-production activities, such as primary processing, packaging and transportation, as farmer groups.

Future market interventions by the state governments need to align with the one-nation, one-market concept by laying greater emphasis on building appropriate long term connectivity for agricultural produce, across states and geographies. It is best kept in mind, that though cultivation is limited by the boundaries of the farming operation, the market has no boundaries and needs to operate on a pan-India level to meet the demand across the country, and even further afield to connect with export markets.

Agri-logistics & Infrastructure

1

Promote integrated agri-logistics systems so as to enable efficient transfer of value from farm-gate to end-consumers. Agri-logistics essentially includes farm-level primary processing and storage, market infrastructure, aggregation hubs and larger storage (dry and cold), transportation including multi-modal (dry and cold), distribution hubs and retail merchandising platforms at last mile. These enable monetisation of the transferred value at optimal prices and will enlarge the share of produce that reaches markets.

The integration agenda suffers when the capacity of components in the logistics chain are not planned to match the volumes intended to be handled over time. Care must be taken to match capacities along the logistics chain to target desired capital use efficiency.

Responsibility: DAC&FW, DAHDF, MSME, MoFPI
Timeline: Short term
Refer Volume: I, VIII

2

The current dry warehousing capacity in the country is estimated at 184 million tonnes and the projected storage requirement in 2021-22 is 196 million tonnes. Based on DFI Committee's examination the net capacity of 184 million tonnes already created, will suffice when redesigned and upgraded to meet requirements of different categories and types of crop commodities. Priority attention is needed to upgrade the existing godowns and warehouses, (which include cover and plinth storage) that were created under various schemes. However, it would help to prepare a District and state-wise storage plan to ensure efficient spatial distribution – this alone should become the basis for any new construction. Modern warehouses and silos must be the preferred option if new storage creation is decided upon.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IV, VI

3

The existing dry warehousing infrastructure needs to be upgraded to make them WDRA (Warehouse Development Regulation Authority) compliant and become eligible to issue eNWRs (electronic Negotiable Warehouse Receipts). The Agriculture Ministry in partnership with WDRA may develop comprehensive guidelines/procedures to promote large number of accreditations and enable farmers to access warehousing facility in close proximity of their

farm gate. Advocate and popularise among all stakeholders, including bankers, the system of warehousing and eNWRs. This will help in using the facility of interest subvention based post-harvest loans and buck the distress sale practice now common among farmers.

Responsibility: DAC&FW, MSME, MOFPI, DoFPD
Timeline: Short & Long terms
Refer Volume: III, IV, X

4

In order to promote warehouse based post-harvest loans, in case of notified perishable commodities, it is necessary to substantively increase accreditation of cold storages in the country. As of now there are less than 10 colds storages registered with WDRA. This is highly inadequate and an action plan is necessary to increase accreditation. The list of perishable commodities notified by WDRA needs to be examined and broadened.

Responsibility: DAC&FW, DAHDF, DoFPD
Timeline: Short term
Refer Volume: III, IV

5

In case of refrigerated warehouses, the country has nearly 35 million tonnes of capacity created, mainly designed for produce that can be held for long period (e.g. potato, dried chillies, dry fruits, etc.). While as of now, the capacity of cold stores created appears proportionate to demand, new creation must be carefully planned, to cater to new production capacities and zones that may come up as a result of interventions being made, and to match facilities at first mile that preconditions the produce for cold chain.

Responsibility: DAC&FW, DAHDF, MoFPI
Timeline: Short term
Refer Volume: III

6

In cold-chain, the first mile capacity to facilitate market connectivity of short life horticultural produce (e.g. greens, tomato, mango, litchi, brinjal, etc.) is a vital missing link. Therefore, building aggregation units (i.e. modern pack-houses and pooling points) at village level with transport links must be aggressively promoted. This has special importance in relation to diversification into horticulture. The details of the missing infrastructure components that need to be developed for putting in place an integrated cold-chain system are as in the table below.

Responsibility: DAC&FW, MoFPI
Timeline: Short term
Refer Volume: III, IV

Cold-chain infrastructure - Status & Gap

Type of Infrastructure	*Infrastructure Requirement*	Infrastructure Created	All India Gap	% share Shortfall
Integrated Pack-house	*70,080 nos.*	249 nos.	69,831 nos.	**99.6**
Reefer Transport	*61,826 nos.*	<10,000 nos.	52,826 nos.	**85**
Cold Storage (Bulk)	*341,64,411 MT*	318,23,700 MT	32,76,962 MT	**10**
Cold Storage (Hub)	*9,36,251 MT*			
Ripening Units	*9,131 nos.*	812 nos.	8,319 nos.	**91**

Infrastructure in number, refers predefined unit size; in MT denotes metric tonnes *Source: NCCD 2015 AICIC Study*

7

The anomaly that exists in the required cold-chain infrastructure in terms of proportionality needs to be corrected on priority. The required funds for this correction should be mobilised through higher budgetary allocation and private investments, ensuring rigorously that the investments are made strategically in the appropriate ratio. The new capacities created for an integrated cold-chain system, must ensure to balance the inter-component ratio, to integrate the throughput across the complementary infrastructure components.

A pan-India agri-logistics and marketing cooperative can be encouraged, servicing various agricultural produce and products. This can be promoted under NCDC (National Cooperative Development Corporation) and equity can be held by various stakeholders such as MARKFEDS, IFFCOA, GCMMF, IPL, etc.

Responsibility: DAC&FW support by DAHDF, MoFPI
Timeline: Short term
Refer Volume: III

8

The size of the infrastructure created, especially at village level, should match the volumes to be handled, integrated with the next stage of agri-logistics (both storage & transport). In case of pack-houses at village level, it is important in case of short life produce, that they should be able to only stock 2 or 3 days of harvested produce, so as to naturally stimulate the next stage of market connectivity through transport – thereby designed as staging hubs and not for long term holding. In such cases, long storage may not promote operations for necessary forward market linkage and delayed connectivity can compromise the quality of such produce.

Responsibility: DAC&FW, DAHDF
Timeline: Short term
Refer Volume: III

9

Implementing agencies that assist in creation of new agri-logistics infrastructure must assign the throughput volume as a development target and not only the created capacity or financial expenditure. This will promote other support activities to bring about better capacity utilisation resulting in improved capital use efficiency.

Responsibility: DAC&FW
Timeline: Long term
Refer Volume: III

10

There will be advantage to structure the induction retired personnel from defence and para-military services into post-production activities, agri-logistics and other hi-tech agricultural activities. These typically involve managing and operations of pack-houses, transport systems, poly-houses, industrial equipment, etc.

The operational skills of the retired personnel from armed forces (army, air force, navy and para-military) will be a value addition to the supply chain operations. Marketing and post-production activities require differentiated skill sets including understanding of industrial machines and disciplined operations.

Responsibility: DAC&FW, DAHDF, MSME, MoFPI, DoRD
Timeline: Long term
Refer Volume: III

11

Rural electrification targets may include mandatory supply to the local agricultural logistics and market infrastructure. Availability of power is a pre-requisite for modern agri-logistics.

Responsibility: DAC&FW, Ministry of Power
Timeline: Short term
Refer Volume: III

12

There already exist a large number of schemes of DAHDF (Department of Animal Husbandry, Dairy and Fisheries) that support agri-logistics. These include promotion of rural slaughterhouses; transport vehicles (open cage and refrigerated), mobile marketing units, and cold storage units for poultry products; retail outlets with chilling facility for piggery; capital assistance for fish processing, perseveration and storage infrastructure; establishment of fishing landing centres and harbours; central fish markets in metros; and the like. However, the intensity of investments and pace of development, across all these agri-logistics sectors meant for all components of animal husbandry need to be more robust, considering that this sector is one of the engines of growth in DFI strategy. Funds for this are to be mobilised through public and private sectors.

Under the public sector, a beginning has been already made to create non-budgetary resource based corpus funds. These funds may be strategically utilised with NABARD/NCDC as nodal entities. It calls for hand-holding the state governments and cooperatives who are to borrow the money at concessional rates of interest.

Responsibility: DAHDF, NABARD, NCDC
Timeline: Short term
Refer Volume: III

13

Transportation system for agri-logistics must be recognised to include multi-modes (namely, road, rail, water and air). It would be necessary to promote multi-modal transportation to achieve efficiency in transfer of commodities from production zones to consumption zones across the geography. Further, such transfer should also cater to the export markets.

Responsibility: DAC&FW, DAHDF, MSME, MoFPI
Timeline: Long term
Refer Volume: VIII

14

In order to promote multi-modal logistics and for seamless transfer of goods, the prerequisite is to design and adopt common standards (in packaging, palletisation, carriers, etc.) so that multi-modal cargo handling is facilitated. The non-standard sized trucks, pallets, boxes result in manual handling which does not promote multi-modal movement.

Responsibility: DAC&FW, DAHDF, MSME, MoFPI
Timeline: Long term
Refer Volume: VIII

15

So far, the emphasis in respect of transport logistics in the last 10 years has been on promoting reefer trucks and rail reefer vans. However this too has not been enough and a shortfall of 85 per cent of requirement exists.

Similarly, the country does not have railway wagons that are designed to facilitate multi-modal transport of agri-logistics. The integrated railway logistics (i.e. ICDs, CRTs, etc.) cater presently to imports while the need of the hour is to aggressively address the export markets. Hence the logistics must be redesigned to serve the purpose of evacuating from India to foreign shore, based on an efficient multi-modal systems.

Responsibility: DAC&FW, DAHDF, MSME, MoFPI
Timeline: Long term
Refer Volume: VIII

16

The waterways have not been brought into use for agri-commodity movement. The Sagar Mala, a flagship transport initiative of the government should, among others, cater to handling agricultural commodities. In the absence of this, irrational transportation costs will continue to impact agri-commodities – for example, transporting cotton fibre from Gujarat (production zone) to Tamil Nadu, the centre of spinning mills, is costlier than reaching the same from Africa.

Responsibility: MoS
Timeline: Long term
Refer Volume: VIII

17

Air cargo does not actively address agricultural movement. In case of floriculture the shipments go across the world and in other commodities, small shipments to neighbouring nations also avail air transport. The demand for air cargo is growing including from Himalayan States like Sikkim, and therefore infrastructure to handle perishable shipments at reasonable costs should be given due attention.

Responsibility: Ministry of Civil Aviation
Timeline: Long term
Refer Volume: VIII

18

Regular scheduled runs on container trains can be announced, provided the produce is packaged and safe for long distance travel. Dedicated focus is needed to initiate rail based, multi-modal transportation for sensitive agricultural produce. A low volume freight scheme especially for agri-logistics be considered, to strategically develop into regular and large volume movement on rail modes.

Responsibility: DAC&FW, DAHDF, MoR
Timeline: Short & Long terms
Refer Volume: III

19

The National Centre for Cold-chain Development (NCCD) that was set up as a public-private-partnership of stakeholders, with the objective to foster development of intergrated cold-chain systems, should be strengthened so at to scale up its contributions in this domain.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: III

20

In order to capture maximum value on the produce, integration of every famer in the country with the larger agri-value system (supply chain & value chain management) is necessary. The ability to directly link farm-gate with more markets empowers the farmer with a choice of buyers and also the option to take up other post-harvest operations. This ability is also directly related to the crops' post-harvest holding time which will define the logistics infrastructure.

Hence, every anchor of the agri-value system must diagnose the existing agri-logistics status, and identify the gaps in the system, to be filled on priority. Such assessments should form base of outcome based development that will facilitate the creation of various innovative supply chain models and enable the producer's to capture a larger share in the consumer's spend.

Responsibility: DAC&FW supported by DAHDF
Timeline: Long term
Refer Volume: III, IV, VIII

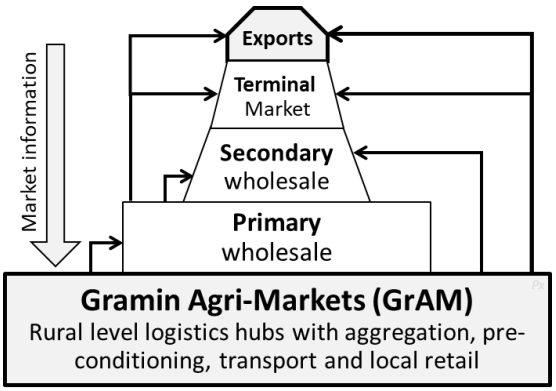
Market Architecture & Marketing

21

A new market architecture, comprising primary rural (grameen) agricultural markets (PRAM/GraM), competitive wholesale markets (APMCs in private and public sector) and export markets, is proposed.

All these three markets will require upgrading with appropriate market infrastructure, institutional and legal / procedural support through appropriate Acts / Rules / Guidelines / Executive Orders, as the case may be.

Responsibility: DAC&FW supported by DADHDF & DoRD
Timeline: Short & Long terms
Refer Volume: VIII



Refer Volume IV, chapter 5.

22

Develop PRAM/GraM in phases at all the 22,000 number of *haats* dotting the country. The basic requirement includes support and market linked infrastructure.

The support infrastructure refers to road connectivity from the farm gates, boundary walls to define the PRAM/GraM area, civic amenities, electricity, internal roads, etc. Most of this can come from existing government schemes like MGNREGA and PMGSY. The market linked infrastructure refer to weighing, assaying, packing, storage and dispatch systems, and the

aggregation and sale platforms including connectivity with eNAM platform. The funding for these can come from the market budget as also the specially designed corpus funds.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IV

23

Given that small and marginal farmers dominate the landscape whose produce on sale are of small size, aggregation is the solution to efficiency of transaction. The proposed PRAM/GraM will now be serving as aggregation platforms within a radius of 5 to 6 km from farm-gate. The centres will facilitate local retail, as well as function to aggregate and dispatch produce directly to optimal markets/terminal markets that feed last mile retailers.

This intervention has to be facilitated by right sized transport and storage. This opportunity should be tapped for promoting enterprise among rural youth by establishing credit linked back-ended financial aid to the entrepreneurs.

PRAMs/GrAMs should be kept outside the purview of the existing State Marketing Acts. The government may initiate with guidelines to facilitate the development of these aggregation hubs. Subsequently, to remove any amorphousness between these retail oriented market platforms from wholesale markets, the government should formulate a facilitating Model Act for the primary rural agri-markets, which the states can suitably adopt.

Responsibility: DAC&FW supported by DoRD
Timeline: Long term
Refer Volume: IV

24

Land parcel for aggregation centres and integrated pack-house (PRAM/GrAM) be identified at the village level. Pre-designating a land parcel will allow for faster permits; and Change Land Use (CLU) can be waived for near farm facilities such as pack-houses and small processing units.

Responsibility: DAC&FW, MSME, MoFPI
Timeline: Short term
Refer Volume: III, IV

25

The state governments may convert the existing principal and sub-market yards into full-fledged and independent markets. In addition, notify accredited warehouses, cold storages etc. as independent markets under the provisions of the State Marketing Act.

The Committee suggests a cumulative of 10,000 number of primary wholesale (APMCs/APLMCs) and terminal markets. As provided in the Model APLMC Act, 2017, offer support to even private sector markets and ensure level playing field to both public, private and PPP based markets.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IV

26

Since PRAM/GrAMs are a historic step forward towards aggregation of the fragmented agri-products, it would be good to have optimal blend of utility and aesthetics. In order to do the best, ideas may be crowd sourced through competitions on design and standardisation. It would help to standardise the layout and construction material to promote seamless activities, besides creating a uniform look and feel. Some of these can also become agri-tourism centres.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IV

27

The Model Agriculture Produce and Livestock Marketing (Promotion & Facilitation) Act, 2017 released by the central government enables development of different types of markets for livestock in both public & private sectors. This should be adopted by the States as it facilitates the setting up of private markets of different nature. The private sector must be encouraged to make investments for growth and promotion. Here too, a proper blend of aesthetics and utility must be kept in mind.

Responsibility: DAC&FW
Timeline: Short & Long terms
Refer Volume: IV, XIII

28

The Model APLM Act, 2017, allows provision for the automatic notification of agri-produce warehouses, silos and cold stores as markets. This will facilitate more immediate access of storage facility and also help in expanding the market network. Existing premises would therefore be facilitated as market platforms, adding to resource use efficiency.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: III, IV, XIII

29

In case of existing public sector APMCs, new generation infrastructure including electronic weighing machines, assaying labs, cleaning, grading and packaging units need to be set up. This may be achieved through both public sector investments and also by attracting private investments by rolling out suitable policy guidelines. There exists scope for PPP mode of investment.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IV, XIII

30

The evacuation of the fresh agricultural produce to markets is the first priority for farmers. With improved transport and communication, the ability to do so has improved substantially. Yet it should be recognised, that there will remain non-evacuated surpluses at village level that will need to be processed into other forms to extract maximum value from the output. Hence, promote cottage and village level processing units under micro and small enterprise sectors as part of the marketing strategy. These become another near-farm market channel for the farmers.

Responsibility: DAC&FW, MSME, MoFPI
Timeline: Long term
Refer Volume: III, IV, X

31

More multi-purpose market yard complexes, comprising of aggregation hubs including pre-cooling of horticultural produce, farmer's service centres, reefer transport (road and rail), cold storage, etc. need to be established for direct use of farmers, as direct users or under FPO management as part of a national logistics policy.

The food parks facilitated under Kisan SAMPADA Yojana, allows such complexes, while incorporating food processing. There is ample scope to enhance needed support to food processing in case of meats and fish products, millets, oil-seeds, as also in a few of the horticulture crops. Suitable prioritisation may be done.

Responsibility: DAC&FW, DAHDF, MoFPI
Timeline: Long Term
Refer Volume: III, IV

32

Infrastructure, including for bio-security at markets, needs to be developed at livestock markets. Animal welfare is not addressed at existing live animal markets, and is need of the hour. Market infrastructure should also cater to specialised activities such as sheep shearing, wool treatment, silk yarn pre-treatment etc. as per local producers' needs. Wool markets can be improved by providing modern shearing facilities and such facilities can be developed at specialised GrAMs (proposed for development) in sheep rearing areas. The shearing tools and raw wool handling can be provisioned as a service option at these GrAMs, besides the subsequent e-marketing of the wool to the woollen industry.

Responsibility: DAHD&F
Timeline: Short term
Refer Volume: VIII

33

Processing facilities such as slaughter houses and fish blast-freezing units need to be upgraded and provided a spatial spread. There are about 4,000 slaughter houses registered with local bodies and more than 25,000 unregistered premises, which indicates the need to modernise the existing slaughterhouses and facilitate their registration. The local self-government bodies including gram panchayats, municipalities etc., should support and promote slaughterhouses in accordance with prescribed standards.

Responsibility: DAHDF, MoFPI, MSME
Timeline: Short Term
Refer Volume: III

34

The cold chain connectivity in domestic fish markets needs to be strengthened as the domestic consumer is the mainstay of fishers and hinterland demand remains untested due to insufficient cold-chain connectivity. Unlike horticultural produce almost all production from livestock and fisheries benefits from food processing, as a marketing intervention. Therefore, it is recommended that special attention is directed for increased development of food processing industries and the market linked supply chain of these sub-sectors.

Responsibility: DAHDF, MoFPI
Timeline: Short term
Refer Volume: IV

35

The Centre and the States should work concertedly to achieve a truly unified national agricultural market (NAM) within a period of three years (ie. 2019-20). This can be achieved by increasing the coverage of markets under e-NAM to a cumulative of 1000, and promoting alternate online platforms in the public sector by the states, as well in the private sector, besides joint venture platforms.

In order to facilitate this, Government of India's e-NAM platform may serve as a common platform with inter-operable architecture, so that all other platforms can be integrated centrally, and with one-another. The Ministry needs to adopt open source software at the earliest, and lay down the IT system standards and specifications to be adhered to.

Responsibility: DAC&FW
Timeline: Long Term
Refer Volume: IV

36

The Centre and the States/UTs may set up special purpose vehicles (SPV) to own and operate the national agricultural market (NAM). To realise this, the DAC&FW may appoint an expert agency to give specialist advice on the transactions involved.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IV

37

There is need to bring dedicated focus on the empowering aspects of agriculture, i.e. agri-logistics, agricultural markets and agricultural marketing, including price and demand forecasting.

DAC&FW may re-designate the existing Marketing Division to include Agri-logistics or provide special focus by creating a new Division of Agri-logistics. The Marketing Division also needs to align its activities with the Divisions of Trade and International Cooperation (IC). The heads of these three Divisions should meet through an institutional mechanism under the guidance of an Additional Secretary. This can similarly be replicated in DAHDF too.

Responsibility: DAC&FW, DAHDF
Timeline: Short term
Refer Volume: IV, XIII

Market Support

38

It is recognised that an efficient and effective marketing system will bring the maximum benefit to farmers. In reality the market conditions are less than perfect and price and market support will continue to be sine-qua-non. Notwithstanding increase in MSP year on year, lack of assured procurement detracts from the intention.

The government may consider at least 50 per cent margin on all paid out costs of production, for the notified commodities, incurred by farmers in cash or kind, including imputed value of family labour. This, combined with assured procurement, for the share of production government requires to procure, would be a good income intervention in favour of farmer.

From perspective of equitability, a universal coverage in terms of geography and all MSP notified crops, needs to be considered. The other recommended market interventions, as they get implemented, will lead to more optimal demand linked value realisations.

Responsibility: DAC&FW, DoFPD
Timeline: Short term
Refer Volume: IV

39

Government should broad base and strengthen procurement operations to cover as many crops as possible (other than wheat & paddy) and be secular across the production regions. It is suggested that the procurement operations be conducted with view to stabilising market prices and not as income transfers. This will require the government to adopt a procurement threshold level of 15, 10, 5 per cents, of the marketed surpluses for pulses oilseeds and other cereals, respectively.

Income transfer approach is as yet not conducive, given market imperfections. This approach while being cleaner & simpler is appropriate when spot markets are robust, information symmetry is in place and market integration has brought in transparency & efficiency.

Responsibility: DAC&FW, DoFPD
Timeline: Short term
Refer Volume: IV

40

The Market Intervention Scheme, comes into picture whenever there is a drastic drop in the price of a commodity which is not covered under Minimum Support Price scheme. In the current mechanism, when there is crisis in the market, the states approach the centre, when a committee is setup to examine and estimate the costs to fix the MIS price. This can cause delays in market intervention especially perishable crops, whose marketing is a complex process. To make such farmer-friendly interventions more meaningful, there is the need to facilitate a rapid response mechanism.

To facilitate this it is recommended to set up a technical body with members drawn from DAC&FW, ICAR, SAU and State Governments, etc. that will prepare advance guidance value for major crops, particularly tomato, onion and potato every season, so that the response will be quick and state governments can promptly start the procurement process.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: IV, VIII

41

In order to broadbase procurement operations, develop alternative instruments and offer a bouquet. The Committee suggests 3 options – Market Assurance Scheme (MAS) as a replacement to one in operation Price Support Scheme (PSS); Private Procurement and Stockist Scheme (PPSS); and Price Deficiency Payment Scheme (PDPS). The states may be offered the choice to roll out one or more of these depending upon the crops to be covered and market situation.

Since MAS and PPSS are interventions that will suck out the surpluses and in correcting demand-supply equilibrium, they are well suited to crops that are in surplus. PDPS, which compensates the farmer for the market price that is lower than MSP, can be adopted in oilseed

crops, whose production is far short of the demand. However, the Central Government is offering the States these options along with financial support may make adoption of market reforms conditional.

Responsibility: DAC&FW, DoFPD
Timeline: Short term
Refer Volume: IV, XIII

42

All the existing schemes including FCI operations, PSS, MIS and PSF as also the newly proposed MAS are primarily government owned and driven schemes. In order to achieve higher percentage of procurement, it is necessary to bring in private sector to supplement the government led schemes.

The Committee recommends that the MSP linked procurement be opened to private sector where the selected / empanelled enterprises are allowed to enter the market for purchase of the farmers' produce at MSP. In order to elicit desired response, an appropriate package of incentive consisting of service charge (one that can cover handling costs) and a conducive business environment may be offered. Therefore, a new instrument to for procurement by private stockists (private sector enterprises) is proposed – see chapter 6, Volume IV.

Responsibility: DAC&FW supported by DoFPD
Timeline: Short term
Refer Volume: IV

43

A benchmark floor price or reserve price for private auctions at regulated markets can be considered. The reserve price may be the Cost of Production (CoP) as estimated and recommended by the CACP.

Keeping in mind that the per unit cost for each commodity can vary, depending on the ecology and other conditions in a region, the DFI Committee recommends that the States may be allowed to adopt a differentiated reserve price by topping up the CACP recommended CoP with a hardship factor (H), determined on the basis of the average yield per hectare of a crop in a district/state, the status of irrigation (rainfed or irrigated) in the area, and the cost of inputs. The district should aim to reduce this economic overhead by taking appropriate development to reduce factor H.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IV

44

States may nominate agri-trade representatives in other states to promote demand driven inter-state agri-trade, to take advantage of a unified national agricultural market. Besides improving the external market interface of small and marginal farmers, to integrate them into the marketing system, it is also critical to mobilise them into a large number of farmer producer and village producer organisations (FPO/VPO).

A minimum target of 7,000 FPO/VPO be adopted where each such organisation may cover 1000 farmers and/or 1000 hectares. Developing entire village zones as Village Producer Organisations (VPOs), to collaborate and produce one or two crops can be considered. There

is need for FPO/VPOs to group contiguous land parcels to achieve desired benefits. They may also be incentivised by treating them at par with Cooperatives.

Responsibility: DAC&FW and DAHDF supported by DoRD, DoPR
Timeline: Short term
Refer Volume: III, IV

45

Ongoing fiscal incentives be directed for purpose to promote and support the private sector in interacting with FPOs/VPOs or PACS. FPOs/VPOs/PACS can certify the farm collaboration or procurement by private sector enterprises, and the incentives be linked to these operations. To scale up the FPO/VPO it is suggested to amend the Companies Act, to facilitate private sector shareholding in FPOs which may be allowed upto 26 per cent.

Responsibility: DAC&FW
Timeline: Long term
Refer Volume: III, IV

46

States must develop FPOs/VPOs/Cooperatives that can integrate their production with the demands of the processing industry, thereby supporting the industry as well as bringing an assured market to the farmers. This will also reduce wastage of goods that cannot be immediately linked to consumers and recover value from such output. The Model Contract Farming & Services Act, 2018 can be adopted to facilitate such integration.

Responsibility: DAC&FW, MoFPI
Timeline: Short & Long terms
Refer Volume: VIII

47

A domestic freight subsidy for FPOs to transport their produce over road, rail and waterways can be considered. The discounted freight can have a sunset clause, based on fixed volume and value of produce being transported. On achieving critical mass, the subsidy for that lane be stopped. Support to be applicable only when shipment is initiated by FPC / PACS, or a village or block level assembly or aggregation centre or integrated pack-house.

Responsibility: DAC&FW, DAHDF
Timeline: Short term
Refer Volume: III, IV

48

Rural youth to be given opportunity to own and operate village pack-house or as driver-entrepreneurs (on the lines of driver-truck owners) to operate transportation for FPO/VPOs, or as a service to PRAM/GrAM. With rural areas as source of transport, reverse logistics to supply consumer goods to villages will also benefit.

Responsibility: DAC&FW, DAHDF, DoRD
Timeline: Short term
Refer Volume: III

49

All Krishi Vikas Kendras (KVKs), Central Agriculture Universities (CAUs) and State Agriculture Universities (SAUs) can adopt local aggregation centres (rural market yards and/or aggregation and pack-houses) with a purpose to increase market linkages and develop the

commercial competitiveness of each such centre. The collection and supply into these aggregation centres can be facilitated by individual Panchayats or FPOs/VPOs or Primary Agriculture Cooperative Societies (PACSs).

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: III, IV, VIII

50

To promote value led production system, the DAC&FW may develop guidelines and launch an Agriculture Value System Partnership Platform which will function to build collaboration with government, private sector, cooperatives, NGO, etc. across sectors, with the primary objective to mentor farmer's enterprise and the activities that result in doubling farmers' income. A broad organisational structure and mandate is in chapter 8, Volume IV.

Responsibility: DAC&FW supported by DAHDF
Timeline: Short term
Refer Volume: III, IV

51

There is need to set up teams at state or district levels to measure and assess food loss quantities in the agricultural supply chain, so as to set benchmarks to target an incremental reduction of physical losses of agricultural produce over the next 4 years. The reduction in food loss should form a measurable outcome target for the agencies tasked with developing various post-harvest infrastructure.

Responsibility: DAC&FW, DAHDF, ICAR
Timeline: Short term
Refer Volume: III

52

Consumers need to be educated about the nutri-rich status of millets. For instance millets or nutri-cereals are gluten free & are generally low in glycaemic index; are rich in calcium & other nutrients; and high in fibre. Ironically, a biased perception of millets as poor man's food has affected demand for them adversely. Specialised marketing and awareness campaign to develop a larger demand for nutri-cereals may be undertaken. The Government may notify a year as "Year of Nutri-cereals" to bring the desired focus on these forgotten crops. Simultaneously, it may make efforts to seek FAO's support to announce "International Day of Millets" and "International year of Millets".

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IV, VIII

53

Nutrition-led marketing to reinvigorate demand for the 'parampargat' produce, traditionally cultivated and sustainable in India, can be taken up for public service. Such promotional marketing will also help mitigate malnutrition problems (over and under nourished). Most marketing is focused on specific products and brand promotion by commercial entities. There is little marketing of non-branded, yet nutritional, produce of India.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IV

54

Development of Special Agribusiness Zones (SABZ) for millets will go a long way for the development of particular millets which is popularly cultivated in the local areas. Various SABZs can be developed across the country based on locational strengths. These SABZs can develop around FPOs, farm gate level primary processing facilities, ware housing units and value added food products.

Entrepreneurs can be backstopped with the value addition and process technologies developed at Indian Institute of Millet Research (IIMR), Hyderabad which in turn will enhance the farmers' share in consumer's rupee. The SABZs will serve as promotional hubs for realizing export potential of value added products from millets. Linking the millets producers with processing industry provides a win-win solution for farmers, processors, consumers and the environment.

Responsibility: DAC&FW, MoFPI, ICAR
Timeline: Short term
Refer Volume: III, IV, VIII

55

Develop organised retail for the promotion of more 'SAFAL' type organisations so as to consolidate consumer demand in major cities. Special status be given to start-ups that plan businesses related to agriculture logistics and marketing. A start-up incubator to support and promote enterprises involved in post-production activities be established by government.

Responsibility: DAC&FW, DoFPD, MoFPI
Timeline: Long term
Refer Volume: III, IV

56

Organic product standards in practice in the country are derived from US and European standards. Develop national protocol and regulatory legal framework for organic certification standards coherent with Codex Alimentarius.

Responsibility: DAC&FW
Timeline: Short Term
Refer Volume: VIII, VI

57

DAC&FW may constitute an inter-ministerial committee to study and suggest ways to harmonise the various product standards and grading parameters adopted by different agencies (BIS, APEDA, FSSAI, Agmark, etc.). This is a pre-requisite to creation of a NAM which works on the online platform.

Responsibility: DAC&FW, BIS, APEDA, FSSAI
Timeline: Short term
Refer Volume: IV

Agri-Export Markets

58

Export of agri-produce may be taken up as an active market activity, at par with focus on GrAMs and APMCs/APLMCs. This calls for active partnership among various stakeholders – Ministry of Agriculture, Ministry of Commerce, and Ministry of External Affairs. An 'Agricultural Trade Cell' may be established for this purpose.

An aggressive agricultural trade policy is recommended, to raise the agricultural exports to double the total volume of exports with achieve a target of USD 100 billion in value by 2022-23. Further the basket of commodities exported should be made broad-based and reach beyond cereals and meat, which currently account for the bulk of the exports. Export of all type of agricultural goods, value added products, semi processed as well the primary agricultural produce of farmers, should be equally promoted.

Responsibility: DAC&FW, DAHDF, DoCI, MEA
Timeline: Short term
Refer Volume: IV

59

Agricultural trade policy with a long term perspective of 5 to 10 years be adopted, such that there are no knee-jerk reactions that result in fluctuations that disable the associated trade relationships. Both domestic and export markets are affected by the trade regime. A permanent inter-ministerial committee including those of commerce, consumer affairs and agriculture may be constituted with the mandate to monitor closely both the domestic and global price situation for different commodities, and recommend to government the needed changes keeping in mind the conflicting interests of the producers and the consumers. This can serve as a common Committee to serve two purposes, namely, (i) demand and price forecast; and (ii) advice on import-export duty structure. This Committee may be supported by a technical body like restructured DMI as Directorate of marketing and Intelligence.

Responsibility: DoCI supported by DAC&FW, DAHDF, DoCA
Timeline: Short term
Refer Volume: IV

60

Indian embassy/high commission system should include the post of Advisor (Agri-trade) to be filled by domain experts/experienced development administrators/policy makers in agriculture and allied areas, of suitable seniority. These trade experts would be tasked to monitor the market conditions in their host countries, interact with traders & exporters in India and assist in resolving their market access issues.

Responsibility: DAC&FW supported by MEA
Timeline: Short term
Refer Volume: IV

61

Export promotion agencies of the govt. can be restructured to incorporate a market research and analytics cell, so as to develop pull-based exports, and not merely to push products and brands tentatively into unstudied markets. Monitoring of market share and a feedback mechanism should be incorporated to make producers responsive and remain competitive in export markets.

Responsibility: DAC&FW, DoCI
Timeline: Short term
Refer Volume: IV

62

Promotion of exports also requires investment in infrastructure. These include agri-logistics at airports and seaports besides internal container depots. Currently, the export shipments undergo inordinate delays due to congestion and lack of basic infrastructure e.g. airports don't

have trolleys, and shipping ports don't have suitable facilities. The master plans for of sea ports should design for increased agri-produce export volumes with systems for food handling and export facilitation.

Responsibility: DAC&FW, MoCI, MoS, MoRTH, MCA
Timeline: Short term
Refer Volume: VI

63

For export markets, the source of the shipments i.e. integrated pack-houses should have infrastructure for treatment of the cargo, such as vapour heat treatment, irradiation (where needed), x-rays and pre-shipment inspections. APEDA may prepare an action plan for strengthening the infrastructure for exports, based on a comprehensive study especially at the already identified export clusters.

Responsibility: APEDA supported by DAC&FW, DAHDF
Timeline: Short term
Refer Volume: VIII

Improving efficiency

64

There is the need to rationalise the government subsidy schemes and strategically allocate more share to develop the weaker links in the supply chain, especially those that boost investment in infrastructure and assets at village level.

The performance and achievement of schemes that support infrastructure development, should adopt metrics of resource use efficiency, such as capacity used, volume of agricultural goods marketed, expansion in market range of farmers, losses mitigated, etc. Mere focus on creation of capacity does not lend to convergence of other support to bring gainful and desired use of the capacities created.

Responsibility: DAC&FW, DAHDF, MoFPI
Timeline: Shot & Long terms
Refer Volume: III

65

The capital goods used for creation of, and for modernising the agricultural logistics, such as PRAM/GrAM, reefer vehicles, warehousing, silos, cold stores, etc., can be exempted from GST to reduce the cost burden to incentivise development of agricultural logistics and marketing network.

Responsibility: DAC&FW, MoF
Timeline: Long Term
Refer Volume: III

66

To maintain a future ready approach to logistics and market development, the schemes need to provision the active promotion of various energy saving systems for energy intensive post-production activities. Such systems can be in the shape of hybrid energy sources for milk chillers or warehouses, program logic control systems, thermal storage banks, solar powered and other solutions to capture or recover waste energy, and other appropriate technologies that can bring more sustainable energy uses in transportation and other areas of logistics. These

interventions will also align the future development with the energy efficiency commitments made under the Kigali agreement of the Montreal Protocol.

Responsibility: DAC&FW, DAHDF, ICAR, MoFPI
Timeline: Long term
Refer Volume: III

67

The government may revisit the guidelines/eligibility criteria relating to post-harvest sub-vented loans, so as to make it available to small and marginal farmers, even when they may not have availed themselves of a crop loan; or having availed of a crop loan repayment is due only because there still is time for repayment. This will assist small farmers to redeploy their available resources in a more efficient manner to better manage their enterprise.

Responsibility: DAC&FW, NABARD, WDRA
Timeline: Short term
Refer Volume: IV

68

Currently the system of prepared project reports, tends to deter and delay credit offtake even in case of small value added investments. Certain identified components, which are capped at a specific cost and for purpose of aggregating or transporting produce, may be considered under a prescribed lending format that is simple for availing priority sector credit. Instead of requiring fresh detailed project reports as for greenfield projects, the components that help an existing enterprise to achieve improved use efficiencies in post-harvest management may be considered for fast-tracked credit, instead of requiring

Banks may formulate ready to use loan application formats (credit product lines) to ease the access to credit for various equipment and components that help to modernise existing operations in post-harvest infrastructure.

Responsibility: DAC&FW, DAHDF, NABARD
Timeline: Short term
Refer Volume: III

69

In addition to strengthening the existing livestock markets (2000 in numbers) across the country, market integration by upgrading ePashuhaat (the online trade platform) needs emphasis. Similarly, the initiatives like NCDFI eMarket for diary sector participants need to be strengthened. This will include support of integrated logistics and associated facilitation of physical trade for delivery fulfilment.

Livestock marketing is dominated by the cooperatives and private sector. Inducing higher efficiency in these would help the especially the small farmers as they do not have safe and easy access to livestock markets. Infrastructure support and policies should aim to facilitate such access to promote trade and bring these markets to full utility.

Responsibility: DAHDF supported by DAC&FW and ICAR
Timeline: Short term
Refer Volume: IV, VIII

70

The farm harvest price (FHP) is available at state and district level or the wholesale price data during the peak season in the APMCs. FHP data is currently available only at the state or

district level and has a certain time lag. Appropriate mechanisms for collection of recent FHP at more disaggregated level like blocks/villages would be desirable.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: I, III

71

The marketed surplus is available at the aggregate level, and this does not hold much importance from the point of view of demand driven product movement from one region to the other, or from one market to other markets. It would be appropriate if the surplus at each market level is also assessed, for managing and balancing supply and demand. This will also help reduce the price volatility arising at certain locations/markets.

Measuring of market surplus (excess supply at the market level) besides marketable and marketed surplus needs to be undertaken.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: I, III, IV

72

It is recommended that at the national level, an institutional mechanism for a market intelligence system be created, to assess commodities prices, consumption trends and thereafter project required demand in quantities. The demand projection must cover periods in advance of sowing cycle; annual, bi-annual, monthly and weekly and can initially target the top 10 cities of the country. Information on demand and price forecast can help mitigate some of these aggravating factors.

Responsibility: DAC&FW
Timeline: Long term
Refer Volume: III, IV

73

DAC&FW may undertake the restructuring of DMI, moving from marketing & inspection, into the Directorate of Marketing & Intelligence so that it is able to advise the government on market prices as related to the farmer-producer.

DMI for this purpose, may adopt a suitable price forecasting model. However, this forecasting may be initially shared with caution until its eventual robustness is verified and demonstrated. Restructured DMI may give technical backstopping to the recommended institutional mechanism for demand & price forecasting; and international trade.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IV

74

Two Marketing Boards that specialise in storable and non-storable crop types be developed. One may focus on "store and sell" operational model and the other would specialise in "connect and sell" model, especially with mandate to access the unified national market as well as to support export promotion (to support APEDA).

These marketing boards may be set up under PPP (Public-Private Partnership) mode with a special one-time grant. The Boards would require to liaise with state level marketing organisations and be in alignment with the National Value System Platform.

Responsibility: DAC&FW
Timeline: Long term
Refer Volume: VIII

75

A national policy to streamline logistics, keeping special focus on addressing the challenges in agri-logistics, may be developed to serve as a guide for future strategies by various government agencies.

The priority and thrust of such a logistics policy should be on minimising the touch-points or injudicious handling in the logistics chain, maximising the direct physical connectivity and throughput between sources and terminal destinations, minimising the barriers to free movement of agricultural produce between states for manifesting a unified national agricultural market, ensuring that interventions will drive logistics connectivity in currently un-serviced pockets of the country, and with the umbrella objective to empower small and marginal farmers to collectively connect them with the larger domestic market as well the global markets. The benchmark indicators to drive the policy objectives may be consequently be designed in context of operational effectiveness, expanding coverage of logistics to subserviced areas, as well as service efficiency.

Responsibility: DAC&FW, DoE, MoCI
Timeline: Long Term
Refer Volume: III, IV

For full context and other details, the linked domain specific Volumes of the DFI Report may be referred to.

Chapter 5
Resource Use-efficiency and Diversification

As the DFI strategy brings focus on income of farmers and the agricultural mandate comes to be redefined, whereby the production system of the country aims to feed not only the human & cattle populations, but also provide raw materials to energy & industry sectors, the large dependence on rice-wheat based Indo-Gangetic Plains, for the nation's food security needs to be closely monitored, for continued sustenance. Due to continuous extraction of the region's natural resources including soil & more critically soil organic carbon, water etc, the production environment is under threat. All the related issues need to be addressed on priority, with particular emphasis on soil-carbon. Hence, resource use efficiency forms the core of sustainable approach to agricultural production. And this is certainly not limited to the Indo-Gangetic Plains alone. Resource use efficiency is the need of the hours across the country, for purpose of sustainability and reduction in cost of cultivation.

The broad contours of the agricultural production system in the country have been defined by the need to achieve food security for the country. Now that the vision is to impart income security to the farmers of the country, diversification of the system across all the sub-sectors of agriculture assumes importance. It is no gainsaying, that the new engines of growth are housed in horticulture, dairy, livestock, fisheries and aquaculture.

Diversification across crops and sub-sectors holds special meaning and purpose in Indian agriculture, as it is innately a de-risking mechanism capable of negotiating both endogenous and exogenous risks associated with the system. Some of these constitute, dominance of small & marginal farms, heavy monsoon dependence, climate change, and the like.

Diversification when adopted at farm level promotes resource use efficiency, sustainable intensification, nutritional security and productive employment, as it networks supplementary and complementary relations between and among different farm activities. In this context, diversification should form the basis of agriculture system in the country which will ensure optimal farm incomes at the farmers' level and domestic sufficiency at the national level.

In the following sections, recommendations relating to resource use efficiency of various factors of production are made.

Soil health management

1

i. The Government's Soil Health Card (SHC) Scheme has begun to get more efficient in terms of delivery since its first launch in February 2014. This is on account of upgraded soil testing laboratories, private sector participation, better manpower capabilities and greater awareness. However, the attention that needs priority is on educating the farmers about the efficacy of using the nutrient recommendations. One of the critical pre-requisites to achieving this is total re-orientation of the Public Extension System (PES), so that their faith in the

efficacy of SHC scheme is concretised. This is a pre-requisite to gaining farmers' faith in SHC based nutrient management.

ii. SHC can become more practical, if 'on-demand' service is facilitated. This includes generation of electronic SHC (eSHC), nutrient recommendations on any crop and at any time. This facility should be made available to the farmers online, downloadable at local Citizen Service Centres (SHCs), on-mobiles etc.

iii. While the government's free delivery of SHC may be as per the fixed cycle, (2 years as of now), there should develop a more flexible system, so that farmers are able to seek paid services at any point of time as per their specific needs.

iv. Create an eco-system for private initiative to own and meet end-to-end requirements of soil health card (SHC) scheme starting from soil sample collection to laboratory test and finally the distribution of card with recommendations. The recommendations should however be based on the research findings and advice of the NARS (National Agricultural Research System); more precisely as per the recommended package of practices of the local SAU.

v. One of the major challenges in SHC is ensuring integrity of sample collection and wet chemistry based testing. The technical competence of manpower and capacity of infrastructure is very important. Hence:

- Diploma and Certificate courses be customised, that will produce adequate manpower to meet the demand in both public and private sectors that take up SHC management.
- Strengthen public sector infrastructure to serve as referral laboratories and as Regional/State Testing Laboratories. These should mandatorily adopt Good Laboratory Practices (GLPs) and be accredited.
- Encourage private sector infrastructure, in the nature of mini and major labs; mobile and static labs, capable of carrying out multiple tasks of SHC system; and also be capable of testing for comprehensive parameters (major, secondary & micro-nutrients; physico-chemical properties). Private enterprise be promoted by facilitating credit linked subsidy back-ended avenues among the educated youth.
- Since a single service based activity may not be financially viable, it may be considered to promote a single stop service centre that meets multiple needs of farming. For example, soil testing, assaying (for commodity quality testing), extension service, input sales, farm machinery etc. Farming as a Service (FAAS) is the concept that deserves promotion.

vi. Water impacts soil and plant growth. Hence, water testing may also be included based on identified parameters, particularly when ground water is used. In due course, plant tissue based testing for nutrient status and its management must also be adopted.

vii. Long term studies have demonstrated that, existing fertilizer recommendations included in the package of practices are sub-optimal for several crops. It is critical that all states review the 'General Fertilizer Recommendations' for need based improvements. ICAR and SAUs must take up this task on priority.

viii. Fertilizer recommendation should target field-achievable maximum economic yield (MEY) from the cultivar. It is defined as the yield level that gives highest possible economic return per hectare. This will rationalise the quantum of nutrients used in contrast to use of higher quantum blindly, and thereby result in lower cost of production.

ix. Customised Fertilizers (CF), though introduced in 2008 are yet not popular Small scale industries may be allowed to manufacture CFs for small zones like Taluk or District.

CFs also need to be given a level playing field by offering them subsidy at par with straight fertilizers. CFs cannot catch up with straight fertilizers which benefit from subsidy.

x. Promote liquid fertilizers for greater efficiency of uptake and savings.

xi. Soil Organic Carbon (SOC) is the key to sustainable soil health. It improves soil structure and availability of nutrients to the plants. Hence, major attention is required on increasing the utilisation of organic manures through adoption of multiple approaches – bio-agents, green manures, legumes, FYM, compost etc. Over period, SOC in Indian soils has reduced to an average of 0.3 per cent and needs to be built up urgently.

xii. Build capacities of fertilizer input dealers, so that their advice to the farmers is scientific, evidence based and rational. To begin with it is necessary to prescribe minimum qualifications and adhere to the same.

xiii. Innovation in fertilizer products has not received adequate attention. Public investment in research towards this needs to be increased.

xiv. Government (Public) Extension System should focus on advocating and promoting balanced use of fertilizer and soil health management, letting private sector play the dominant role in soil test infrastructure and services.

xv. A central data base of soil sample test results should be maintained and offered access to all including researchers and private sector. It should further lead to Land Use Based Planning for production system.

xvi. The current wet chemistry based soil testing system linked to sample collection on a grid basis has certain limitations, in terms of accuracy of results. Further, Indian farming being largely manual, the uniformity of the soil health across individual farms/grids is not always accurate. Hence, the newer technologies based on spectrometry technologies maybe brought in for better accuracy. This will also help in reducing the time lag between collection of soil sample and nutrient recommendations.

	Responsibility: DAC&FW, ICAR
	Timeline: Short term; Long term in respect of R&D initiatives
	Refer Volume: V

2

Upgradation of SHC system: The SHC scheme is a laudable and progressive initiative. Based on the 3 years of experience, it is time to revisit and make necessary changes, so as to improve accuracy of test results, reduce cost and time involved and address soil health in a more comprehensive manner. Soil health is a function of physical, chemical and biological properties of the soil. In the SHC, while physical & chemical properties are well taken care of, the same cannot be said of biological parameters. Currently organic carbon has been taken as the proxy for biological health of the soil, but may not be adequate.

Greater efficiency can be brought to SHC by adopting a 2-tier system of testing for parameters. There exists lot of soil data collected over the decades by various agencies like the National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) & AICRPs of the ICAR, SLUISI of DACFW etc. Data and information by all such agencies may be collated into a single database and analysed for 'Tier-I' interpretation of parametric values. This will show regional variations, and therefore suggest the specific parameters that will need to be tested for different

agro-climatic situations. In tune with this, 'Tier-II' should involve testing for parameters with high probability of deficiency eg., Copper, one of the micro-nutrient now being tested for may not be deficient in most parts of the country, and may therefore not be needed to be tested. If such 'Tier-I' filtration approach is adopted, the efficiency of testing at 'Tier-II' will improve and reduce cost of testing besides improving speed & accuracy.

Standardisation of geo-referenced sampling procedures will help in optimising the number of samples to be collected from a given area. Soil health management using SHC as a tool will move a progressive step forward, if ICAR can advise on a more efficient sample collection procedures, agro-climate based parameters to be tested and use of hyper spectral imaging techniques.

Responsibility: DARE-ICAR
Timeline: Short & Long terms
Refer Volume: V, VII

Water management

3

India's food security has come at the cost of the country's water security. Also, nutrition security is yet to be realised as can be interpreted from the findings of National Family Health Survey (NFHS), 2015-16.

The Green Revolution of the 1960s was led by rice and wheat, and with continued support at producers' level (MSP and assured procurement) and also at consumers' level (subsidised distribution through PDS and NFSA, 2006), both supply and demand have been triggered to feed on each other. Deprived of such 'twin support' other more nutri-rich and resource use-efficient crops like millets & pulses have lagged behind.

In a study, 'Alternative cereals can improve water use and nutrient supply in India' published in 'Science Advances' (a global science journal), the unhappy relation amongst the parameters, namely, current cereal output pattern, nutrient output and water use efficiency has been brought out.

In building a water management strategy, the following aspects may be kept in mind:

- Of the cereals grown in India, rice consumes the highest water per tonne of output while delivering the least nutrients-iron, zinc and protein. Nutrition security is the current demand of the country.
- Substitute rice by more nutrient-dense and less water-intensive cereals. This will yield a higher nutrition output. The suggested substitutions are maize, sorghum, pearl millet and finger millet.
- Achieve high water saving by substituting rice in the northern grain belt. Draw up a road map of current rice-intensive districts in Punjab, Haryana and Western Uttar Pradesh and incentivise crop substitution in a staggered manner, aligning it with increasing output of cereal substitutes.

- Similarly, there exists scope for swapping of rice for maize and sorghum in 38 and 22 rice-growing districts in Madhya Pradesh and Maharashtra respectively. This will also result in water saving.

In re-architecting the foodgrain kaleidoscope of India, care must be taken to ensure that the current food secure status is not diluted in any way, and is transformed into one of food security, nutrient sufficiency and is the outcome of an efficiency in resource use technology & practices.

A long felt need for a comprehensive and 'under single roof' water management approach has been fulfilled by adoption of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY). It aims to address end-to-end issues all along the chain of water management. Some suggestions for greater robustness in this regard are:

'Har Khet Ko Paani' – Increasing water sources.

i. In addition to the ongoing 99 number of major and medium irrigation projects (AIBP-Accelerated Irrigation Benefit Project) taken up for completion by December, 2019, the remaining 50 such long pending projects may also be taken by expanding the size of the corpus fund under LTIF (Long Term Irrigation Fund). A mission mode approach to water conservation in rainfed areas should get top priority.

ii. A minimum of 1 (one) million small water storage/diversion weirs / water harvesting structure may be planned per annum.

MGNREGA would be the best source of funding these. In addition to creating new systems, renovation and modernization of traditional systems also need attention. Mission Kakatiya of Telangana State is an example worthy of replication.

iii. The tail ends of command areas of major and medium irrigation projects are generally deprived of water availability. The reasons could include poorly maintained distribution system, non-adherence to notified cropping patterns (opting for water guzzling crops like paddy, sugarcane etc. in lieu of low water duty crops) and excessive use by headrace farmers.

This needs correction by emphasizing on crop alignment, upgradation & maintenance of distribution system, adoption of micro-irrigation systems for efficient use of water and promotion of Water Users Associations.

It may also be useful to build large reservoirs in the vicinity of tail end and store excess water from the reservoir available during monsoons, to be used as supplement in times of shortage. A comprehensive plan may be prepared for all Medium and Major irrigation projects to implement this.

Promoting water use efficiency – 'Per drop more crop'.

A drop of water saved is a drop of water received. This needs the highest attention through adoption of precision technology and efficient water management practices. Some suggestions are as follows:

i. Currently the gap between the irrigation potential created (IPC) and the irrigation potential used (IPU) is a staggering high of 23 million ha. (mha). Closing this gap deserves the highest attention.

ii. Operation and Maintenance (O & M) of the distribution system is below standard, causing water leakage and wastage. This needs to improve, and involvement of people through 'Participatory Irrigation Management (PIM)' would be useful. Promote large number of Water Users Associations (WUAs) and Paani Panchayats.

iii. Precision agriculture by way of micro-irrigation (drip and sprinkler); and sensor-drone-big data analytics based technology is important. Micro-irrigation (MI) must become a compulsory agenda in all forms of irrigation – flow, lift, small sources (WHS/DW/Ponds etc.). In all command areas of minor/medium/major irrigation projects, micro irrigation system should be compulsorily adopted.

As of date, only about 10 million ha. of the total of 63 Mha. of irrigated area is covered under micro irrigation. An annual coverage of a minimum of 2.5 Mha. is necessary to quickly achieve water use efficiency and narrow the gap between IPC and IPU. Under 'Krishi Bhagaya' programme of Karnataka, small irrigation ponds dug in rainfed areas have proved very useful in protecting a standing crop from monsoon vagaries, when connected with steel pipe conveyor and MI system. This programme deserves to be scaled up in a major way across the rainfed areas of the country.

iv. Crop alignment and Conservation agriculture must be strictly practised in all command areas for optimal water use efficiency.

Responsibility: ICAR, DAC&FW, ISRO, MoWR, DoRD, DoLR
Timeline: Short & Long terms
Refer Volume: V

Ground water recharge

4

Ground water based irrigation accounts for 60 per cent of the irrigated area created in the country. Due to over-exploitation, large tracts including in the food bowl of the country (Punjab, Western Uttar Pradesh, Haryana) have turned into 'dark zones'.

These dark zones need to be treated urgently by adopting multi-pronged approach of ground water recharge, crop alignment and community based water management. Watershed based treatment should form the principle of intervention.

It is time to consider whether power supply at no cost or even at highly concessional rate is appropriate. This approach has led to a caution free habit among water users, which is to the disadvantage of the larger farmer community as well as other citizens. In Punjab, for example, the state policy of free power for agriculture combined with dominance of water guzzling paddy has caused indiscriminate use of ground water, and 110 of the 148 Blocks have become vulnerable.

The power tariff structure may be revisited, while compensating the farmers by direct payment of a certain sum on per ha. basis linked to measured actual use. This is likely to check indiscreet use of water management.

For example, the Telengana Model of paying Rs.4,000 per acre per season to the farmers under the State's 'Rythu Bandhu' initiative to defray some of their farm expenses may be a good way out with suitable modifications. What would however be needed is to design the programme, that clearly establishes the linkage between payments and water use habits by the farmer. This may bring greater discipline in drawing ground water. In fact, farmers may be willing to pay, if the service quality is improved. There is much that is wanted in this regard.

Latest technology that helps in remote operation of the water pump may also be promoted. This will prevent water being wasted by the farmers' habit to switch on the motors during nights, without bothering to shut down when the field is adequately irrigated. Of course this culture has been influenced by uncertain timings of power supply from the grid.

Ground water table needs consistent monitoring by installing piezometic in all the Gram Panchayats. Now that water budget has been estimated for all the districts under the 'District Irrigation Plans (DIPs)', a close monitoring of water use and water recharge would be possible to realise a balanced water budget. A web based platform would serve as a good dashboard for such monitoring.

Responsibility: ICAR, DAC&FW, ISRO, MoWR, DoRD, DoLR
Timeline: Short & Long terms
Refer Volume: V, VII

Special emphasis on rainfed areas

5

The poverty map of India and the rainfed area map tend to overlap to a large extent. As brought out in Volume I of the DFI Report, the ratio of farm income is lower compared to non-farm income in drought prone districts of the country.

According to the 'Rainfed Atlas' of 'Revitalising, Rainfed Agriculture Network (RRAN)', about 55 of the 100 poorest districts in the country are rainfed. Of the bottom 10 poorest districts, seven (7) are rainfed districts. Hence, in the strategy for doubling farmers' income, the rainfed regions should get highest attention. The optimal solutions are:

- Ensuring protective irrigation, which can come from small water storage structure.
- Adopting watershed management, integrated farming and conservation agriculture.
- Growing alternative crops – food crops such as millets which are climate resilient and need less of water as also other inputs.

Responsibility: ICAR, DAC&FW, ISRO, MoWR, DoRD, DoLR, NRAA
Timeline: Short & Long terms
Refer Volume: V, VII

Water pricing and regulation

6

i. Strengthen 'Water Users' Associations (WUAs)' and transfer them the responsibilities of O&M (Operation & Maintenance) of tertiary distribution system & of water rate collection; and of release of water on volumetric basis, which is purchased by the WUAs. This of course is only a Long term intervention and can be rolled out in phases by continuously orienting & sensitising the farmers and building their capacities. This can be expected to bring in the much needed discipline among the water users within the command area.

ii. Block system of irrigation - Due to continuous use of water (particularly through flood system), many soils (especially black soils with high water absorption capacity) in many major command areas have turned saline & alkaline.

A block system of irrigation, where under, the water is released only on one side of the main canal (on-water season) in alternate seasons (Kharif-Rabi) may be tested. This will motivate farmers to go for alternate and low water duty crops like pulses, oilseeds & millets in the season, when water is not released (off-water season) by using available soil moisture. This will improve the soil health steadily.

iii. Promote use of recycled water to expand peri-urban cultivation and water harvesting in habitations to adopt kitchen gardening, roof top gardening, hydroponics etc.

In fact, in case of large metropolitan cities where sewerage discharges are huge, secondary treated water can be used in agriculture in the hinterland cultivation zones. For example, in case of Bengaluru urban agglomerate (with a population of 10 million), secondary treated sewerage water is adequate to fill all the ponds in the neighbouring 3-4 rainfed districts and enable supply of protective irrigation when rains fail. The Bangalore Water Supply and Sewerage Board (BWSSB) treats & releases 130 MLD (million litres per day) into the KC Valley, that feeds agriculture in the neighbouring district. In Singapore, sewerage water is treated to be used for human consumption too. Based on its learnings, other States may adopt too.

Responsibility: ICAR, DAC&FW, ISRO, MoWR, DoRD, DoLR
Timeline: Short & Long terms
Refer Volume: V

State Water Policy

7

All the States are advised to adopt, a 'State Water Policy' based on a 'Model Water Policy' to be prepared by the Ministry of Water Resources of Government of India.

Responsibility: MoWR
Timeline: Long term
Refer Volume: V

Seed management

8

A robust 'Seed Rolling Plan' should be ensured based on active partnership of DAC&FW-ICAR-States, who in turn build a network with efficient seed producers, across both public

and private sectors. Seed production plan should be based on targeted SRR (Seed Replacement Rate), VRR (Varietal Replacement Rate) and SMR (Seed Multiplication Ratio).

Special attention is needed in case of forgotten crops like millets, horticultural crops and location-specific problems & suitability including climate change issues. The Seed Rolling Plan should also include contingency requirements for compensatory seeds arising from natural calamities. The losses incurred by seed producers due to contingency production should be compensated suitably through a specially created Sinking Fund.

Seed production environment

i. All the crop varieties released and notified recently may be got registered under PPV and FR Act, if the breeder so desires. Further, release of crop varieties for specific soil types i.e. acidic, calcareous and saline nature be given priority

ii. Rapid multiplication of the new seed variety is essential, so as to avoid time lag between release and adoption by the farmers. Currently, it is a long drawn process. All the new varieties developed by the breeders are examined and identified for release at the All India crop seed workshop. Thereafter, the Breeder/Breeder Institute prepares Release and Notification proposal for consideration of the Central Sub-Committee on Crop Standard, Notification and Release of Varieties. After approval by this Sub-Committee for release, the proposal goes through various procedures before final notification is made under the Seeds Act. A lot of valuable time is lost, and if the breeder delays in submitting the proposal, there could be additional time lag.

It is therefore suggested, that once the Sub-Committee has approved for the release, pending notification under the Seed Act, at least 75 per cent of the test stock (one that is with the Breeder, but cannot as yet be called as a nucleus seed) can be considered as 'breeder's seed' and initiated into production of 'foundation seed'. This will help in saving of about a year in reaching out the new variety to the farmers. Speed of release is important.

iii. Encourage SHGs/FPOs to undertake HYVs and hybrid seed production on cluster basis. They can be incentivised by establishing Gram Panchayat Level Seed Processing-cum-Storage Godowns. This approach will broadbase the seed production system and reduce reliance on a few large producers as happening now.

iv. Discourage multiplication of low yielding old, as also pests and disease susceptible varieties, encourage multiplication of nutrient efficient and climate resilient varieties with consistent yield. This is necessary to weed out long standing varieties that have gone beyond the age norms. Participatory seed production involving farmers through FPOs by creating seed production, processing-cum-seed storage godown facilities at Gram Panchayat Level is an effective strategy to produce and make available quality seeds of high yielding varieties/hybrid seeds at low price. This will be a win-win situation for both seed growing farmers as well as other farmers.

As 60-65 per cent of the farmers use farm saved seeds, technological intervention for up-gradation of the seed quality has been under implementation since 2005 under Seed Village Programme. This has helped the farmers become self-reliant. However, not all states are using this scheme efficiently, and hence a state-wise and crop-wise review would help in a more universal adoption of the scheme.

v. Since, there is increasing adoption of alternate cropping systems like Organic farming, Conservation agriculture and the like, it is necessary to identify varieties for different crops that are responsive to such systems, and integrate them into dedicated seed production systems, that are raised under organic cultivation environment.

vi. It is important that the seed production plan of the year is based on a more accurate assessment of crop-wise quantities of seeds based on varietal requirement. The potential of seed based productivity can be harvested only where both SRR and VRR are achieved as per recommendations. All the states should prioritise production and distribution of quality seeds of various crops across agricultural & horticultural segments.

Also, the SAUs should optimise the agronomic practices for various inputs including seed, keeping in view the high cost of seed.

vii. Application of bio-technology for seed traits and quality assurance is useful.

iii. Application of modern tools viz., QR code, bar code for all class of seeds for confirming the source is essential to ensure the seed generation system

ix. Establishment of network on developing national database of DNA profiles of varieties which are in seed production chain is useful.

	Responsibility: DAC&FW, ICAR, SAUs *Timeline: Long term*
	Refer Volume: V

9

Maintaining the quality of seed

i. The quality of seed be determined based on germination and survival, and not on the size.

ii. Systematic and meticulous minimum field standard to retain genetic purity of the seed and minimum seed standard prescribed in IMSCS be effectively followed and maintained by all seed producers.

Sale of and access to quality seeds

i. In relation to post-harvest handling, the Indian seed processing/ conditioning industry has perfected the techniques of quality up-gradation and maintenance to ensure high standards of physical condition and seed quality. By virtue of the diverse agro-climates, several geographical zones in the country have emerged as ideal seed storage locations under ambient conditions. In terms of seed marketing and distribution, in addition to existing seed dealers and distributors, proposed 22,000 PRAM/GrAM (Grameen Retail Agriculture Markets) will provide good opportunity for sale of seed nearer to villages. This activity can be offered necessary support and further strengthened.

ii. 'Seed Export Hubs' with appropriate infrastructure, institutions and incentive system (more of ease of doing business and financial) should be promoted across the country, with emphasis on agro-climate and crop alignment principles. India can emerge as a major seed exporter to African and Asian countries, where similar climatic conditions as in India prevail. The youth can be supported to build enterprises.

Enforcement for quality assurance

Enforcement for quality assurance – Under the Seeds Act, the States are empowered to enforce adherence to prescribed standards. The enforcement machinery is weak on various counts including inadequacy of manpower and seed testing laboratories.

It is suggested, that an independent Directorate of Enforcement, separate from the development-extension Directorates is established at the State/UT levels. This Directorate be made responsible for enforcement under various relevant Acts in respect of all the agricultural inputs including seeds, pesticides (chemical and organic), fertilizers (chemical and organic) and others. For effectiveness,

- they should be adequately staffed;
- the staff should be technically qualified and well trained; for continuous upgradation of knowledge undertake refresher programmes;
- infrastructure including testing laboratories should be sufficient;
- ICT should be deployed for efficiency & accuracy eg. deployment of QR bar code for various packets/sachets will help in quality maintenance; and
- computer generated random numbers for inspection of shops will bring in objectivity & effectiveness in check.

	Responsibility: DAC&FW, ICAR, SAUs
	Timeline: Long term
	Refer Volume: V

10

Restructuring & reorganisation of seed support services

i. There is an urgent need for restructuring & reorganising State Seed Corporations (SSCs) to bring them in tune with the industry norms in terms of infrastructure, technologies, approach and the management culture to be able to survive in the competitive market, and to enhance their contribution to public sector seed production system.

ii. Streamline seed research system to deliver commercially viable technologies on production, storage and processing, seed quality enhancement and control etc.

iii. Organisation and strengthening of seed certification agency need careful planning, taking into consideration the anticipated acreage for certification of various crops and varieties, area of operation, farm sizes etc.

	Responsibility: DAC&FW, ICAR, SAUs
	Timeline: Long term
	Refer Volume: V

Pest management

11

The recommendations aimed at bringing down the expenditure on pesticide represents a strategy based on collation of policy, procedures, Research & Development, information technology, institutional systems and capacity building activities. The efficacious

implementation of these recommendations is predicated upon a concerted and coordinated synergy among all the stakeholders concerned.

It is important to separate various regulating & enforcement functions relationg to inputs (pesticides, fertilizers etc.) from extension functions at the state level and create an independent Directorate of Enforcement with a mandate to ensure cost and quality standards.

Policy issues

i. Most of the new molecules with patents are imported, which adds to the cost per unit. Special encouragement should be given for discovery and manufacture of active ingredients in India. The local manufactures should also be encouraged to export, so that they can afford to sell at lower price in the domestic market by way of cross-subsidisation to an extent.

As on date, the number of registered pesticide molecules in India is about 280, as against more than 500 in EU, and nearly 1000 in US. It is about 300 in the Asian neighbor of Thailand. It would help to simplify the registration process and enable registration of more number of molecules which will introduce competition among alternatives and drive down prices.

ii. There is a need for a comprehensive policy on products sold as 'organics', 'bio-stimulants' etc. which are neither tested by a competent body nor registered at CIB-RC. These may also not have been recommended by any scientific body for usage in pest management. Active ingredients in these products are not disclosed, keeping both the user and the subject experts in dark. Many a time, these organic products are used along with the other synthetic insecticides as single application. Therefore, it increases the cost of plant protection significantly. Further, as the nature of the molecule is not known, it puts the consumer at serious risk on account of pesticide residues.

iii. The registration is usually for major crops, but expansion of labels to minor crops / related crops is very essential and is possible through crop grouping. A policy evolved by CIBRC on crop grouping and label expansion through data on field trials and also risk assessment for fixing MRLs (Maximum Residue Limits) and recommendation of PHIs.

All molecules for which registration application is filed with the regulator for use in the country for the first time may be registered as done earlier by clubbing section 9(3) along with 9(3B) of the Insecticide Act, 1968. This implies, that the Registration Committee needs to register a formulation after the fixation of its Maximum Residue Limit (MRL) u/s 9(3) as recommended by the JPC and set across by FSSAI as mandated; wherein, the technical needs to be compulsorily registered u/s 9(3B) with a commercialization rider to extend beyond the provisional period of 2 years, and during this period of provisional registration balance data required to be submitted can be generated and further be registered u/s 9(3) within a period not exceeding a total of 3 years from the date of provision registration.

This will enable introduction of both patented or non-patented molecules in the country, and ensure data protection of a minimum of 2 years and maximum of 3 years for companies willing to invest in new molecules being introduced for the first time in the country. As a result, the subsequent prospective registrants will be encouraged to go in for registration for indigenous manufacture or new import source, thus providing an end to the monopolistic availability of the said molecule registered for the first time for use in the country. This will result in competitive pricing.

iv. "Prescription-based sales" of pest management inputs may be considered, as done in Kerala for spices and Maharashtra for pomegranate, grapes & sugarcane).

v. Protective cultivation has become popular and with diversification into high value crops, its adoption is growing. However, there are no formulations registered for use in protective cultivation, wherein fertigation that combines application of water, fertilizer and plant protection can be encouraged. In this regard, molecules that are suited to fertigation need to be registered.

vi. Seed treatment registrations have been accorded priority. However, seed treatment solutions are not available for all seeds of national importance. Bio-pesticides need to be encouraged for seed treatment with a focus on export oriented produce.

vii. Plant protection products needed for treatment of agri-produce during storage (post-harvest management) need to be given importance in registration.

viii. Pesticide treated plastic wraps for slow ripening of fruits or plant protection products need to be encouraged and evaluated.

ix. Pesticides may be considered as an essential item and price control may be opted for generic pesticides similar to the Drug Price Control.

Responsibility: DAC&FW, ICAR, SAU
Timeline: Long term
Refer Volume: V

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Procedural issues

All RPTLs (Regional Pesticide Testing Laboratories) and CIL (Central Insecticide Laboratory) should be GLP (Good Laboratory Practices) and ISO 17025 complaint.

i. The RPTLs should create a kind of networking with all SPTLs for knowledge sharing and to meet the challenges in analysis of pesticides for quality control purposes.

ii. It would be useful to draft two Ready Reckoners, namely. "Requirements for establishment of RPTLs" and "Requirements for establishment of SPTLs" and adopted for promoting adherence to quality standards vis-a-vis GLP and ISO 17025 compliance.

iii. As the Certified Reference Materials (CRMs) and Technical Materials (TMs) are very elaborate and expensive, CIL should keep an inventory and supply the same to all RPTLs and SPTLs.

iv. The methods of analysis are not available with all laboratories, as Bureau of Indian Standards (BIS) practices are not published for all pesticides and formulations. The manufacturing methods may therefore be made available to all SPTLs through CIBRC / CIL.

v. It is necessary to create and disseminate Standard Operating Procedure (SOP) to states for establishment of State Pesticide Testing Laboratories and Pack Houses for bolstering backward and forward linkages.

vi. It is necessary to strengthen the DAC&FW sponsored central sector scheme "Monitoring of Pesticide Residues at National Level (MPRNL)" being implemented at ICAR-IARI, New Delhi and its 25 NABL accredited centres in the State Agricultural Universities and National Research Centres. The project identifies crops and regions having preponderance of residues in India in order to bring focus of extension efforts for IPM and food safety (MRL fixation).

vii. Simplify and expedite registration procedure (i.e. reducing current time span of 4 years) with a view to grant registration swiftly & transparently. This will enhance competition among the manufactures, which in turn can be expected to bring down prices. In addition, simplification of the registration procedure for bio-pesticides/ botanicals is also essential. Expansion of label claims of already registered pesticides to other crops should also become the norm.

viii. Establish registration procedures for organics / natural products / concoctions / mixtures of natural products / products based on traditional knowledge for encouraging them in accordance with desired norms.

ix. Strengthen of techno-legal Cell of the Directorate of Plant Protection, Quarantine and Storage (DPPQ&S) for facilitating swift action in cases of misbranded/spurious instances of pesticides. Quick response (QR) coding or similar technologies to build traccebility and checks on supplies need to be promoted to prevent spusrious supply.

x. Each State falls under a particular agro-climatic zone (which may or may not vary across the state) and is instrumental in defining a particular crop pattern and uniqueness of pest scenario. These patterns need to be closely studied and analysed from the perspective of Package of Practices (PoPs) issued by the respective State Agricultural Universities. This will enable to identify the required kind of pesticides and may them to manufacturers and importers of formulated pesticides within the state and / or nearby location.

xi. Crop Cluster Development Scheme (CCDS) approach may be considered for adoption. This will help in promoting efficient way of pest management. The rate of pesticide dose in application should be linked to the seed variety in the given crop cluster or agro-climate zone or state, as the case may be. A cluster based cultivation helps to bring in higher scales of operation and the resultant efficiency. It will also make it possible to contract out the services to professional service providers.

xii. Basic harmonized training modules to be formulated, and translated in all regional languages to help provide a holistic approach to address the issues related to safe & effective use of pesticides. The next step will involve crop specific detailed training based on the generic and not the brand name.

xiii. All websites of the State Agriculture & Horticulture Departments need be at least bilingual i.e. English & regional language. This will help in connecting with other states for new learnings and adoption of best practices.

	Responsibility: DAC&FW, ICAR, SAUs
	Timeline: Long term
	Refer Volume: V

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Research & Development

i. Institutions (both ICAR and SAUs/CAUs) should adopt region-wise model clusters with a view to reach farmers by providing them timely advisory on plant protection measures to bring down unnecessary expenditure. This will help farmers to take appropriate decisions with respect to plant protection chemicals

ii. The region-wise and crop-wise usage of plant protection molecules need to be recorded religiously. Regular statistics of these, similar to yield estimates will help to plan appropriate region-wise measures to check abuse of plant protection molecules.

iii. Collaborative institute projects with a time frame of 3-5 years should be proposed by scientists in Plant Health (Entomology, Pathology, Soil science) along with the Divisions of Agricultural Extension and Agricultural Economics in all ICAR and SAU systems, taking district as a unit of study, by providing all necessary and timely advisory support to cover target farmers across different crops. Pilot study should be imitated wherever vulnerability is higher.

iv. Research be undertaken on analysis of pesticide residues in agricultural commodities, soil, water etc. through supervised field trials to generate data on persistence and dissipation of newer and existing molecules for fixation of safe waiting periods, MRLs, and approval of label claims. Presently ICAR-All India Network Project on Pesticide residues (AINP-PR) at IARI, New Delhi conducts such studies through its 15 NABL accredited coordinated centres located across the country.

v. Research on enhancement of pesticide efficacy and stability through use of adjuvants (synergists, potentiators, stabilizers) and employing proper dispensing mechanism (spray technologies) to reduce sizeable quantity of pesticide consumption should be strengthened. Availability of new molecules that are less labour intensive, less harmful to environment and those that facilitate less for more coverage needs to be ensured.

vi. Research should be targeted for elevating the level of pest resistance to major invaders rather than developing resistant cultivars, which is an uncertain and time consuming task. Cost reduction in pesticide use is on pro-rata basis with resistance level. Stability of such varieties is greater than those with resistance.

vii. Development of fore-warning system with suitable precision in respect of key pests is useful. This will enable timely pest management interventions to reduce the pesticide load in the environment.

iii. Create field diagnosis protocols that serve as a step-by-step guide for diagnosis of field problems. A protocol should encompass all the known problems of a crop and include various diagnostic approaches like visual, chemical, digital, etc. These protocols should be revised from time-to-time as new technologies, new problems, new research findings, etc., come to light.

ix. Nuclear technique, also known as sterile insect technique (SIT) is one of the IPM practices, that can be promoted in managing fruit flies, moths etc. It is a form of sterilization of insects and systematic release of huge number of male insects. The sterile males compete with insects in the wild, and through mating with wild females, contribute to reducing overall pest numbers.

	Responsibility: ICAR, SAUs, DAC&FW
	Timeline: Long term
	Refer Volume: V

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Information technology

i. Creation of Portal that can serve as a forum of analysts where access can be provided for all methods and CRMs, and also discussions on challenges in analysis will lead to sharing and dissemination of knowledge.

ii. National data/inventory of pesticides registered in the country be maintained.

iii. Create a Portal in collaboration with the States and Pesticide Associations which will provide information on all the registered pesticide dealers along with their education

qualification. The portal should also include information on pesticides produced and sold by the companies along with their prices.

iv. Collation and compilation of comprehensive data on the consumption of pesticide/bio-pesticide, number of pesticide dealers, their education qualification etc. would be useful.

v. A dedicated "Coding Cell" be established at the Directorates of all the States, where the Inspector samples are received, coded and sent to SPTLs for tamper proof analysis.

vi. Electronic platform for pest surveillance needs to be developed and rolled out in coordination with state governments. Some tools like PESTWATCH are available which provide on-line information for pest monitoring and forecasting. FAO provides satellite-based images of large locust habitat areas supported by rainfall and green vegetation data for the technical staff to reduce the locust population and their monitoring. Such modules may be developed or adopted for pest surveillance for either a state approach or cluster approach. This will help in providing real time dissemination of pest management techniques to the farmers. The data generated through the electronic pest surveillance will also help in creation of Centralized Prescription Repository (CPR). The current system is largely manual, limiting the quality and utility of surveillance and its outcome.

vii. Creation of a Centralised Prescription Repository (CPR), that caters to all the diverse cropping situations and preferences is useful. The CPR should contain all the authentic prescriptions to tackle pest situations at different crop stages and at varying intensities of damage for different regions of the country. Further, the CPR should include the entire range of preferences such as biological, organic, conventional, mechanical, cultural, etc., for each specific agro-climatic zone. The CPR should be continuously updated with inputs from the latest research findings, changing pest scenarios, policies and other regulations, technologies developed, etc. This should be backed by suitable policies that is binding for all to adopt from the prescriptions listed in the CPR.

viii. Big data analytics of pest situations being reported from across the country: As digital extension systems are continuously expanding in the country, there is a need for establishing a big data analytics and interpretation centre. This centre should be able to provide all the necessary alerts across every district of the nation for each of the cultivated crops. Lack of such data systems has led to delayed administrative and policy-level decisions. Effective data analytics can help in interpretation of data and drawing of messages for containing pests within certain limits of their occurrences. Large scale pest occurrences and server damages can such data analytics would be of vital importance for predicting pest occurrences and for pest quarantine

ix. Geo-Positioning System (GPS) can reduce pesticide consumption by approximately *10* per cent as it prevents double treatments in wedges and in turnings. It can be used to calculate the needed amount of pesticides and can be connected to sowing / planting machines allowing the seeds or the plants to be placed in a pattern, which subsequently allow to hoe the plants across the rows and to hoe closer to the rows than what is possible without GPS.

x. Fertilizers and pesticides (biological & chemical) are primarily required for the growth of crops & control of pests, respectively. Unmanned Aerial Vehicles (UAVs) can be adopted to avoid risk to human health and environment that are likely when application of pesticides & fertilizers is undertaken manually. Such applications can be localized,

restricted or specific in nature to avoid exposure of spray operators during application. Multiple uses of such UAVs can also relay remote sensing images that may be analysed by appropriate available software.

xi. Electronically-controlled or managed chemical spray application technology can be more precisely used for application of agricultural pesticides at intended targets. Reduced chemical drift will improve water quality by minimizing the delivery of chemical compounds through the air to water bodies. Such application systems require the use of GPS data loggers (i.e., devices that record the track, time and location of field trips for download to maps) in order to document site-specific compliance with all label requirements for drift mitigation.

xii. Adopt a system of QR, on all the pesticide packages. The ability to track and trace the origin of the pesticide will check spuriousness.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Long term
Refer Volume: V

Institutional upgradation

i. Establishment of RPTLs in all states, and particularly in those states where the pesticides are used extensively is critical. The RPTLs should be endowed with requisite infrastructure, analytical equipment and trained manpower. They should be able to analyse all the pesticides as in the schedule for identification of spurious pesticides, and should serve as a Model to SPTLs. All RPTLs and CIL should be GLP and ISO 17025 complaint. The RPTLs should create a kind of networking with all SPTLs for knowledge sharing and to meet the challenges in analysis of pesticides for quality control purposes.

ii. Establishment of a few new Central Integrated Pest Management Centres (CIPMCs) and strengthening of existing CIPMCs for vigorous monitoring and surveillance of agriculture fields is necessary, besides encouraging farmers to adopt IPM. In many states with large geographical area, a single CIPMC as exists now is not adequate. A rationalisation is required based on geographical area and cropping intensity.

iii. Establishment of additional SPTLs in sync with the number of registered pesticide dealers and strengthening of existing SPTLs is another upgradation needed. In this regard, the Central Government may share Standard Operating Procedures (SOP) with the States, which, *inter alia*, may include best practices, optimum number of pesticide testing laboratories needed, list of equipment's, information about accreditation etc. Every state should establish at least one SPTL. All major states should designate one SPTL as lead laboratory, where all facilities as in RPTLs should exist and also help in analysis of other state samples for second verification purposes and for Inter-Laboratory Comparisons (ILCs). All SPTLs should be GLP and ISO 17025 complaint.

iv. Creation of a dedicated and independent Enforcement Cell in the State Agriculture Department for collection of pesticide samples for their analysis deserves priority attention.

v. Establish 'Pack Houses' for bolstering backward linkages. In this regard, the Central Government may share a SOP with the States.

Capacity building

i. Strong enforcement of quality control to ensure supply of quality pesticides: Regular training of enforcement officials/officers on pesticide quality control and prosecution

procedure and training of laboratory analysts at periodic intervals be organised to update their skill

ii. Sensitisation of farmers through media, T.V, trainings, Farmers Field Schools etc. about use of recommended pesticides as per label prescription, at right dose against right pests & at right time will help. Typically, pesticide and water are mixed to the full capacity of the sprayer. On the contrary injection syringes and implantation methods can be more efficient and targeted and therefore economical.

iii. Regular training of extension officers on pest management including IPM. State Agriculture Department to undertake vigorous monitoring and surveillance of agriculture fields and encouraging farmers to adopt IPM strategies for controlling pests.

	Responsibility: DAC&FW, ICAR, SAUs
	Timeline: Long term
	Refer Volume: V

Agricultural mechanisation

15

It is advisable to adopt a more broad definition encompassing deployment of machinery across all the sub-sectors of agriculture (crop husbandry, horticulture, dairy, livestock, poultry, small ruminants, fishery etc.) and call it as 'Agricultural Mechanisation', and not limit it to 'Farm Mechanisation', that limits application of mechanical power to field crops alone.

From the income perspective, that involves reducing the cost of production, increasing the total output and capture of maximum value of the output, mechanised operations are more effective vis-a-vis the manual or draft power.

The consumption of farm power in India stands at an average of 2.02 kw/ha. in 2017-18 and compares very poorly even with Asia-Pacific countries. A target of at least 4 kw/ha. should be the aim by 2022. And it is achievable.

Considering the preponderance of small & marginal holdings in the country, R & D should aim at developing and designing scale-neutral machinery. Further, machinery that can suit different terrains of the geography deserves priority attention.

Agriculture Machineries can be provided as a service, which means, that farmers should have easy access to both machinery and related services on rent in preference to owning the same. NCDC assisted agriculture machinery hubs in States such as West Bengal and Bihar are examples for reference.

Farmers may be owing some of the machineries and may be in need of repair and such other services. These facilities should also be available at decentralised level including through mobile services. Such services can be facilitated by promoting:

- 'Custom Hiring Centres' (CHCs) at the rate of a minimum of 1 (one) per village (when large) and 1 (one) per Gram Panchayat or per PACS comprising a cluster of small villages. These should be able to meet the demand for all basic services, and would therefore be expected to possess low duty machinery.

- 'Agriculture Machinery Banks' (AMBs) at the district/sub-district level, possessing heavy duty machinery like combine harvester, laser land leveller etc.
- 'State/Regional Services' possessing more sophisticated and heavier machineries, that can service larger areas to meet certain specific demands; and also possess ICT/GIS/Space technology based services.
- These centres at different levels, should be supported to broaden their technologies to include modern systems like drones, sensor based applications, etc. and also those needed in the sub-sectors of animal husbandry, fisheries, etc.

Promotion modes
The above types of services can be promoted by adopting one or more of the approaches below:

i) Enterprise mode – the youth can be specifically trained and financially supported (credit linked back-end subsidy) to set up CHCs. In order to make such enterprises viable, other agricultural services can also be integrated to offer 'One Stop Shop'. Some of the services deliverable are pesticide, fertilizer & seed retailership, I.T. based extension services etc.

ii) SHG/FPO/Trust/PACS based CHCs.

iii) NGO/CSR (Corporate Social Responsibility) based CHCs and AMBs.

Shared utility - uberisation
It is possible that some of the machineries are owned by individual farmers. Tractors are a common example. Aggregation platforms have proved highly successful in city transport services. On similar lines, uberisation is feasible in agricultural mechanisation. Hence networking of individual owners, CHCs, AMBs and Regional/State Service Centres can happen by onboarding a common platform and meet the demand in real time and cost effectively. Professional Service Providers with large investments and capable of establishing a brand name can opt to promote franchise model for quick scale up across the region/state. The youth can grow up professionally as franchise based entrepreneurs. Since agricultural operations are seasonal and time bound, the farmer in need of a service cannot afford to wait and would benefit only when response to his call is positive with nil/least time lag.

Further, transaction cost will need to be rational, and therefore, the machinery will need to be sent to the farmer's work site from the nearest location. Uberisation is the most optimal solution to such demands. This brings an advantage of enhancing the use-time of the machinery purchased, and therefore, the realisation of a positive RoI (Return on Investment).

Service facilities:
It is important to ensure availability of repair and service facilities in close proximity, so that operation & maintenance issues are addressed. Mobile service centres can also be promoted to cater to minor repair demands. This requirement also generates scope for enterprise creation.

The concept goes beyond providing machinery on hire. It encompasses a number of services including offering labour, managing actual field operations in respect of not only agricultural machinery, but also other agricultural operations. For example, harvesting of coconut, arecanut and the like is a specialised function, and the traditional tree climber may not always be available these days. A 'farming services' centre can meet such service demand.

In sugarcane belts, it is common to see labour contractors undertaking harvesting, and labour groups travelling long distances, even across the states. Mechanised services can become effective minimised social cost, that migration of labour engender.

Machinery for waste management – In the Indo-Gangetic Plains (IGP), where rice-wheat is the dominant cropping system, burning of rice straw to meet the deadline of wheat sowing time is a common practice. This is not only not sound ecologically but also causes a loss of opportunity to capture the value that lies in the paddy straw. This wasteful practice describes most agricultural activities. In the strategy for doubling farmers' income, gainful use of all biological products, and not just the grain or fruit, is necessary to generate additional farm incomes. Hence, agricultural mechanisation plans must include farm waste management machines and devices, and make residue management a productive activity.

Newer technologies like protecting cultivation structure (polyhouses, greenhouses etc.) micro-irrigation systems etc. will pick up increasing demand. Repair & service of such technologies will also need to be catered to.

Contract Farming and Services

In the context of predominance of small & marginal farms, it is difficult to achieve efficient scale of operation at individual farm level. An alternate management strategy that has the potential of bringing in operational efficiency is to adopt service contracts. A large service provider can enter into a contract with the farmers over a large cluster, extending even to a Taluk or District to provide mechanisation services for a various services along the value chain. This will also enable timely and technology intensive operation and bring in precision nature of agricultural system.

This approach is amenable not just to mechanisation, but all other agricultural activities like irrigation management, pest management, harvesting, transport etc. This will also release the farmers from drudgery and free them to take up alternate jobs.

With the Model Agriculture Production and Livestock Contract Farming and Services Act, it is possible to promote contract services. The states should therefore find it useful to legislate a State Act to this effect.

Responsibility: DAC&FW, DAHDF, ICAR, MoC
Timeline: Long term
Refer Volume: V

Agro-biodiversity

16

In addition to ex-situ conservation through a network of gene banks, it would help to emphasise on in-situ conservation by implementing projects in different agro-ecologies of the country.

On the lines of PPV&FRA for crops, establish Farmers Rights Authority(ies) in respect of animal and fish genetic resources after adopting an appropriate enabling Act. This Authority may be an integrated one for both animals and fish genetic resources or independent for each.

Responsibility: DAC&FW, DAHDF, ICAR
Timeline: Short & Long terms
Refer Volume: V

Adopting Sustainable Technologies and Practices

While Green Revolution has transitioned the country from food deficit to food security and further to food surplus status, some elements of extractive principles and indiscreet practices, have over the long period resulted in threats to production sustainability and ecological viability and economic feasibility.

The most visible manifestation of diminishing marginal returns on inputs, is the need to throw more of them to produce the same unit of output. Depleting ground water, spread of problem soils (acidic, saline & alkaline), loss of soil organic carbon (SOC) and yield plateaus manifest the different dimensions of the problem and challenge.

The strategy for doubling farmers' income warrants sustainable intensification (SI). It implies achieving higher yields per unit area, while taking care of natural resources and ecosystem services.

The sustainable approach now needed to be adopted should rebuild soil organic carbon, promote soil & water conservation, enrich bio-diversity, reverse desertification & pesticide pollution and incorporate resistance against pests & diseases and demonstrate resilience against the adverse impacts of climate change. It is time to adopt policies that will bring focus on environmental services, such as soil conservation, watershed services, carbon sequestration and bio-diversity.

In consonance with this approach, alternate cultivation practices have been advocated for quiet sometime are also in practices in certain pockets of the country, as also outside. In the recent years, the call for alternate practices like organic farming and conservation agriculture is growing stronger. In the opinion of the DFI Committee, these systems can be promoted with a caution, and more of R&D for validation of the technology and standardisation of the practices is necessary, before scaling up. However, what can be adopted on large scale are practices that promote resource use efficiency and sustainability as depicted by Integrated Pest Management, Integrated Nutrient Management, Good Agricultural Practices, Neem Coated Urea, Soil Health Card based fertilization, Micro Irrigation, Soil and Water Conservation and the like. The recommendation that follow may be appreciated in the context of this big picture.

Soil Organic Carbon (SOC) management

17

The highest attention now needed in promoting & sustaining soil health is to rebuild the status of soil organic carbon (SOC), which has reduced to an average of 0.3 per cent in Indian soils.

The management practices that will increase the soil C are reduced tillage, erosion control, diversified cropping system, balanced fertilization etc. Maintenance of crop residue, large roots and crop biomass in the soil would enhance organic carbon stock in the profile even under continuous cropping systems.

In general soil disturbance should be as minimal as possible.

Adoption of Conservation Agriculture is recommended, particularly in degraded soils. However, ICAR may undertake field trials and develop models and protocols before large scale adoption.

Responsibility: DAC&FW, DARE-ICAR
Timeline: Short & Long terms
Refer Volume: V

Agro-ecology as a basis for agriculture

18

Promote agro-ecology based agricultural practices, which implies a blend of modern agricultural science and indigenous knowledge systems.

The agronomic practices should facilitate revitalization of small farms with emphasis on diversity, synergy, recycling and integration; as also on social process that value community participation and empowerment. The essence of agro-ecology based agriculture is, that it reconciles optimally the economic demands on the system with the ecological sustainability (or the carrying capacity).

Hence, adopt technologies and practices appropriate to varying eco-systems, which include:

- Irrigated eco-system
- Rainfed agro-ecology
- Dryland agriculture
- Coastal agro-ecology
- Shifting cultivation system
- Rice-fallow eco-system

For specific recommendations under each of these, refer Chapter 3 of Volume V of this Report

Responsibility: DAC&FW, DARE-ICAR
Timeline: Short term
Refer Volume: V

Conservation agriculture and residue management

19

The food bowl represented by Indo-Gangetic Plains (IGP) of Punjab, Haryana and Western Uttar Pradesh is threatened with stagnating productivity, burning of crop residues, declining resource quality & water table and climatic change impacts (rising temperature).

In this region, it is useful to adopt Conservation Agriculture beginning with wheat production in rabi, following kharif rice harvest. The minimum practices that may be adopted are regulation of soil disturbance, *in situ* residue management and crop rotation. Cultivation of pulses, for example, can be promoted.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VI

Climate change - mitigation and adaptation measures

20

Climate change resulting from accelerated pace of release of Green-house Gases (GHGs) is the dominant environmental challenge of today and tomorrow. Agriculture production system is directly challenged due to expected rise in temperature, changes in quantum & pattern of rainfall, annual frequency of occurrence of extreme weather events. Some of the expected impacts and those needing appropriate response include:

Activity	Impact
Soil	Drier reduced productivity
Irrigation	Reduced supply, increased demand
Pests	Increased ranges & population
Crop production	Reduced productivity
Livestock	Increased diseases & heat stress
Fishery	Affected abundance & spawning
Economic outcomes	Reduced agricultural output

In above context, large scale promotion of 'Adaptation' and 'Mitigation' measures is required.

Adaptation measures

- Promote crops that use soil moisture & other inputs more efficiently.
- Promote inter-cropping extensively as they buffer against weather extremes better, use resources (light, water, nutrients) more efficiently, and are less vulnerable to pests & diseases.
- Promote conjunctive use of surface and ground water. Adopt micro-irrigation systems, rainwater harvesting, ground water recharge, soil & water conservation technologies.
- Identify agro-climate specific crops and varieties resilient to drought.
- Promote livestock, including small ruminants
- Promote agro-forestry, horticulture
- Adopt integrated farming system (IFS)

Mitigation measures

- In place of transplanting of rice, opt for direct seeded rice/aerobic rice, which require less water and check & envision of CH_4 and CO_2.
- Adopt carbon sequestration practices.
- Promote resource conservation technologies.

Responsibility: DAC&FW, DAHDF, ICAR
Timeline: Short term
Refer Volume: V, VI

Land related interventions

21

i. Harmonise databases of land resources at the national level, so as to address the key issues of land degradation, reclamation, evaluation and land use planning.

ii. Prepare and adopt a perspective plan for comprehensive treatment of degraded land based on watershed approach.

Responsibility: DAC&FW, DoLR
Timeline: Long term
Refer Volume: V

Soil and soil health management

22

i. Soil health is complex and is influenced by an inter-play of various physical (bulk density, aggregate stability, moisture retention etc), chemical (nutrient availability, exchange capacity, etc.) and biological (mineralisation, microbial biomass, etc.) properties.

   While physical & chemical properties are well known and are accepted for testing, biological properties are as yet not well understood among the soil scientists.

ii. However, the presently rolled out Soil Health Card (SHC) scheme tests 12 parameters including 3 major (NPK), 1 secondary (S) & 5 micro (cu, mo, pb, fe, zn) nutrients, and pH, EC & organic carbon (OC). Organic Carbon has been considered as a proxy parameter for the biological health of the soil.

   It is recommended, that farmers should necessarily manage their soil nutrition strictly in accordance with the crop specific soil nutrient recommendations. Major attention should be paid by the farmers to soil organic carbon, and hence addition of FYM, city compost; cultivation of leguminous crops and the like deserve absolute emphasis.

   For SHCs to gain credibility among farmers, the quality of recommendations is linked to the integrity of soil sample collection and accuracy of laboratory testing in the laboratories. Hence, pay attention to these aspects.

iii. Distribution of SHC is only a first step, though a major one. The critical dimension of SHC is the effectiveness with which it is used. Hence, educating the farmers by undertaking Result Demonstrations on different crops will enhance the habit of dependence on SHC recommendations.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: V, VII

Water related suggestions

23

i. Adhere strictly to crop alignment, which refers to cultivating crops as per availability of water and other agro-climatic parameters.

ii. Adopt low water duty crops in place of water guzzlers like rice, sugarcane etc., unless water is adequately available.

Even under water surplus situations, water saving technologies must be deployed. These include right varieties, agronomic practices and technologies. Make micro-irrigation compulsory for all crops and even in command areas of irrigation projects.

iii. Promote protective irrigation systems (small irrigation ponds, etc.) compulsorily in rainfed areas. Further, link water use to micro-irrigation system.

iv. Ground water use needs regulation through legislated piece of law.

v. Re-use and recycle waste water as much as possible. The waste water of all major urban cities must be treated and used in peri-urban agriculture/horticulture.

vi. All states be advised to adopt a 'Comprehensive Water Use Policy' for Agriculture.

Responsibility: DAC&FW, DAHDF, ICAR, MoWR
Timeline: Long term
Refer Volume: VI

Other important interventions

24

i. Adopt a comprehensive residue management system across the country to uses more than 500 million tonnes of crop residue generated annually.

The paddy straw management in Indo-Gangetic Plains deserves priority attention.

The measures include *in situ* and *ex situ* conservation; preparation of enriched fodder; aggregation and use in generating bio-fuels (methane, ethanol).

ii. Adopt rice cultivation as a predominant crop in acid sulphate soils of coastal areas.

iii. Diversify rice cultivation into millets, pulses & oilseeds in Indo-Gangetic Plains to a certain extent without severely affecting the country's food security.

iv. In view of the outcomes of climate and other ecologically diverse changes that have occurred, there is need for the ICAR to undertake study and re-categories agro-ecological zones. This will provide new direction in respect of overall sustainable strategies to be adopted in agriculture.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: V

25

As an unalterable principle, adopt sustainable system of production with a view to ameliorating the scarce natural resources and the sensitive bio-diversity such as to secure long-term agricultural productivity. Through sustainable approach, enable the agricultural system to convert inputs into output in an efficient manner. This calls for management around land, soil and soil health, water and miscellaneous other interventions including forestry and ecology.

Responsibility: DAC&FW, DAHDF ICAR
Timeline: Short term
Refer Volume: V

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Interventions for sustainability need to be comprehensive in terms of land, soil and soil health, water and other related components. The specific recommendations in respect of these have been detailed vide Section 7.2, 7.3, 7.4 and 7.5 respectively in Chapter 7 of Volume-V may be referred to.

Responsibility: DAC&FW, ICAR, DoRD, DoLR, DoPR, MoWR, MoEFCC, NITI Aayog
Timeline: Short & Long terms
Refer Volume: V, VII

Sustainable strategies

The preceding recommendations relate to specific sustainability concerns, largely at the disaggregated level – soil, water, residue management; and two macro-level issues, namely, agro-ecology and climate change.

However, sustainability in agriculture will require similar approach at spatial level described by watershed, rainfed, integrated farming and organic farming systems. These systems have been dealt with in detail in Volume VI. Disaggregated interventions under these spatial systems have been construed in Chapter 6 ibid, vide sections 6.1, 6.2, 6.3 and 6.4

In the following paragraphs, some broader strategies at spatial and managerial level are recommended.

Watershed management

27

Watershed management refers to the study of the relevant characteristics of a watershed aimed at sustainable distribution of its resources, and the process of creating & implementing plans, programmes & projects to sustain & enhance watershed functions that affect the plant, animal and human communities within these watersheds. The purpose is to generate gainful employment and optimal incomes for the welfare of the watershed community.

Watershed is defined as a geographic area through which water flows across the land and drains into a common body of water, whether a stream, river, lake or ocean.

The approach to watershed treatment revolves around soil and water conservation by adopting appropriate engineering and agronomic practices.

While comprehensive watershed approach has been in practice in the country for at least four (4) decades by now, the biggest challenge is maintenance & sustenance of the watersheds after completion of the initial active phase of treatment that involves a period of 3-4 years. The strategy therefore should address both treatment and post-treatment phases.

i. Promote transparency, accountability, and stakeholder involvement and collaboration through governance and coordination mechanisms particularly at the micro-watershed level

ii. Understand Integrated Watershed Management (IWM) principles and adopt them at the local village level and establish a new standard for governance. As trends in watershed management continue, develop an effective delivery mechanism that will energize stakeholders, recognize contributions made, and celebrate community successes.

iii. A wide spectrum of tools needs to be applied, as "one size fits all" approach is not effective to deal with the increasing complexity of watershed management issues. Apply customized approach to suit various situations and challenges. Application of voluntary guidelines, promotion of targeted water policies, and consensus-based tools are the need of the hour.

iv. Institutionalise program as per the needs of people to transform the program from supply- based to one of demand-based. Optimise use of the local resources that people have interest in, and make best use of these for conservation & development of land & water and in the process ensure livelihood generation for the people of the area.

v. Develop guidelines for monitoring of watershed projects in different areas, build data collection networks, modelling, and develop indicators to report on development of soil health and water quality.

vi. Develop and improve decision making through use of geo-spatial technology tools to analyse and guide water management decisions, particularly at the micro-watershed scale, through research and the development of integrated models.

vii. Undertake and further evaluate various mechanisms and approaches to better understand what works, where, and under what circumstances, with a view to sharing information on best practices.

viii. Enhance the availability of real time precise scale data and information on factors important to IWM. These include land use and cover, slope, erosion soil depth; and water quality, use, and availability -- through surveys, monitoring, and enhancement of databases at an appropriate scale.

ix. Promote tank-based watershed development by including tank rehabilitation as a component of local watershed development activity

x. Advocate supportive policies to aid community action in conservation and development by interacting with the local, state and central governments. Promote different stakeholder groups, such as watershed members association, water users association, cattle owners associations, forest management groups, self help groups, farmer producers organisations etc. They should be oriented & trained to own and manage different responsibilities.

xi. In order to make watershed interventions demand-driven, a certain proportion of contribution should necessarily come from the stakeholders.

xii. Soil & water conservation and crop alignment should get the highest attention.

Responsibility: DoLR, DAC&FW, ICAR, DoRD
Timeline: Short & Long terms
Refer Volume: V, VI

Rainfed Agriculture

28

India has an enviable magnitude of net cultivated area that counts at 141-142 million ha. and ranks only next to that of USA. Of this, the major cultivation is under rainfed condition accounting for 53 per cent, exposing it to varying degrees of vagaries related to nature. However, there exists high diversity in rainfed systems, ranging from resource-rich areas with good agricultural potential to resource-poor regions with relatively lower potential.

Largely rainfed agricultural systems lack dependable source(s) of water and rely upon monsoons, and hence cultivation is risk-prone. The mean annual rainfall also varies across the rainfed areas, and the agro-ecology specific activities need to be adopted accordingly. The suggestions are presented in the table below:

Rainfall zone (mean annual rainfall)	Strengthening predominant traditional rained farming systems	Agro-ecology specific components along with efficient in situ and ex situ rainwater management practices
< 500 mm	Livestock-crop based	Small ruminants, nutritious cereals/millets
500-750 mm	Crop-horticulture-livestock based	Small/large ruminants, predominant rainfed crops and dryland horticulture
750-1000 mm	Crop-horticulture-livestock-poultry based	Predominant rainfed crops, dryland horticulture, agri-horti systems, rainfed vegetable crops, small/large ruminants, improved breeds of poulty
> 1000 mm	Multiple enterprise based on multiple water use	Predominant rainfed crops, lowland rice with water saving technologies, dryland horticulture, vegetable crops, other high value crops, agri-horti systems, small/large ruminants, improved breeds of poultry, fish and other income generating enterprises like seed production, apiary, mushroom cultivation etc.

Some specific recommendations are as follows:

i. The broad contours of a rainfed agriculture plan may comprise
   - Low water-duty and climate resilient based crop alignment
   - Crop and sub-sector diversification – field crops, horticulture, livestock, dairy, poultry & farm-linked activities (bee keeping, mushroom cultivation etc.)
   - Plantation – agro-forestry, bamboo etc.
   - Soil and water conservation; and soil organic carbon management.

ii. Millets (nutri-cereals), pulses & oilseeds are suited to most rainfed regions, and may be promoted. Protective irrigation by creating water ponds may be ensured, whose efficiency is enhanced by linking the source to micro-irrigation (drip or sprinkler, depending upon the crop). Paddy may be adopted only in high rainfall areas (low land rice where rainfall is more than 1000 mm).

iii. Dryland horticulture – fruit plants like mango, pomegranate, ber etc. may be promoted by adopting micro-irrigation systems.

iv. Vegetable cultivation may be promoted where water harvesting has been done through small ponds & the like combined with micro-irrigation systems; by adopting protected

cultivation (green house etc.).

v. Promote agro-forestry by growing them as row plants or / and on bunds. Choose appropriate species, that will enable inter-cropping, and do not affect the cultivation of field crops by their expansive shade.

vi. Bamboo cultivation may also be promoted under the Restructured National Bamboo Mission.

vii. Soil and water conservation practices must receive highest attention. Mulching, cover crop, contour bunding, trench fencing etc. will help in checking soil & water erosion.

In order to maximise water conservation, create small irrigation ponds (by using MGNREGA funds), which will provide protective irrigation to the crop at its critical stage of growth, if rains fail. Water use efficiency will increase if micro-irrigation system is deployed to use the stored water.

viii. Soil organic carbon management is highly critical in rainfed systems. Hence addition of FYM (farm yard manure), external compost, in-situ composting, green manuring and the like need adoption.

ix. Integrated farming system (IFS), watershed management, organic farming and conservation agriculture, are highly suited to rainfed systems. Hence, may be made integral to rainfed agriculture.

x. ICAR led 'National Innovations in Climate Resilient Agriculture (NICRA)' during 2011 has identified 151 number of districts as highly / critically vulnerable to climate chage following 'indicator method'. All these districts are highly drought-prone and may be taken up by National Rainfed Area Authority (NRAA) for comprehensive drought proofing to be achieved by 2022-23. The treatment will require about 3 years of time, and roadmap may be prepared accordingly.

ICAR-CRIDA may be revisiting the 'Vulnerability Assessment' of the districts based on IPCC's recent 5th Assessment Report (AR5). The new list of the districts that may emanate from this needs to be taken up. It is further suggested, that CRIDA may train the SAUs in 'Vulnerability Assessment' at Block and Gram Panchayat levels, so that drought proofing strategy becomes more relevant.

xi. Dairy & livestock (both large & small ruminants) and poultry are well suited to rainfed areas, and should constitute an integral component of integrated farming. Livestock are more resilient to vicissitudes of climate compared to crops. This sector has never registered a negative growth rate even during years of severe drought, unlike crop sector which has shown high vulnerability.

xii. Fodder cultivation and feed mixtures should receive due attention to support livestock rearing. In addition to cultivating fodder on the farms, the gochars (land reserved as a common land of the village for fodder) should be secured and used for silvi-pasforal systems).

xiii. In order to enable farmers to monetise their outputs optimally, market linkages are important. Hence promote Agri-value Systems (Volume IV), access to GrAMs and APMCs including online trade (eNAM). However, when IFS is practised, the produce lots are likely to get fragmented in a situation of already small & fragmented lands. Hence, aggregation of the lots by promoting commodity interest groups (CIGs), SHGs, FPOs, contract farming will be helpful.

xiv. Since rainfed agriculture is highly vulnerable, risk cover of crops under Pradhan Mantri Fasal Bima Yojana (PMFBY) and that of livestock under Livestock Insurance Scheme (LIS) would be needed.

xv. Availability of institutional credit – production loans for crops & livestock, as also term loans must be ensured, given that earnings from farming in rainfed areas are relatively lower.

xvi. The ratio of farm incomes under rainfed cultivation relative to irrigated systems is lower. Hence secondary agriculture (utilizing farm generated resources to create business & wealth), as also other non-farm activities would be critical to realise higher farmers' income in rainfed cultivation areas.

xvii. Optimize the balance between centralized water management and services with community water ownership and management. For example, the Hiware Bazar project to revitalize groundwater, community operated water supply systems in Punjab, farmer management groundwater systems in Andhra Pradesh and by the DHAN foundation, are successful projects that can be studied for replication.

xviii. Adopt a comprehensive – full-system view of the problem and design and implement integrated programs that bring together different elements. A good example is Integrated Drought Adaptation in Andhra Pradesh (AP) that brought together 19 initiatives as diverse as village seed banks, crop diversification, groundwater management initiatives, in order to make farming in the state resilient and adaptive in situations of drought.

xix. Identify and encourage effective and inspirational role model farmers who can galvanize large communities and accelerated adoption and buy-in. Such an inspired local leadership can become champions of change at the local level.

xx. Demonstrate the science of geo-hydrology and empower farmers with the knowledge, skills and equipment to measure and monitor available water resources and plan sustainable water use.

xxi. Design a comprehensive ICT program that includes mass media, school and community level activities, as well as door-to-door engagement. Establish the association between various land use practices and their adverse impact on the storage capacity of the reservoir.

xxii. Form Village Water Supply Committees for self-management of rainwater harvesting, equitable and regular water supply and revival of traditional water bodies. Harvest groundwater potential judiciously and adopt efficient water management in daira lands in eastern region of the country.

xxiii. Delineate Rainfed Agro-Economic Zones (RAEZ) and develop agro-ecology specific Potential Rainfed Crop zoning for bridging yield gaps by developing commodity crop-centric value chains, providing safety nets (weather based crop insurance), crop intensification/diversification/substitution, contingency plan implementation on real-time basis, crop planning based on market intelligence/ crop zoning/alignment to regulate cropped area and production to realize higher commodity prices.

xxiv. Implement and popularize agro-ecology specific in situ rainwater management practices on individual/community basis as a mandatory activity of state line departments for promoting higher moisture and nutrient use efficiency. Map potential sites for rainwater harvesting in farm ponds with catchment-storage-command area

relationship approach. Desilt village tanks to increase volume of water for irrigation of crops and groundwater recharge/stabilization.

xxv. Develop Land Resource Inventory (LRI) at cadastral level (1:10000 scale) for site-specific nutrient management/Integrated nutrient management, balanced nutrition and reducing input costs.

xxvi. Develop capacity for disaster management planning at the local level preparedness planning, vulnerability mapping while preparing the community level drought management plans, in livestock and dairy sectors, agromet-advisory services etc.

Responsibility: DAC&FW, DAHDF, ICAR, NRAA
Timeline: Short & Long terms
Refer Volume: V, VI

Integrated Farming System

29

Under the conditions of agricultural production system obtaining in India, farming is faced with inefficient scales of operation due to small & marginal size of farms; and high vulnerability due to climate related risks, which are getting exacerbated on account of climate change occurrences. The situation necessitates incorporation of risk management approach to production system. Integrated Farming System (IFS) offers such a comprehensive tool.

This approach views farming in a holistic manner, and deploys resource management strategy to achieve economic & sustained production, while preserving resource base and high level of environmental quality. Sustainability is the principle objective, where production process is optimized through efficient utilization of inputs.

i. In case of small and marginal farms, and particularly in situations of less endowed farming system like rainfed agriculture, Integrated Farming System (IFS) is the best option. It serves as a risk negotiation tool and ensures atleast some returns to the farm family. Hence, promote IFS models vigorously.

ii. ICAR has developed large number of IFS models suitable to different agro-climatic situations. The State Directorates of Agriculture / Horticulture / Animal Husbandry / Fisheries may identify most suited and practical models for different regions within their states and advocate for adoption at farmers' level. (Suggested IFS models for different States/UTs under all the 15 agro-climatic conditions are presented in Table 4.2, Vol. VI. This table also includes the prevailing system, that need upgradation as per AICRP findings on IFS).

There are a number of models also developed by NGOs across the country, which may also be adopted, as appropriate.

iii. The IFS approach that incorporates more than one activity leads to fragmented outputs from an already small sized and fragmented parcel of land. It is therefore essential to promote SHGs, FPOs, Cooperatives and other forms of farmer-mobilisations, so that small lots of different agri-produce generated under IFS practices can be aggregated for efficiency of market transactions.

iv. In promoting different crops and different agricultural activities under IFS, both complementary and supplementary relations that exist between/among them should be identified and taken advantage of.

v. Promote agro-ecology-specific alternate land use systems; agro-forestry systems based on land capability of both private and public lands. Traditional IFS technologies that have evolved through times may be identified and standardised by the scientists.

vi. Promote pasture, silvi-pasture systems, fodder trees, multiple tree based systems in non-arable lands, particularly in village common lands.

vii. Go for boundary plantation with perennial tree species for forage, green leaf manure, mulching and ecosystem services for moderating microclimate at individual farm level

viii. Livestock (both large & small ruminants) should form essential components of IFS, as they are more climate resilient than crop systems.

ix. Secondary agriculture should be adopted under IFS, in order to generate additional jobs and incomes. (For details, see volume IX on Secondary Agriculture)

Responsibility: DAC&FW, DAHDF, ICAR, DoRD, NRAA
Timeline: Short & Long terms
Refer Volume: VI

Organic farming and Conservation agriculture

30

It is an integrated, environmentally and economically sustainable production system, which maximises reliance on farm-derived renewable resources and management of ecological & biological processes and interactions.

It results in higher soil organic carbon, better soil quality and less erosion. It maximises soil moisture retention.

It involves a shift from intensive cultivation system based on agro-chemicals & HYVs/hybrids to extensive use of organic manures, animal manures, beneficial soil microbes, bio-pesticides, bio-agents and indigenous technical knowledge (ITK).

There is evidence to the effect that conversion of highly intensive agriculture to organic systems result in considerable reduction in crop yields (upto 25-30 per cent), especially during initial 3-4 years of conversion phase. It takes time for soil systems to regain and crop yields to restore to comparable levels.

Conservation agriculture is another alternate production system, that relies upon utilisation of organic resources grown on the farm, zero tillage (so as not to disturb the soil structure), triggering of soil microbial & biological activities and use of inputs like jeevamrut, panchgavya etc. It differs from organic farming, in certain ways. Organic farming is open to use of external organic resources and normal cultivation practices as in conventional agriculture.

Hence, a rational approach to choice of area and crops for practising organic farming is essential. The system can be more beneficially adopted in rainfed and such other poorly endowed regions; and in intensive cultivation systems, the option suggested is 'Towards Organic'. It implies adoption of Integrated Nutrient Management (INM), Integrated Pest

Management (IPM), inter and mixed cropping, crop rotations etc. Since food security of the growing population will remain a challenge, a cautious approach is always advisable.

i. Promote organic farming in regions with poor endowments like rainfed & hilly tracts, where consumption of external inputs is low and per hectare yields are also low. In such regions there is no fear of yield drop and on the contrary a higher yield can be expected to be realised because of comprehensive interventions made in poorly performing farms. Evidence suggests that such areas will benefit from higher yields than before.

ii. There is scope to bring about 14 million ha (10 per cent of the net cultivated area) under organic farming. Area suitable for coverage under organic farming may be identified, and the practice promoted in phases as a value system. Further, promote cluster based organic farming so that efficiency of scale can be brought to bear upon the practice at all stages of agri-value system, namely, pre-production, production and post-production stages.

iii. Promote organic farming of niche commodities in regions where the country has comparative advantage. To begin with, advocate organic farming for low volume high-value crops like spices, medicinal plants etc., besides, fruits and vegetables along with R&D support.

iv. Organic farming has high scope for large scale adoption in north eastern region, hill states and rainfed areas; and this may be strengthened with adequate technological backstopping along with need based input support system, marketing and value addition facilities. About 1 million hectare area now under shifting cultivation can be brought under organic cultivation and certification with appropriate interventions.

v. Facilitate region-specific resource inventory, including animal wealth, farm residues/by products and their competitive uses, non-conventional nutrient sources of organic/biological origin etc. for development of rational research-based technology packages of organic farming. The availability of organic manures in adequate amounts and at affordable costs to the farmers is essential.

vi. Standardize technologies for on-farm recycling/rapid composting of on-farm residues and wastes to meet at least 80 per cent of N, P and K requirements and strengthen extension efforts to change the mind-set of the farmers.

vii. Leverage entrepreneurial potential with respect to production of organic inputs, processing and marketing of organic food to enable start-ups to address all critical steps viz., organic inputs (bio-fertilizers/bio-inoculants, bio-pesticides), processing, packaging materials, marketing etc.

viii. Organic standards in practice in the country are derived from US and European standards. Develop national certification protocol and regulatory legal framework for organic certification standards coherent with Codex Alimentarius.

ix. Promote a strong research back-up to develop and improve national standards for organic farming. Set up robust research laboratories to monitor the quality of organic produce so as to prevent the sale of substandard material. Develop food quality parameters of organically produced food comparable with conventionally produced food and display on organic products to gain consumer confidence. Educate farmers about the importance of adopting certification standard – PGS (Participatory Guarantee System), and NPOP (National Programme for Organic Production). Large number of

Certification Agencies also need to be promoted including in the private sector. In the long run a robust third party certification will be needed, so as to ensure adherence to process & product standards and win the demand for organic produce in the market both domestic and global.

x. Compared to agro-chemical based cultivation, organic cultivation is likely to face some yield drop. The returns to farmers have to be made up by capturing higher value in the markets on these premium products. Hence, adherence to prescribed standards, certification, branding and marketing assume critical importance. Therefore, focus on training, orientation, mobilisation into CIGs/SHGs/FPOs and integration into agri-value systems (for details see chapter 8, Volume IV).

xi. The major challenge to organic farming lies in generating adequate quantum of bio-mass on- and off- farm to meet the nutrient requirements.

Hence, agro-forestry, cropping systems & legume based nitrogen fixation on the farms; bio-mass generation on common property resources; and production of bio-agents, linkage to city-compost etc. need a systematic development.

Whereas organic systems yield less food, organic foods have significantly less to no synthetic pesticide residues compared with conventionally produced foods. It has been proved through a network of ICAR research system, "Network Project on Organic Farming (NPOF)" in India, that when practised prudently and in the context of agro-climatic conditions, crop and soil type, organic farming can give as good a yield as conventional farming over a period of time. The National Agriculture Research System (NARs) will need to look more closely at appropriate varieties for various alternate production system like organic farming, conservation agriculture etc. For, it is generally known that green revolution technology is based on high yielding varieties, that produce high yields by their ability to absorb high intensity of inputs-agrochemicals, water etc.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: V,VI

Related additional suggestions

31

i. The universal soil health card (SHC) scheme is very appropriate. There is need to connect Soil Health Card Portal with Integrated Fertiliser Management System (I-FMS) of the Department of Fertilisers, to ensure that SHC based fertiliser is supplied to all the farmers. Equally important, is to educate the farmers on use of the recommendations. The farmer should be enabled to receive electronic SHC (eSHC), anytime for any crop, based on the sample test already carried out.

ii. Prepare a district level nutrient map to promote district-and-crop-specific customized fertilisers based on the soil health card data. Furthermore, every Panchayat should have soil testing facilities or they should be able to arrange for soil testing through other government or private agencies. Private sectors, NGOs and rural youth should be encouraged to establish infrastructure for soil testing and advisory services. Once nutrient mapping is completed for all districts, and crop-specific fertilizer prescription is made, this will not only economise fertilizer input but also enhance input-use efficiency and farm income.

iii. Large quantities of farm waste / biomass (green manures, legumes) are good sources of organic carbon. Hence, major attention is required to utilize these sources efficiently through adoption of multiple approaches – bio-agents, FYM, compost etc.

iv. Introduce and provide carbon-credit to the farmers practising conservation agriculture for carbon sequestration and greenhouse gas mitigation. The carbon credit can be linked as additional interest subvention or to other support mechanisms.

v. Though mitigation practices are important to reduce the drivers of non-sustainable practices, it is the adaptation strategies that are essential in the long run. Adaptation is an anticipatory and planned process, managed through policies, technologies and developmental work. Adaptation technologies, broadly categorised as crop/cropping system-based and/or resource conservation-based, must be implemented in consonance with the socio-economic policy.

vi. Legumes are ideal crop components for conservation agriculture (CA) for soil cover and rotation. Water use efficiency improves with CA as it allows for earlier planting, reduced soil evaporation, better weed management, and increased access to nutrients

Responsibility: DAC&FW, DAHDF, ICAR
Timeline: Short & Long terms
Refer Volume: V

For full context and other details, the linked domain specific Volumes of the DFI Report may be referred to. However, it is advised that for years to come conventional agriculture based on HYVs/ Hybrids and intensive use of agro-chemicals will be the main theme of crop production system. Hence, sustainable agriculture cannot be confined to alternate systems like organic farming, conservation agriculture etc. In order to use the natural resources on a sustainable basis, Good Agricultural Practices should in general influence the conventional agricultural system. These include spatial approaches like integrated watershed management and at the farm level, practices like IFS, INM, IPM etc.

Chapter 6
Productivity Enhancement & Cropping Intensity

One of the three primary variables in doubling the farmers' income by the year of India's *75*th Independence Anniversary, is enhancement of total output at both farmers level and at macro level. Given the inelasticity of land, high density of farm families, and low realisation of technically and economically feasible productivity potential across the sub-sectors, the most appropriate strategy is to work for achieving higher productivity. It is a low hanging fruit.

Efforts towards productivity are motivated at farmers' end, with improved economic returns, which require efficient and effective market linkage and other factors such as risk mitigation, extension services and more. Simultaneously, production enhancement also comes from repeated use of the same inelastic land in a given year, by adopting appropriate technologies and facilitation. These two aspects of productivity gains and higher cropping intensity to yield higher total output, are considered in the recommendations hereunder.

Simultaneously, for the strategy to become income-centric, change in the crop geometry is essential, which implies crop diversification in favour of high value crops, and all this, while ensuring that the targeted output from the remaining crop area is achieved.

General recommendations

Achieving higher yields across the crop-categories deserves the highest attention. The race towards this goal cannot be uniform, for this approach will end up with continued inefficiencies of resource use (particularly water), unfavourable inter-crop parity making shift to desired crops impossible.

The broad strategy in aiming at higher per unit yields should include:

- Increasing the per ha yields of millets from the current 1.1 tonnes to 1.6 tonnes.
- Increasing the per ha yields of pulses from the current 0.7 tonnes to 1.4 tonnes.
- Increasing the per ha yields of oilseeds from the current 0.96 tonnes to 1.5 tonnes.

Note: The aim should be to achieve higher growth rates in case of millets, pulses and oilseeds vis-a-vis rice and wheat. The catch up in productivity combined with higher MSP + assured procurement should facilitate crop substitution & diversification.

The strategy should aim at resource use efficiency, and therefore, the monitoring measures should be appropriate. These include:

- The yield measurement should change from grains/ha to grains (calories) + nutrients/ha. [The essential nutrients may be delineated in accordance with the findings of the 'National Family Health Survey (NFHS)', for purpose of targeting the nutrient yield/ha].

- An important measure should be yield output/unit of water. This is important considering the water stress that has developed in the country, particularly in the food bowl of India, namely, Indo-Gangetic Plains (IGPs).

The strategy should aim at higher farm incomes while meeting the food and nutrition security of the country as a pre-requisite. More specifically, it should include:

- Based on the estimated demands for food (calories) and nutrition (identified nutrients), by 2022-23, 2025-26 and 2030 respectively, aim to realise the target from lesser than the area under current cropping pattern.
- The areas under staple cereals now at more than 50 per cent of Gross Cropped Area (GCA) should reduce, supported by higher productivity, and proportionate land released for growing other crops like nutri-cereals (for diversifying the food plate), pulses (proteins for nutrition), oilseeds (to bridge the domestic production deficit) and high growth sectors (dairy, livestock, fisheries).
- The country's agricultural landscape in 2022-23, 2025-26, 2030-31 should be described by a new crop geometry (high in both calorie & nutritional output; resource use efficient & sustainable) and product-matrix (demand linked and high income generating commodities).

More importantly keeping in mind the tight timeframe for achieving a doubled income status for the farmers, productivity enhancements have to be primarily derived from harvesting the technical and economic potential of the varieties already released, without waiting for new varieties, which can be a long term target. In the short run, improved agronomic practices and high efficiency of resource-use will contribute to bridging the potential yield gaps.

Field Crops

1

Identify the location specific causes of existing yield gaps and thereafter adopt strategy to bridge the same between district and the state average, and state and the national average to maximise productivity. The causes for low crop yields can be abiotic and biotic in nature, related to production environment, market access, purchasing power/income, agricultural work force, and terrain factors, besides water and fertilizer management.

	Responsibility: DAC&FW, DARE-ICAR
	Timeline: Short term
	Refer Volume: VIII

2

To achieve higher yields in case of staple cereal crops, the production environment (ecology) and resource availability are an important factor. There is accordingly the need to shift from water guzzling crops of rice, wheat and sugarcane, while ensuring higher yields, towards less water consuming crops like pulses, oilseeds, nutri-cereals, vegetables and fruits.

Bring policy measures for encouraging the farmers to make a shift from rice (kharif)-wheat (rabi) cycle in Indo-Gangetic Plains (IGP) to pulse/oilseed/low water duty cereals in kharif

followed by wheat in rabi. In all cases, however, the food and nutritional security should receive paramount importance.

Responsibility: DAC&FW, DARE-ICAR
Timeline: Short term
Refer Volume: VIII

3

Concentration on a few cereal crops has reduced profitability, distracted investment, and dampened growth in the agricultural sector. High value crops offer comparatively better growth opportunities in terms of value of output contribution as compared to the staple crops. Shifting some area from staple cereals to high value produce can lead to a sizable increase in the returns for farmers. This would also bring in water use efficiency and sustainability of soil health.

A five (5) year roadmap for a targeted diversification from rice in kharif to alternate & more resource-use efficient crops may be adopted.

Responsibility: DAC&FW, DARE-ICAR
Timeline: Short term
Refer Volume: VIII

4

In addition to productivity enhancement approach, as a route to higher production, adopt suitable agronomic practices, short duration varieties, appropriate cropping systems and better water use efficiency to realise higher cropping intensity. This will lead to higher productivity per unit of arable land during one agricultural year. The bottom line strategy needed is to realise higher productivity per unit of asset (land, water, etc.) per year, and not merely per season productivity. In fact when such measurement approaches are used to make inter-country comparisons, the performance of Indian agriculture does not show up as poorly when per ha. yields for a season are used. For example, in Punjab State, the average output per year that the farmers realise is 11 tonnes/ha of grains from paddy-wheat crop cycle. Few, other countries have the agro-climatic advantage of benefiting from more than one production season in a year, as in India. The crop architecture should, therefore, aim at packing as many crop-cycles no possible within a year. However, soil nutrition and soil health in general will have to be taken care of with respect to sustainability.

Responsibility: ICAR, DAC&FW
Timeline: Short term
Refer Volume: VIII

Rice

5

Promote cultivation of hybrid rice which has potential to increase the productivity substantively. Rice along with wheat constitutes the staple cereal basket of the country. Hence, targeted output of rice must be ensured through higher productivity as a part of paddy substitution strategy. The nation's average yield of paddy must be targeted to effect an increase from the current 3.2 t/ha to 3.5 t/ha by 2022-23.

Responsibility: ICAR, DAC&FW
Timeline: Short term
Refer Volume: VIII

6

Promote use of latest high yielding varieties (HYVs) / hybrids of rice; and achieve seed replacement rate (SRR) of 80 per cent in HYVs, and 100 per cent in case of hybrids. In addition to SRR, ensure that varietal replacement rate (VRR) receives due attention including adhering to the prescribed life period of 10 years. All varieties that have crossed this threshold should be weeded out of the seed chain.

Responsibility: ICAR, DAC&FW, SAUs
Timeline: Short term
Refer Volume: VIII

7

Promote bio-fortified high nutrient rich varieties of rice, with high contents of iron & zinc. The varieties already developed by the country's NARS (national agricultural research system) may be promoted by integrating them into the seed production chain.

Responsibility: ICAR, DAC&FW
Timeline: Short term
Refer Volume: VIII, XIII

8

Identify the rice varieties that are in demand in the export market and accordingly promote special varieties like high yielding basmati, aromatic non-basmati varieties and sticky rice to capture higher share in the global market. Sticky and small grain rice is preferred is ASEAN countries, and not the long grain non-sticky rice that is common in India. It is such market intelligence that can convert into market linkages, if production decision is appropriately responsive.

Responsibility: ICAR, DAC&FW, APEDA
Timeline: Short term
Refer Volume: VIII

9

Promote water use efficient rice varieties, technologies and practices, preferably using micro-irrigation system. An output of 1 (one) kg of rice consumes an average of 3000-5000 litres of water, which is not a sustainable practice. The continuous cultivation of paddy in some parts of the Indo-Gangetic Plains has resulted in over-exploitation of ground water, besides soil degradation.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: VIII

10

Rice is consumed as staple food by more than half of the world's population. Puddling, a procedure of ploughing soil in standing water, expends a substantial amount of water. Therefore, there is need to adopt alternatives of rice establishment techniques like unpuddled transplanted rice (UPTPR), zero tillage transplanted rice (ZTTPR), and zero tillage direct seeded rice (ZTDSR). Large scale Result Demonstrations undertaken by Extension Machinery and KVKs will help in promoting adoption of these technologies.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short & Long terms
Refer Volume: VIII

11

Average productivity of rice in India is low compared to its technical potential. Quality and judicious use of inputs such as water, seeds, fertilizer and pesticides with efficient use of modern technology are needed. One of the important reasons for low average yield of the country is large scale cultivation of upland paddy in high rainfall areas of eastern Indian states like Odisha, Jharkhand, Chhattisgarh, Assam, etc. These areas can be more profitably cultivated by substituting paddy by crops like low water duty cereals, namely, millets besides pulses & oilseeds.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short & Long terms
Refer Volume: VIII

12

Crop substitution by diversifying from paddy is the need of the hour in Indo-Gangetic Plains and uplands of eastern Indian states. However, substitution strategy has to follow substantive increases in productivity of rice in the remaining area, so that food security is not compromised. Hence, any substitution plan for rice must be accompanied by a comprehensive strategy to realise higher yields in the remaining area under rice. This strategy can further be supplemented with higher production of cereal substitute like millets.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short & Long terms
Refer Volume: VIII

13

By 2022-23, target a total rice output of 124 million tonnes, which is an important aspect of ensuring food security.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: VIII

Wheat

14

In view of climate change implications causing rising temperatures and rainfall deviations, develop and promote the varieties of wheat that are tolerant to heat and moisture stress in different growing zones. A rise in temperature by 1 ^{o}C is estimated to result in a yield drop of 5-10 per cent per ha of wheat.

Responsibility: ICAR, SAUs, DAC&FW
Timeline: Long term
Refer Volume: VIII

15

All staple cereals, including wheat, have a large consumption base and therefore the bio-fortified varieties should be promoted to assure nutritional security.

Responsibility: ICAR, SAUs, DAC&FW, DoFPD
Timeline: Short term
Refer Volume: VIII

16

Some of the major constraints to good productivity experienced by the farmers include, non-availability of seeds of newly released wheat varieties, rodents, high cost of inputs, non-

availability of farm machinery, infestation by *Phalaris minor,* declining water table etc. Farmers need to be educated and trained on recent wheat production technologies, complete package of practices and soil health management. There is need for priority attention to ensuring of quality seeds as well as quality inputs. Farmers also need to be updated on impact of climate change on wheat cultivation and about the coping strategies they should be adopting to mitigate it.

Responsibility: ICAR, SAUs, DAC&FW
Timeline: Short term
Refer Volume: VIII

17

The concern is to increase the productivity of wheat per day in preference to yield per unit area. This will be a more profitable approach to achieving higher total output on an annual basis. This calls for encouraging short duration varieties, which will enable raising of a summer crop, wherever irrigation source is available. Validation of scientific techniques/technologies like conservation agriculture practices, raised and furrow based irrigated system, use of bio-fertilizer and drip irrigation, secondary and micro-nutrients and soil amendments, climate resilient varieties facilitate realisation of increased income at various magnitudes by reducing the cost of resource use.

Responsibility: ICAR, SAUs, DAC&FW
Timeline: Short term
Refer Volume: VIII

18

Cultivation of durum wheat has resulted in additional profit to the tune of Rs 26,643/ha (+56.05 per cent) owing to the grain demand for exports as well as manufacture of diverse products. However, the durum wheat has been under cultivation only in certain pockets of India, especially in Central Zone and Peninsular Zone. It may be promoted in other zones of the country too.

Responsibility: ICAR, SAUs, DAC&FW
Timeline: Short term
Refer Volume: VIII

19

Another old species, dicoccum wheat, known as emer wheat is now grown in south peninsular zone and some parts of western India. With its low glycaemic index and high nutrient values, it is known as a health food, particularly for those needing to manage their diabetes. This can be encouraged by adopting high yielding variety, DDK 1029 and branded as premium product in both domestic and export markets.

Responsibility: ICAR, SAUs, DAC&FW
Timeline: Short term
Refer Volume: VIII

20

Wheat is next only to rice in terms of its importance, so far as India's food security is concerned. The climate change linked to rising levels of greenhouse gas (GHG) emissions, is expected to cause a rise in temperature during the 21st century. This alone is expected to adversely impact the productivity of wheat. As per studies, a rise in temperature by 1 ^{o}C causes a yield decline of wheat in the range of 5-10 per cent. This is a visible drop. As a long term strategy, R & D will need to focus on evolving heat-tolerant varieties, besides working on

appropriate technology package and management practices to counter the probable negative impact of temperature rise on yield. Parallely, it would help buffer the food security by strategising to increase cultivation of climate-resilient crops like millets, and popularize them on the food plates of the consumers. This alternate strategy is important in the larger perspective of greater certainty of climate change impact.

Responsibility: ICAR, SAUs, DAC&FW
Timeline: Long term
Refer Volume: VIII

21

Diversification of the rice-wheat system under conservation agriculture (CA) in the Indo-Gangetic plain will be the key to sustainability. Diversified cropping systems including pigeon pea-wheat, maize-wheat, and adoption of pulses in the predominating cropping systems are examples of a sustainable crop production system.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: VIII

22

Target a wheat output of 119 million tonnes by 2022-23.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

Maize

23

The maize yields per ha in India are very low when compared to other major maize growing countries and global average. A critical key to realisation of higher yields lies in promoting single cross hybrids (SCHs). States like Tamil Nadu and Bihar, that have brought 100 per cent of their maize area under SCHs have been able to register higher productivity in the recent years. This may be replicated in other states as well, using a suitable mechanism.

Only about 30 per cent of the area in the country is under single cross hybrids (SCH) as of now, and indicates the extent of large area to be covered and potential of higher output that can be realised.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: VIII

24

Promote maize not only for human consumption but also for poultry, dairy and industrial sectors. In consonance with this, promote appropriate varieties that will suit the respective end-requirement. Maize being amenable to large number of industrial intermediate and final products, its production may be integrated into the appropriate value chain.

Responsibility: ICAR, SAUs, DAC&FW
Timeline: Short term
Refer Volume: VIII

25

Maize being a C4 plant, possesses high technical yield potential which as yet has not been harvested in India. As of now a very low percentage of crop's technical potential has been harvested in India. At an average yield of 2.7 tons/ha it compares very unfavourably with high realisations in countries like USA, China, Brazil, etc. These countries have already achieved more than 5 tonnes per ha of grain yield, and in fact USA is as high as 12 tonnes per ha. Hence, the need for focused attention on yield upgradation, to reach an average of at least 4 tons/ha by 2022-23.

Responsibility: ICAR, SAUs, DAC&FW
Timeline: Short term
Refer Volume: VIII

26

As maize is a day neutral and climate resilient crop with high yield potential, it can be promoted as an all season crop. Wherever rice-wheat cropping system can be changed without impacting the food security, adopt maize as replacement crop, for rice in kharif and for wheat in winter and spring.

Responsibility: ICAR, SAUs, DAC&FW
Timeline: Short term
Refer Volume: VIII

27

Several dairy farmers in Punjab have mechanised maize based silage. Other states may replicate the protocol and technique to suit the needs of their dairy farms. Bringing maize into organised use in the dairy sector, promotes efforts in productivity enhancement at farm level.

Responsibility: DAHDF, DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: VIII

28

Develop climate-resilient maize germplasm and hybrids. The breeding programs can be reoriented to engineer maize germplasm resistant to biotic and abiotic stresses. Future of maize production, and consequently, the livelihood of several million smallholder maize farmers, will depend to a great extent on affordable access to climate resilient cultivars.

Responsibility: ICAR, SAUs, DAC&FW
Timeline: Long term
Refer Volume: VIII

29

Strengthen production of baby corn, sweet corn, wax corn and other speciality corns in the hinterlands, along with the establishment of suitable processing industries. Speciality corns are good for diversification and value addition besides supporting livestock feed industries.

Responsibility: ICAR, SAUs, DAC&FW
Timeline: Short term
Refer Volume: VIII

Millets - Nutricereals

30

Millets have come to be neglected causing a drastic decline in area coverage, while being most appropriate for rainfed and less endowed ecologies. Their relevance assumes critical role in view of climate change implications. Hence promote millets as climate resilient crops, particularly in rainfed areas.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

31

Millets are rich in various nutrients besides being low in glycaemic index, making them super foods for a healthy living. Hence, promote millets as nutri-cereals, and as staple crops. This will broad base the cereal consumption basket, currently dominated by wheat and paddy. Millets popularised as nutri-cereals will come to acquire a critical mass in the market, and support higher production. A virtuous cycle between supply and demand will need to be created for a spiralling growth of nutri-cereals.

Responsibility: DAC&FW, NRAA
Timeline: Long term
Refer Volume: VIII

32

The current production of nutri-cereals is low at 17 million tonnes. In order to promote nutri-cereals as a staple food, and enhance their accessibility, it would be necessary to achieve a jump in production to around 34 million tonnes by 2022-23. This suggests the need to adopt both approaches of productivity enhancement and area expansion.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

33

Of the nine millets commonly cultivated in India, three major millets, namely, jowar, bajra and ragi, may be taken up on priority considering the extent of area under cultivation, quantum of production, scope for higher productivity, and consumer preference. This approach is influenced by the need to achieve a certain critical quantum in the market and enhance availability, accessibility and affordability.

Further, given the minimum requirements of water, small millets like *kodo*, little and barnyard millets can be successfully grown in the post-kharif fallows using residual moisture available in rainfed areas. Similarly, there are other millets like finger millet which have higher nutritional benefits and can be produced. Most of the millets are short duration in nature (generally 65-80 days) and can be successfully grown in the post-kharif fallows. Therefore, bring additional area under millets which will significantly increase the cropping intensity in dryland agriculture and contribute to higher output and farm incomes.

Responsibility: DAC&FW, NRAA
Timeline: Short & Long terms
Refer Volume: VIII

34

In order to achieve the critical production level, and enable integration of nutri-cereals into public distribution system (PDS), the productivity target should be raised to an average of 1.6 tons/ha from the current 1.1 tons/ha. Simultaneously, additional area has to be offered to nutri-cereals.

Responsibility: DAC&FW supported by DoFPD
Timeline: Short term
Refer Volume: VIII

35

Area under millets has to be substantially increased from the current extent of 16 million ha. The scope for such expansion lies in (i) using post-kharif fallow lands with residual moisture in high rainfall regions (central & eastern Indian states) estimated at 12 million ha; (ii) crop substitution for rice in kharif in Indo-Gangetic Plains; (iii) promoting millet based inter-crops; and (iv) development of wastelands, mostly available in central India and bringing them under millets.

MGNREGA funds can be used to develop these common wastelands into cultivable lands. An integrated and target oriented strategy may be drawn up for this purpose.

Responsibility: DAC&FW, ICAR, DoRD
Timeline: Short term
Refer Volume: VIII

36

One of the prerequisites for promoting millets is establishing primary processing facilities at the farm-gate/village level. Hence, primary processing units should be included under NFSM and agriculture machinery schemes of the Ministry of Agriculture. They may also be promoted as enterprises supported by credit and subsidy linkages as also made part of Custom Hiring Centres, Contract Services etc.

Responsibility: DAC&FW, MSME, MoFPI
Timeline: Short term
Refer Volume: VII, VIII

37

In order to strengthen and sustain production of millets, adopt a market-led approach. For this, advocate and promote awareness about nutri-cereals among consumers across the country, to create demand. The year 2018, declared as the 'Year of Millets' by Government of India, should be used for reorienting research, policy advocacy and demand creation by adopting an aggressive and comprehensive public outreach programme. This entails co-opting multiple stakeholders, road shows and workshops and multi-media campaign.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

38

Sorghum and other millets are a good source of fodder. Integrate nutri-rich millet fodder with existing millet supply chain models to contribute to enhancing farmers' income.

Responsibility: DADHF, DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

Pulses

39

Food and nutrition security of the country warrants a stable pulse production achievement in the country. The recent interventions have brought about substantive increase in pulse production taking the output to about 23 million tonnes. The projected demand by 2022-23 is 25 million tonnes and by 2030 it is 32 million tonnes.

In order to achieve the required supply and in a stable manner, a comprehensive production strategy will need to be adopted. Notwithstanding impressive gains in the 2 years of 2016-17 and 2017-18, slippages can happen, particularly if monsoons play truant. Hence, the need for a close monitoring, so that India becomes self-sufficient with respect to pulses. The five year road map 2016-17 to 2020-21 adopted by DAC&FW may be upgraded into a six year plan.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

40

The components of a comprehensive strategy for self-sufficiency in pulses include enhancement in yields (from the current average of 0.7 t/ha to 1.4 t/ha); area expansion (inter-cropping, using post-Kharif rice fallows and increased cropping intensity).

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VII, VIII

41

Focus on enhancing the farmers' access to adequate quantity of quality seeds. The existing seed replacement rate (SRR) under pulses is a low of 15-20 per cent.

In order to achieve a high yield that comes from good seed, ensure that SRR increases to 42 per cent (by 2022-23) taking care of varietal replacement rate (VRR) simultaneously.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: VIII

42

In order to take care of SRR and VRR, the seed production system needs to be diligently planned though the chain consisting of breeder seed, foundation seed and certified seed. The ratio of requirement from one stage to the other must be ensured. The proposed diligence calls for an advance planning of 2 years and close coordination among the three principle stakeholders, namely, DAC&FW, ICAR and State Governments.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: VII, VIII

43

To strengthen the seed production system, co-opt both public and private sector seed producers. Identify the number of seed hubs and seed village programs needed to meet the pulse seed requirement. The quality of certified seeds, produced in the seed hubs may be closely monitored and tracked by deploying ICT.

In case of seed village programs, where truthfully labelled farmers saved seeds are produced, the quality must be taken care of. Seed production system deserves highest attention. Bar coding system may be introduced so that the source, i.e., the producer and certifying agency can be traced.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: VII, VIII

44

Support decentralised seed production system by establishing seed processing plants at Gram Panchayat levels and institutes like KVKs/SAUs and ICAR centres. This infrastructure and approach may be replicated in case of other crops also.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: VII, VIII

45

There exist visible yield variations across the major pulse growing states. It is recommended to identify blocks, districts and states where yield levels are visibly lower than the district/state/national averages respectively and cover them under specially designed "NFSM Pulses+". Such areas may be given additional support after diagnosing the reasons for low productivity.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

46

Pulses are generally cultivated under conditions of rainfed and less endowed farming systems, rendering them vulnerable to monsoon truancies. It is, therefore, necessary to create small irrigation structures combined with micro-irrigation systems to offer protective (lifesaving) irrigation, particularly at the critical crop growth stage.

The model of *Krishi Bhagya* in Karnataka, encompassing source creation through small farm ponds, lift irrigation, piped conveyor systems and micro-irrigation system is worth emulating in other states.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: V, VI, VII, VIII

47

Pulse crops are vulnerable to pests & diseases during growth as well as storage stages. Integrated Pest Management (IPM) practices are well suited to pest management.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: VII, VIII

48

To incentivise the farmers to continue with pulse production, a favourable inter-crop comparison with competing crops like cereals, cotton will have to be ensured. This entails a

fair & competitive market price, protection against liberal imports and MSP-linked procurement if markets fail.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IV

49

The maximum scope for area expansion under pulses comes from post-kharif fallow lands, which is estimated at 12 million ha, largely in central & eastern India where residual moisture is good due to higher annual rainfall. An important intervention needed is securing cultivated area from open grazing of cattle. Promote green fencing.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: V, VIII

Oilseeds

50

Oilseeds are the Achilles heel of India's food production system. The country continues to remain hugely deficit in edible oils on account of low domestic production of oilseeds. There is urgent need for setting up an "Oilseed Technology Mission" with a specific target to bridge the supply gap in phases by 2022-23, 2025-26 and 2030 by when India should become self-sufficient. The strategy for self-sufficiency should encompass all three sources of oils – seven edible (soybean, rapeseed-mustard, groundnut, sesame, sunflower, safflower & niger) & two non-edible (castor & linseed) oilseed crops, all of nine (9) constituting the primary sources; secondary sources (rice bran, cotton seed, solvent extracted oils); and tree borne oils (TBOs), namely, palm oil, coconut, other tree & forest origins.

Responsibility: DAC&FW, ICAR
Timeline: Short & Long terms
Refer Volume: VIII

51

Oilseed production from primary sources should be increased from the current 31 million tonnes, to 45 million tonnes by 2022-23. This will help in increasing the edible oil production in the country from the current 7.1 million tonnes to a range of 11-14 million tonnes. Contribution from secondary sources and TBOs will add another 3 million tonnes, restricting the import dependency to about 16 million tonnes, which otherwise will be much higher by 2022-23.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

52

To enhance oilseed production, focus should be on increasing the oilseed productivity, in addition to bringing more area under their cultivation. Target an area increase under primary sources of edible oils from 26 million hectares in 2015-16 to 31 million hectares by 2022-23; and production from 25 million tonnes to 45 million tonnes. In consonance, productivity should increase from 968 kg/ha to 1500 kg/ha in the same period.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

53

Address the prominent issues that relate to current level of low oilseeds productivity. As of now, not more than 30 per cent of the technical potential of the existing varieties has been utilised. Some of reasons include cultivation in poorly endowed regions, lesser than recommended SRR, imbalanced nutrition, endemic and persistent pest and disease attacks, and poor harvest practices etc. The approach should be to bridge the yield gaps that exist between FLDs and farmers' fields to enhance tapping of the genetic potential. In order to achieve the targeted 1500 kg/ha by adopting recommended varieties & SRR besides the agronomic practices holds the key.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

54

Within the 9 seasonal oilseeds, rapeseed – mustard can become the core focus, as it offers major scope in terms of area coverage, productivity and oil conversion factor. Soybean and groundnut are two others that can help in scaling up the output. The roadmap should bring special focus on these three primary sources to meet the targeted production levels.

Suggested technologies for productivity enhancement of major oilseeds

- Rapeseed-Mustard: timely sowing; seed treatment; maintenance of plant population; application of boron & zinc, based on soil test; inter-cropping with chickpea or lentil; irrigation management & foliar spray; management of aphid.
- Soybean: varietal cafeteria approach using zone specific varieties; seed treatment & bio-fertilizers; reduced higher seed rate; broad-bed-furrow (BBF) planting; balanced nutrient management; irrigation at seed fill stage; inter-cropping (pigeon pea / maize etc.)
- Groundnut: BBF in kharif and crisscross planting in rabi; Protective irrigations at flowering & pod formation stages; application of zinc; seed treatment & use of bio-fertilizers.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

55

Yield performance of oilseeds in the country is 66 per cent of global average with castor as an exception (in which case India leads). There exists vast scope to bridge the yield gap and the highest scope of 160 per cent exists in case of sunflower and 22 to 89 per cent in case of others.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

56

Extend oilseed cultivation to non-traditional areas and non-traditional seasons, such as spring sunflower in IGP region; mustard in north eastern states etc. Promote inter-cropping of mustard, for which large number of FLDs/cluster FLDs may be undertaken under NFSM.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

57

Harvest the advantage of castor productivity and promote its cultivation by assessing domestic demand and export potential. The country's non-edible oil demand is also growing, and there exists greater scope for use of castor oil in industry. In order to promote domestic production of second and third generation derivatives, having higher economic value, adopt a suitable policy framework for castor. This is to help the farmers reap higher farm income.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

58

The area under mustard can be enhanced by substituting it for wheat in Punjab, Haryana and Western U.P. with increased yield and higher MSP, it will be able to compare well with wheat in inter-crop parity. There is scope for wheat substitution area by 5-10 per cent. Mustard may also be promoted in unconventional areas including north eastern states.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

59

Address constraints in promoting oil palm cultivation. Some of these include long gestation of oil palm tree (which can be addressed through inter-cropping to support better income flow), fluctuation in global prices of crude palm oil, etc. Area expansion can be incentivised by compensating the oil palm growers whenever the international Crude Oil Prices (COP) fall below a certain threshold. Based on current (2018) global trend, a threshold of US$800 per tonne is recommended, for compensation if the prices fall below it.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

60

In order to finance such a price mechanism, creation of an "Edible Oil Development Fund" (EODF) is suggested with contributions coming from a specially levied cess @ 0.5 per cent on the imports of CPO and RBDPL.

Responsibility: DAC&FW, DoCI
Timeline: Short term
Refer Volume: VIII

61

Incentivise investments required for achieving higher productivity at farmers' level by a protective and steady trade regime. The domestic market can be price buoyant, when import duty is protective. Simultaneously domestic processing plants need to be robust and supported to run their full capacity. Despite huge domestic supply deficit, the farmers have not been enjoying high market prices. This is due to availability of cheap imported vegetable oil in the market. A fine balance is needed in meeting domestic demand through imports and ensuring a favourable price in the domestic markets.

Responsibility: DAC&FW, DoCA, DoCI
Timeline: Short term
Refer Volume: VIII

62

The capacity utilisation of the domestic oil industry (oil mills, solvent extraction plants, is about 35-50 per cent. This is on account of low availability of raw material and eased import of refined oil. As domestic oilseed production scales up, the import of crude oil could be made easier, so that domestic industries benefit. In order to support local refineries the import of CPO needs an incentive relative to refined palm oil. It is suggested, that while import duty on both categories is raised to protect the local production, simultaneously, the import duty differential between crude & refined oil be maintenance at a minimum of 20 per cent.

Responsibility: DAC&FW, MoFPI, DoCI
Timeline: Short term
Refer Volume: VIII

63

One of the important area expansion strategies includes utilising estimated 12 million hectares of post-kharif fallows, for promoting oilseeds besides pulses and nutri-cereals. Care must be taken to reconcile the crop plant type and geometry of these three crops in utilising the rice fallows for rabi cultivation based on their respective moisture requirement. Since all these three crop categories are common to rainfed and hilly areas, area promotion strategy must take into account supplementary and complementary crop relationships.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

Sugarcane

64

Recognising that sugarcane is cultivated as a cash crop, the approach to income enhancement of farmers lies in increasing per hectare yield and sugar recovery with no further increase in cost of cultivation. In order to double the income of sugarcane farmers by 2022-23, target an increase in average yield from 71t/ha (in 2016-17) to 79 t/ha (in 2022-23) and average sugar recovery from the current average of 10.6 (in 2016-17) to a minimum average of 11 per cent (in 2022-23)

Responsibility: ICAR, DAC&FW
Timeline: Short term
Refer Volume: VIII

65

The technical and economic potential of the crop is as high as 339 tons per hectare and the current realised average yield is as low as 21 per cent of the potential. A package approach based on R&D, technology adoption at farmers' level and financial support can help in enhancing the share of yield potential that exists.

Responsibility: ICAR, SAUs, DAC&FW
Timeline: Short & Long terms
Refer Volume: VIII

66

High cost of cultivation of cane crop is a cause of concern as it is both labour and input intensive. Two of the major interventions needed to reduce cost of cultivation include adoption of micro-irrigation and mechanisation. The policy adoption of compulsory micro-irrigation in sugarcane cultivation by Government of Maharashtra is an example that can be replicated

across the country. Farm mechanisation can come by way of promoting custom hiring centres, farm service contracts etc.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VII, VIII

67

Greater emphasis is required on transfer of technology and management practices to farmers. It is seen that over the last 2 decades, the productivity and production and sugar recovery have more or less plateaued, despite release of new varieties and production technologies. This needs to be corrected.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

68

The relationship between the two principle stakeholders that constitute the sugar industry, namely, farmers and mills has been a cause of concern on account of delays in payment of cane dues to farmers, which detracts from productivity and stable production. This issue needs to be resolved for ensuring that both cane cultivation and sugar industry are able to operate at optimal levels of efficiency. One of the major irritants in the relationship revolves around timely payment of cane bills due to the farmers by the mills.

Responsibility: DoFPD, DAC&FW
Timeline: Short term
Refer Volume: VIII

69

Adopt policies that would enable sugar mills to improve their revenue pot by diversifying into multi-product complexes as recommended by Rangarajan Committee in 2013. The upgradation should happen from 'Sugar factory' to 'Bio-energy factory' to 'Agro Processing Complexes', so that maximum revenue value is captured from the cultivated cane.

Responsibility: DoFPD, DAC&FW, ICAR
Timeline: Long term
Refer Volume: VIII

70

Government may examine to permit production of ethanol from B-heavy (or B-grade) molasses, as also directly from sugarcane juice, as against production from C-heavy molasses only, as of now. This will require to be stabilised by fixing appropriate prices and adopting a consistent policy regime by the Government.

Such a diversion from sugar to ethanol production may however be allowed after ensuring that the country's sugar demand is not put at risk.

This policy can be expected to result in higher recoveries from optimal sugar price and ethanol, for the sugar mills. With increased revenue pot, the mills may be in a better position to pay the farmers in time as per annual notified Fair Average Price (FAP).

Responsibility: DoFPD, MoPNG
Timeline: Short & Long terms
Refer Volume: VIII

71

Even when sugar is produced, it should not be for purpose of use as sweetener alone, but also be produced to utilise as feedstock for several feasible industrial products.

Responsibility: DoFPD, DAC&FW
Timeline: Short term
Refer Volume: VIII

72

By and large, cane cultivation should be promoted as a use-specific crop – sugar, ethanol, alcohol etc. – and therefore the right variety be promoted.

Responsibility: DAC&FW, DoFPD, ICAR
Timeline: Short term
Refer Volume: VIII

Cotton

73

Cotton productivity has reached a plateau over the last five years and this has to be broken by adopting appropriate multiple abiotic/biotic resistant varieties. ICAR-AICRP has developed and released more than 300 cotton varieties and hybrids for different cotton growing tracts. Based on local conditions, suitable varieties and hybrids from among these may be identified and promoted. The State Agricultural Universities (SAUs) will need to undertake field trials and recommend the most suited varieties for the local agro-climate.

Responsibility: ICAR, SAUs, DAC&FW
Timeline: Short term
Refer Volume: VIII

74

Cultivation should be holistically planned to maintain uniform quality of cotton from a region. Indiscrete choice of varieties and hybrids will introduce variations in the fibre length, strength, micronaire, etc. and dilute the quality of supply to cotton mills. This will have impact on valuation and price that farmers receive.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

75

Take advantage of one of the world's largest gene bank for cotton available in India with accessions of all the four cultivated cotton species. This offers an opportunity to breed new varieties and hybrids that can combat multiple challenges, including those from climate change uncertainties.

Responsibility: ICAR, SAUs
Timeline: Long term
Refer Volume: VIII

76

Promote high density planting system as it is helpful in enhancing yields, particularly in low fertility fields.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

77

Adopt broad spectrum and cheaper post-emergence chemicals for weed management in cotton. Cotton, being a long duration and wide spaced crop, provides ample scope for weed infestation. Labour being costly, weed management is a challenge. Inter-cropping can also be used to check surge of weed growth.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: VIII

78

Vulnerability of cotton to pests severely impacts productivity. Promote varieties that are resistant to sap sucking pests, which provide a robust foundation for IPM. This intervention coupled with appropriate seed treatment will enhance productivity and do away with the need for pesticide application for the first two to three months after sowing.

Responsibility: DAC&FW, ICAR, SAUs
Timeline: Short term
Refer Volume: VIII

79

Cotton being a long duration crop with slow initial growth offers vast scope for promoting inter-crops. Promote multi-tier cotton based vegetable inter-cropping for realising high gross returns, net returns and per day profitability for farmers.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

80

Adopt sub-soiling technique to break the hard pan, which is a major problem in many cotton growing regions of the country impeding root penetration and a cause for low yields. Hard-pan breaking requires land preparation that involves sub-soiling at a depth of 40-45 cms. This technology, though well known, is not being implemented and should be made popular.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

81

Bt cotton hybrids, since their introduction in 2002 in India, have helped in achieving high productivity. However there has occurred a saturation point in recent years, making it difficult to realise further higher productivity and profitably. Another shortcoming of Bt cotton hybrids, is their non-suitability to rainfed areas, since their duration is long, at 180-200 days. It is therefore suggested to promote Bt cotton varieties, that are suitable to rainfed and low length growing regions. Alongside, promote high density planting system of these varieties, to take benefit from low cost of production.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

82

Cotton productivity can be improved through efficient and optimal use of precious farm inputs, including water and nutrients. This is also one of the important intervention to break the yield

plateau in case of Bt cotton. It is therefore suggested that drip irrigation be promoted in cotton in large scale, along with drip-fertigation and mulching.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

83

Farm mechanisation is helpful in effecting significant improvement in cotton productivity and profitability. Cotton requires an average of 240 mandays from planting to picking making it highly labour intensive. Since labour is not always available in time, besides being costly, field operations are adversely affected translating into poor yields. Hence, aggressively promote farm mechanisation in cotton, by identifying cotton specific machineries (in contrast with general purpose), including cotton picker.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

84

Thrust on diploid cotton deployment which is a natural source for overcoming biotic & abiotic stresses and for marginal lands is needed. Also identify multi-adversity resistant cotton lines for specific eco-regions.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

85

High productivity at farmers' level is facilitated by adoption of suitable technologies and practices, but are cost intensive. Hence, address the structural weaknesses by promoting contract and services farming and adopting market intelligence and research. Service contract for various cultivation and harvesting activities will rationalise cost of cultivation.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IV, VII, VIII

86

In addition to triggering high productivity in cotton, prioritise production of quality of lint. Quality of lint and yarn in India, are affected by poor fibre attributes, rapid deterioration of fibre quality of hybrids with successive pickings and high percentage of trash and contaminants. These need to be addressed to enable the farmer to fetch better value.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

Horticulture and Sericulture

These sub-sectors of agriculture possess high growth potential, as also employment generation ability. Horticulture sector has been growing at a rapid pace. The area under horticulture has grown to about 26 million ha by 2017-18, and the production from all segments is estimated at 307 million tonnes for the year (2017-18) surpassing the foodgrains output of 279 million tonnes in same year. The corresponding area and production vis-a-vis horticulture in the year

2004-05 were 18.4 million ha and 166.9 million tonnes. It is interesting to note that though area growth was 41 per cent, the growth in production is 80 per cent in this period.

The rate of growth in area expansion is also seen to have declined in horticulture, whereas simultaneously, technology intervention such as protected cultivation is seen to have grown at a faster rate. This indicates that new technology is more promptly adapted in horticulture and this is driving productivity growth. The challenges in harvesting this growth in higher productivity lies in appropriate strengthening agri-logistics, processing and marketing. Being perishable in nature, the produce needs to be reached out consumption points efficiently.

Sericulture too has high scope for generating incomes & jobs, that are relatively higher than in field crops. Sericulture is an activity, that engages the farm families including both young and old throughout the year. The specific recommendations made are in this context.

Horticulture

87

Field level productivity in horticultural crops needs to be enhanced by adopting growth enhancing technologies, pest management systems and farming practices like precision farming.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

88

Good quality planting material is a prerequisite for higher horticultural productivity, especially because of longer gestation period. Take care to supply truthful/genuine planting material, which entails a system of making nursery accreditation mandatory.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

89

Increase the investments in R&D system to develop disease and climate resilient varieties. In the immediate run, fast-track the selection and sourcing of varieties which are already available globally, besides within the country.

Responsibility: DAC&FW
Timeline: Short term (for scrutiny & selection of existing varieties); Long term (diseases & climate resilient varieties)
Refer Volume: VIII

90

Rejuvenation of senile orchards should receive special incentives. The existing rejuvenation pace needs to be upgraded by drawing up a time bound roadmap.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

91

In order to check the comparatively higher food loss in horticulture, there is need to strengthen the horticultural market supply chain, in particular in the form of village level aggregation hubs. These can be located at the proposed PRAMs/GrAMS and should become decentralised hubs for the aggregation and dispatch of perishable fruits & vegetables. This requires basic facilities like preconditioning and packaging systems, staging cold stores, reefer vehicles, etc.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: III, VI, VIII

92

Horticulture Mission should actively promote the provisions that enable prompt evacuation of perishable produce to develop appropriate market linkages, for furthering horticultural growth. The state governments need to reform their respective agricultural marketing systems on the pattern of Model APLM Act 2017, which facilitates licensing of existing cold storages as markets. This in turn will promote village level integrated pack-houses and help minimise unnecessary handling losses.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: III, IV, VIII

93

Ensure dedicated space for horticulture based activities in peri-urban areas. These activities can be linked to urban solid waste (conversion into compost) and liquid waste (after treatment), for better resource use efficiency.

Responsibility: DAC&FW, MoUD
Timeline: Short term
Refer Volume: VIII

94

Promote urban horticulture by incentivising rooftop gardening, aeroponics, hydroponics, vertical gardens, etc. Horticulture crops are highly amenable to modern technologies. Hence promote protected cultivation systems (poly-houses, greenhouses, shade nets, sensor based input uses, etc.)

Responsibility: DAC&FW
Timeline: Long term
Refer Volume: VIII

95

Strengthen horticulture advisory services and keep the trainers updated on latest horticultural technologies and development.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII, XI

96

One of the prime reasons for low productivity is non-availability of quality seeds in right quantity and at right time. Ensure robust 'Seed Rolling Plan' based on active partnership of DAC&FW-ICAR-States and build a network with efficient seed producers, across both public and private sectors. The Seed Rolling Plan should also include contingency requirements for compensatory seeds arising from natural calamities. The losses incurred by seed producers due

to contingency production should be compensated suitably through a specially created Sinking Fund.

Responsibility: DAC&FW, ICAR, NSC
Timeline: Short term
Refer Volume: VIII, XIII

97

Horticulture offers very high opportunity for absorption of technologies, that can aid efficient cultivation and high productivity. Protected cultivation by way of green houses, poly houses etc should be promoted on large scale as youth-centric enterprises. However, production should necessarily be linked to value-chains. Also encourage precision farming technologies like micro irrigation, fertigation etc. which are highly amenable to adoption in horticulture.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: VIII

98

Strengthen integrated cold-chain, by immediately addressing the anomaly that currently exists among different components (reefers, pack houses, cold stores, etc. - details in Vol. III).

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: III, VIII

99

Promote cluster based cultivation so as to link output to processing centres, food parks and ports of exit. By deploying ICT for track & trace all along the value chain, ensure adherence to prescribed standards/thresholds of pesticide residues, quality parameters etc. Other support infrastructure like pack houses, vapour and hot water treatment facilities, Irradiation centres, etc. are needed in the cultivation zones. Export clusters in particular should be jointly supervised by DACFW & APEDA in close coordination with the state machineries.

Responsibility: DAC&FW, APEDA
Timeline: Short term
Refer Volume: III, IV & VIII C

100

Soil Health Card should also cater to the requirements of fruits & vegetables. Soil sample collection protocols for perennials, parameters to be tested and soil nutrient management recommendations may be laid down.

Responsibility: ICAR, DAC&FW
Timeline: Short term
Refer Volume: VIII

Sericulture

101

India has been subjected to large scale dumping of raw silk and has had to resort to anti-dumping duty, which is in force until December 2020. This has helped to stabilise the cocoon and raw silk prices in India and is thereby supported for further growth of the industry.

Responsibility: Ministry of Textiles (MoTex), DoCI
Timeline: Short term
Refer Volume: VIII

102

In countries like China and Japan, while silkworm rearing is a small farmer's enterprise, the seed production, reeling and weaving are carried out in large scale by corporates, which brings technology, efficiency, quality and economy of scale in operations. In India, almost all activities from silkworm seed production to weaving are micro or small scale which makes the sector fragmented and somewhat non-competitive. Most importantly, this leads to variations in quality and inadequate risk taking capacity. It is recommended that the corporate sector be encouraged to participate wholesomely in the silk industry.

Responsibility: MoTex
Timeline: Short & Long terms
Refer Volume: VIII

103

There is an urgent need to rehabilitate the lost mulberry area besides horizontal expansion of mulberry cultivation to meet the additional target of raw silk Production. Besides expansions of mulberry cultivation to new districts of traditional Sericultural states, there is in an urgent need to explore large scale cultivation of mulberry in non-traditional states like, Odisha, North Eastern states, Himachal Pradesh, Uttarakhand, Uttar Pradesh, Jammu and Kashmir etc. In the new areas, only high yielding mulberry verities namely, V1, S36, S1635, G4 etc. should be popularised. In addition, there is vast scope for introducing mulberry tree cultivation in the water deficit regions which will help to grow more cocoons.

Responsibility: MoTex, DAC&FW
Timeline: Long term
Refer Volume: VIII

104

For bringing about improvement in resource use efficiency, there is need to attach special attention on skill development in sericulture, coordinated with the induction of new technologies on rearing, reeling and weaving technologies.

Responsibility: MoTex
Timeline: Short term
Refer Volume: VIII

105

Sericulture extension activities are carried out by the State Governments. However, there is inadequate grass root level extension staff. Moreover, in many states, most of the extension workers are on the verge of retirement and working with less facilities and inadequate training. Therefore, strengthening of the public extension system with manpower and facilities to support silkworm rearing is recommended.

Bringing in a suitable model of private extension system such as Para-professionals, Community Resource Persons, Community Based Organisations (CBO), farmers producer organisation (FPO) etc., may also be explored. Incentivises may be based on outputs and coverage of area/ farmers.

Responsibility: MoTex, Central silk Board (CSB), ICAR, DAC&FW
Timeline: Short term
Refer Volume: VIII

106

Information Communication Technology (ICT) tools like information portals, App.net, information Kiosks etc. are required to be harnessed to provide right information to the farmers, reelers and weavers and thereby empower them.

Besides, State Sericulture Department, extension activities would also be promoted through NGOs, Krishi Vigyan Kendras (KVKs), lead farmers, farmers field schools (FFS) and Agricultural Universities.

Responsibility: MoTex
Timeline: Short term
Refer Volume: VIII

107

Central Silk Board (CSB) and State Department of Sericulture have drawn out a program to establish higher production, productivity and quality of silk output. The program implementation may be expanded into various under tapped areas in the country.

Responsibility: MoTex, CSB
Timeline: Short term
Refer Volume: VIII

108

Project based approach must be undertaken by CSB and states to establish and upgrade basic seed production units and in R&D to develop high yielding silk worm breeds. Similarly, new mulberry varieties with higher yield per hectare can be a focus area.

Responsibility: MoTex, CSB
Timeline: Short term
Refer Volume: VIII

109

Diversification of silk into other material uses, besides meeting traditional demand of sarees, will need to be aggressively promoted. There are various by-products from silk reeling operations and for greater efficiency more effective use of by-products like silk waste, sericin, etc. R&D into medicinal and other uses of sericulture by-products need to be promoted. Corporate sector participation in sericulture can be incentivised in such R&D also.

Responsibility: MoTex, CSB, DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

Animal Husbandry: Dairy & Livestock, Small Ruminants, Fisheries

Dairy & Livestock

Encouraged by the buoyant growth in milk production that has been achieved in the country, dairying, which is one of the most important means of providing livelihood and nutritional security to the rural masses, is being considered as key economic activity to enhance farmers' income.

To achieve the target of increasing farmers' income through dairying, the major challenge is to improve the productivity of dairy animals, bridging the yield gaps that exist at inter and intra-

regional levels as well as across farms, improving the resource use efficiency of the farm inputs and ensuring remunerative prices to the farmers. The key recommendations to address the constraints facing the livestock sector and thereby, accelerating growth in livestock production are summarised below:

110

Provision of timely and quality artificial insemination (A.I.) facilities to the farmers needs to be focused on, including reducing gap in demand and availability of male germplasm (frozen semen starws). This can be achieved through strengthening of semen stations, expanding the AI coverage and putting in place systems for effective AI delivery through information driven management.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII

111

There is a need to improve on the artificial insemination interventions to enhance productivity outcomes in livestock. Early detection of heat, including electronic nose (estrus sensors) will minimise missed opportunity from delays in heat detection. There is need to increase the training/re-orienting of the Artificial Insemination (AI) technicians in certified/accredited AI training institutes and to ensure adherence to the Standard Operating Procedure (SOP).

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII

112

Efforts are required to undertake advanced technological interventions like, Genome selection and Embryo transfer (ET)/IVF for sustained breed improvement.

Responsibility: ICAR, DAHDF
Timeline: Long term
Refer Volume: VIII

113

A comprehensive digitalised system of performance recording of animals, for facilitating selection may be developed and implemented.

Responsibility: DAHDF, ICAR
Timeline: Long term
Refer Volume: VIII

114

Crop residue management should incorporate interventions that can address fodder shortages. This will also help avoid crop residue burning. There will be need to create infrastructure for collection of crop residues, baling, enrichment and storing by introducing modern equipment like mower, reapers, balers, straw makers, etc. at village level. These machines can be housed at Custom Hiring Centres and similar other facilities.

Responsibility: DAC&FW, DAHDF
Timeline: Short term
Refer Volume: VIII

115

There is the need for greater dissemination of region specific technology for green fodder production on arable, uncultivable, saline affected and other problem land, drought/water scarce conditions.

To mitigate scarcity of quality fodder, the promotion of cultivation of newly developed and notified varieties/ hybrids of fodder crops, perennial grasses & legumes and non-conventional/under-utilized feed resources like cactus, lathyrus, sugar beet, moringa etc. may be taken up. Simultaneously, there is need for the promotion of silage making of surplus green fodder.

Responsibility: DAHDF, DAC&FW, ICAR
Timeline: Short term
Refer Volume: VIII

116

Steps may be taken for incentivising of compound feed production by the feed mills, to cater to the nutritional requirement of animals of different productive potential. Promoting production of bypass fat, protein and other feed supplements, especially area specific mineral mixture is recommended.

Responsibility: DAHDF, MSME
Timeline: Short term
Refer Volume: VIII

117

The export policy on maize, oilseeds/cakes & molasses should be revisited from time to time, from the view of providing an enabling environment for regular supply of raw material and supplements to livestock. There is also need to evaluate and rationalise the taxes, duties & levies imposed on fodder ingredients and additives, to make the costs reasonable for livestock farmers.

Responsibility: DAHDF, MoF, MoCI
Timeline: Short term
Refer Volume: VIII

118

The R&D component on cattle feed research, especially through the application of bio-technology in feed compounding and the use of non-conventional feed resources in manufactured feed may be strengthened.

Responsibility: DAHDF, ICAR
Timeline: Short term
Refer Volume: VIII

119

A tracking and tracing system for the cattle feed supply chain, with appropriate BIS standards should be developed, to ensure fodder quality and animal safety.

Responsibility: DAHDF, BIS
Timeline: Long term
Refer Volume: VIII

120

The Ration Balancing Program needs to be upscaled to ensure larger spread, to all livestock farmers in the country. The results from the first phase of this program have indicated improved milk yield and lowered cost of inputs, especially in case of crossbreds and buffalo.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII

121

Steps may be taken to strengthen preventive animal health care programme, including mass vaccination of animals in campaign mode at village level for most common diseases like FMD, HS, Theileriosis, Brucellosis etc. Also, take care of deworming of animals at a mass level, cost effective tick control program, propagating mastitis control prevention programs

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII

122

An ICT based network for epidemiological surveillance, to conduct organised national surveys of endemic diseases, surveillance and diagnosis is required to strengthen these activities. The network should also be leveraged to provide diagnostic kits and more number of trained manpower should be made available at taluk level.

Responsibility: DAHDF, MEITY
Timeline: Short & Long terms
Refer Volume: VIII

123

Despite a vast institutional network, both at the central and state levels, the animal health service delivery system leaves much to be desired. The governance and accountability systems need to be improved to ensure curative health systems progress and achieve anticipated objectives. The budgetary allocation for veterinary supplies, including necessary drugs and medications, needs to be enhanced with suitable monitoring of stock.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII

124

Research efforts need to be intensified for the development of technology and package of practices for early detection of heat, enhance accuracy of insemination, early pregnancy diagnosis, controlling embryonic and calf mortality.

Responsibility: ICAR
Timeline: Short & Long terms
Refer Volume: VIII

125

There is need of setting up dedicated training centres for Animal Husbandry activities (Pashu Vigyan Kendra) on the pattern of Krishi Vigyan Kendra. Alternately, the resources at KVKs may be strengthened with the purpose. Greater dissemination of information on scientific dairy farming practices among dairy farmers through training and extension must be undertaken. This can incorporate use of ICT to fulfil the information need of livestock farmers.

Responsibility: DAHDF, ICAR

Timeline: Short term
Refer Volume: VIII

126

The organised milk supply chain has resulted in better price realisation to farmers. However, the majority of milk production is still transacted in the unorganised sector. The coverage of the organised supply chain can be expanded and it will require the upscaling of existing success stories. The group dynamics that have resulted in such success, need to be carefully replicated in other parts of the country.

Such group dynamics are largely understood, and where needed, the necessary reforms in Dairy Cooperatives, to enable capital accumulation and representative governance for improving their sustainability and profitability, need to be made.

Responsibility: DAHDF
Timeline: Short & Long terms
Refer Volume: VIII

127

The cold-chain infrastructure to maintain the quality and to expand the range of milk supply, needs to be strengthened. Similarly, the milk processing plants need to be modernised and their competiveness improved so as to capture markets outside the country.

Responsibility: DAHDF, ICAR
Timeline: Short & Long terms
Refer Volume: VIII

128

An institutional mechanism may be set up to regularly revisit the milk procurement pricing methodology by milk cooperatives. This can be undertaken as a two or three yearly program, wherein the standardised methodology, domestic and global situation, and other market dynamics are revisited and updated.

Responsibility: DAHDF
Timeline: Short & Long terms
Refer Volume: VIII

Small Ruminants and Poultry

Small ruminants represented by sheep and goat contribute greatly to the agrarian economy; especially in areas where crop and dairy farming are not economical. As per Livestock Census, 2012 number of livestock holders stood at 4.55 million in case of sheep and 33.01 million in case of goat; and the livestock populations were 65 million (sheep) and 135 million. Meat and milk constitute two primary products of goat & sheep, though by convention sheep milk is not marketed.

Poultry is another important segment that has been clocking robust annual growth rates, and the major contribution in case of commercial poultry comes from private sector. Commercial organised sector accounts for 77 per cent and backyard unorganised sector contributes 23 per cent of poultry production in the country.

Small ruminants and poultry are well suited to small & marginal farmers, as also the landless as productive activities, and deserve promotion.

129

Farming of small ruminants is largely a small and marginal farmer activity, while most of the output is for high value consumption. However, this sub-sector has not been given equal policy attention and support.

There is need to allocate special focus on this sector to benefit the large population of small and marginal farmers who rely on small ruminants for livelihood. Small ruminants are highly climate-resilient species, and are therefore well suited to rainfed and other poorly endowed regions.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII

130

Research & Development in small ruminants and poultry must translate into adoption of recommended selective breeds in rearing activities by farmers.

Responsibility: DAHDF, ICAR
Timeline: Short term
Refer Volume: VIII

131

Technologies & practices such as intensive feeding, nutritional interventions, health calendar, prophylactic care, artificial insemination, value added manure, etc. need to reach out to the small farmer for achieving desired benefits. Suitable extension and lab-to-land dissemination approaches must be adopted.

Responsibility: DAHDF, ICAR
Timeline: Short term
Refer Volume: VIII

132

There is an absence of organisation of small ruminant keepers. Development of Village Producer Organisations (VPOs), comprising the small ruminant rearers of each village can be promoted as to develop into village scale enterprises.

The VPOs can be formalised as cooperatives or companies, to induct professional management, in line with crop sector and be given the same fiscal and financial benefits as in case of FPOs. This will facilitate greater organisation in technology transfer and in facilitating animal health care, insurance and institutional credit. Where livestock keeper organisations already exist, they should be strengthened.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII

133

The small ruminant VPOs (cooperatives or companies or societies) can be provided financial and material support to maintain and develop Common Property Resources (CPRs) at village

level. This will motivate gram panchayats to address tenure rights for developing CPRs and bring stakeholder attention to regeneration of such depleted land. Waste land and non-arable land can be developed for stall fed rearing systems. Shelter facility for goats may be provided at village level for such organisations. There is also scope to mobilise funds for the needed land development under MGNREGA.

Responsibility: DAHDF, DoRD
Timeline: Short term
Refer Volume: VIII

134

To enhance the feed & fodder production and pasture development, an efficient and integrated land use management system which includes better utilisation of wastelands and CPRs through proven silvi-pastoral system/agri-silvi-pastoral system needs to be encouraged. State Animal Husbandry and Forest departments can come together to adapt and implement such models in an appropriate manner, balancing the economic needs and ecological demands.

Responsibility: DAHDF, ICAR
Timeline: Short term
Refer Volume: VIII

135

The KVK's can establish free training and subsidised veterinary services for small ruminants. The KVKs can become a source of knowledge and also centres for breeding bucks. Various records including birth, health, medical, mortality, weighing, vaccination, etc. can be maintained at KVKs. In fact KVKs who now focus more on crop segments should begin to pay proportionate attention to animal husbandry sector too. In this regard, the KVKs need to be strengthened in terms of Animal Husbandry and Fishery sector professionals.

Responsibility: DAHDF, DARE, ICAR
Timeline: Short term
Refer Volume: VIII, XI

136

The funds allocated for veterinary services for small ruminant sector must be enhanced, keeping priority focus on providing support to rearers with small herds. Mobile veterinary clinics can be promoted across various regions in the country to cover important migratory routes of these flocks. These units can be made available 24x7 with the presence of trained veterinarian and a support staff.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII

137

The higher share of women involvement in goat rearing, justifies developing of women goat rearer groups, and women farmer friends dedicated for goat sector. The women groups can be empowered to take decisions on goat rearing matters.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII

138

Trade policy must attend to supporting and promoting the supply of goat meat, milk, cheese and other products to compete in the global market.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VI, VIII

139

There is need to ease transportation constraints for small ruminant farmers. An inter-departmental committee, headed by Animal Husbandry Department in each state may be formed to explore convergence in policies/programmes with other concerned departments including sorting out related issues faced by the transporters. Livestock transportation of small ruminants can be exempted from in-transit inspections, if within four hours travel radius. Inspections may be implemented at final destination or at loading point.

Responsibility: DAHDF, MoRTH
Timeline: Short term
Refer Volume: VIII

140

A comprehensive "Small Ruminant Policy" at national level should be developed as a model for states to adopt and implement. The policy can include mechanism for inter-state coordination (neighbouring states) to fix migratory routes, standard of care and hygiene during migration.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII

141

Upgrading of infrastructure facilities for care of the small ruminants by the Department of Animal Husbandry, such as for inputs, goat shelter, distribution, and livestock marketing could be coordinated with SAMPADA scheme of the Ministry of Food Processing, so that production is suitably aligned with development of processing industry.

Responsibility: DAHDF, MoFPI
Timeline: Short term
Refer Volume: VIII

142

There is a considerable gap in the country's raw wool requirement and production. To meet the requirement of the hosiery and carpet sector, almost double the quantity of indigenous wool production is being imported. This is an opportunity to scale up sheep rearing and to organise the raw wool handling facilities. To aid the organising of production and meet post-production quality concerns, the Primary Rural Agri-Markets (PRAMs/GrAMs) in sheep rearing areas can be planned to include sheep rearing, wool aggregation and handling systems.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VI, VIII

143

In order to enhance the incomes from livestock, one of the critical needs is to achieve higher productivity of meat, milk and wool. This calls for the genetic improvement of indigenous breeds, as well as non-descript small ruminants under Genetic Improvement in Sheep and Goat

(GISG). A two-step Action Plan with focus on genetic improvement of separately identified breeds for meat, milk and wool production, with associated breeding plan should be implemented in a comprehensive manner across regions.

Responsibility: ICAR
Timeline: Long term
Refer Volume: VIII

144

Sheep rearing is largely a nomadic practice. Promote mobile veterinary clinics along the migratory routes. Both sheep rearers and the sheep need such health services.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII

145

The 'Innovative Pig Development Projects for North-East' (IPDNE) under National Livestock Missions (NLM), include strengthening of pig breeding farmers, import of germplasm, support breeding programmes, propagate reproductive technologies, and health cover. Appropriate measurable outcomes, including income growth of farmers, may be developed and monitored.

Responsibility: DAHDF, DARE-ICAR
Timeline: Short & Long terms
Refer Volume: VIII

146

The scheme, 'Rural Backyard Poultry Development (RBPD)', is recommended to incrementally upscale its model, from the one that currently supports BPL families for subsistence from backyard poultry, into enterprises comprising 200-400 birds. In case of low-input technology (LIT) birds, it would be possible to later upscale to 1,000-2,000 birds for larger scale poultry farming.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII

147

The existing livestock insurance scheme needs to be made more farmer friendly and expanded to cater to the needs of small ruminants too.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII

148

The Model Agriculture Produce and Livestock Marketing (Promotion & Facilitation) Act, 2017 released by the central government enables development of different types of markets for livestock in both public & private sectors. The states should promote these markets in the interest of livestock farmers including small ruminants. Similarly, contract farming can be adopted to promote stall fed sheepery & goatery, for which the states may be supported in adopting the Model Agricultural Produce and Livestock Contract Farming and Services Act, 2018.

Responsibility: DAHDF, DAC&FW
Timeline: Short term
Refer Volume: VIII

Fisheries

India is home to rich fishery resources, in terms of both size and diversity. There exists scope to develop further both its inland and marine resources. As many as 14.5 million fishermen are engaged in this sector, and their welfare is linked to faster pace of transformation of the traditional sector to commercial scale. It also has scope for expansion as integral to Integrated Farming Systems. This sector has been registering impressive annual growth rates over the last more than a decade and contributed 5.23 per cent to the agricultural GVA and about 0.92 per cent to the National Gross value in the year 2016-17. The DFI Committee recognises fishery sector as one of the engines of high agricultural growth. Some specific recommendations in this context are made as follows.

149

It is necessary to formally recognise the traditional fishermen's user rights across the waterbodies. A policy that offers first right to the traditional fishers is recommended. Leasing polices for use of rivers for fishing must be streamlined for cooperatives and other farmer producer organisations. Similarly lease rights in favour of reservoir cooperatives need to be strengthened with specified user rights. It would help to draft a 'Model Lease of Waterbody and Fishermen's User Rights' and share with the State Governments for adoption.

Responsibility: DAHDF, NITI Aayog
Timeline: Short & Long terms
Refer Volume: VIII-D

150

The Department of Fisheries, Government of Andhra Pradesh is implementing a reservoir fishery program in ten (10) selected districts of Andhra Pradesh. This program has a multi-stakeholder engagement and existing fisheries cooperatives are responsible for total operation and management. All new technical advancements and support systems like hatchery, nursery, feeding system, logistics development support etc. are also provided at these locations. Distinct improvements in production and marketing management along the lines of this model alone can ensure income enhancements of reservoir fishers in the long run and is, therefore, suggested for replication in other states too. The DAHDF may evaluate the Andhra Pradesh model and design an appropriate scheme for all India adoption.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII-D

151

In case of marginal fishermen, besides allocating them brackish water lands, they should also be mobilised into farmer producer organisations (Companies, Cooperatives or Societies) to promote cluster based farming, thus imparting the required scales of economy to the operations. Marine fishing is typically a village level community effort, and it is recommended that village producer organisations (as farmer companies or cooperatives) be encouraged.

Responsibility: DAHDF, ICAR
Timeline: Short term
Refer Volume: IV, VIII-D

152

Efficiency of existing fishing fleets requires to be enhanced through need based upgradation, such as improved navigation and shoal locating systems, fishing gear and fuel-efficient power-operated vessels.

	Responsibility: DAHDF
	Timeline: Short term
	Refer Volume: VIII-D

153

Mari-culture activities, including farming of seaweed, mussel, pearl and others, should be encouraged through small entrepreneurs by providing technological, financial, marketing and logistical support. Cage culture is another opportunity to attract FDI (Foreign Direct Investment) and corporate expertise in fisheries.

	Responsibility: DAHDF
	Timeline: Short term
	Refer Volume: VIII-D

154

Rapid increase in demand for fish has led to the widespread use of unauthorised preservatives and other harmful chemicals, and has been reported from across the country. In this context, it is relevant to set up fish quality certification units in every major harbour/fish landing centre/wholesale market, so that not only the fish landed but also those transported from other markets are adequately checked for the presence of harmful preservatives. This will help create positive and sustained demand for fish.

	Responsibility: DAHDF
	Timeline: Short term
	Refer Volume: VIII-D

155

There is evidence of increased domestic demand for fresh fish, especially from hinterland consumers, which is not matched with suitable capacity by the domestic supply chain. The modernisation of the wholesale markets, retail outlets and cold-chain transportation at varying levels needs to be encouraged. Fresh fish supply requires complete cold-chain, from landing site to retail, to ensure that quality concerns do not hinder growth in domestic demand. The Fisheries and Aquaculture Infrastructure Development Fund (FAIDF), (a non-budgetary Corpus Fund) is recommended to strategically focus on such market connectivity and distribution requirements.

	Responsibility: DAHDF
	Timeline: Short term
	Refer Volume: IV, VIII-D

156

Sectoral and sub-sectoral action plans for fisheries are tabulated in chapter 3 of Volume VIII-D. These can be developed upon to suit capacities and needs of each region or state/union territory.

	Responsibility: DAHDF
	Timeline: Short term
	Refer Volume: VIII-D

157

Inland fisheries require greater and optimal economic, institutional and technical support, to develop as a component of the integrated farming system. Freshwater aquaculture needs to be promoted as a national activity under "Blue Revolution" initiatives.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII-D

158

It would do well to establish a Division of Non-Farm Enterprise Activities in DAHDF to bring focus on fishery related non-farm income generation. For success of such enterprises, it would be necessary to facilitate market links between the village entrepreneurs and the larger industry. Chapter 5 of Volume VIII-D lists some of the various non-farm activities related to fisheries that are possible.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII-D

159

In a business-as-usual scenario, the ocean is expected to contain one tonne of plastic for every three tonnes of fish by 2025, and by 2050, there will be more plastic than fish [by weight] in the seas. The fishers (marine) could be trained in collection and recycling and in making the best use of the collected plastic for supplementing their income.

Responsibility: DAHDF
Timeline: Short & Long terms
Refer Volume: VIII-D

160

Recreational fisheries need to be promoted by professional and experienced angling associations in cooperation with State departments of fisheries. This can generate new income for local stakeholders in hill areas.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: VIII-D

161

Fishermen need to be given Kisan Credit Cards (KCCs), and offered collateral free institutional credit with interest subvention. Such access, that is adequate and timely will help to break the unequal relationship that now exists between fishermen and traders.

Fishermen need access to institutional credit in respect of both short term production loan and long term investment loan. The pattern and seasonality of KCC based loans need to designed taking into account the need & use pattern of credit by the fishermen. It cannot be like that of crop production loans, which are linked to production seasons – Kharif and Rabi.

Responsibility: DAHDF, NABARD
Timeline: Short term
Refer Volume: VIII

162

Link MGNREGA works to inland fishery sector and use the resources to create fishery ponds on the farms in case of small & marginal farmer, and on common property lands for the

landless. These ponds will also help in water harvesting & conservation. And if done in clusters, input & output management will get more efficient, thanks to scales of economy.

	Responsibility: DAHDF, DoRD
	Timeline: Short term
	Refer Volume: VIII

163

Fishermen, particularly in case of marine sub-sector are exposed to high weather risks. Hence, the need for an effective & efficient weather advisory system.

	Responsibility: DAHDF
	Timeline: Short term
	Refer Volume: VIII

164

In order to minimise risks on sea and enhance fish capture efficiency, deploy GIS mapping technology and Vessel Monitoring System (VMS). This will also enhance monitoring, control and surveillance systems.

	Responsibility: DAHDF
	Timeline: Short term
	Refer Volume: VIII

For full context and other details, the linked domain specific Volumes of the DFI Report may be referred to.

Chapter 7
Risk Management

Risk is a term that typically refers to the probability of an endangering act or event. It is closely associated with damage or loss, physical or financial. Therefore, there is need for strategies that will build resilience to recover from challenges resulting from force majeure events, as well as to counter the risks that result from man-made actions. Insurance is the major approach used for risk transfer which involves the contractual shifting of a pure risk from one party to another. Also forewarning about an inclement eventuality can minimise the impact of such events.

Risk mitigation normally requires thought on both financial cover and physical actions. However, the capacity to take on risk, head-on, is limited due to the fear of the unknown and also because of structural weaknesses in the system. Reforms and interventions in the agricultural value system are needed so as to build resilience in the farmers, and to build their capacity to take on risks that are more intrinsically liked with their markets. Technology is emerging as a powerful tool to deploy forecast, early warning, alerts and the like, and help farmers to be well prepared. It can be gainfully utilised in agriculture across its multiple sub-sectors for the farmers & other stakeholders to be informed in advance, and take appropriate actions that will help in mitigating the risk impact, and secure output and income.

Climate related Risks

1

Climate change impacts are becoming more apparent over the last decade or so, and the natural resource endowments are also being impacted due to demographic shifts. This necessitates revisiting and re-categorisation of the existing agro-ecological zones of the country, which were last attempted fifteen years ago by ICAR.

Responsibility: DARE, ICAR
Timeline: Long term
Refer Volume: V

2

Prepare judicious land use planning based on re-categorised local agro-climatic as well as techno-economic potentials specific for each region, as the lands and locations are not equally suitable for same kind of crops. This will help provide fresh direction on all other sustainable strategies and practices.

Responsibility: DARE, ICAR
Timeline: Long term
Refer Volume: V

3

Prepare perspective plan for treating the degraded lands following the concept of participatory watershed management after prioritising the issues and vulnerable areas. This may include studying the long-term implications of changing land use patterns. This will help mitigate risk in vulnerable areas.

Responsibility: DoLR, DAC&FW, DoRD, NRAA
Timeline: Short & Long terms
Refer Volume: V

4

Krishi Vigyan Kendra (KVKs) and Extension Agencies must adopt the 29 number of double stressed districts (refer Chapter 5, Volume I) and design special programmes to support these districts.

The programmes must be implemented in coalition with state agencies and line departments to create favourable and facilitating environment to trigger the path of doubling of farmers' income.

Responsibility: DAC&FW, DAHDF, ICAR, DoRD
Timeline: Short term
Refer Volume: I

5

Adopt new agronomy like adjustment of planting dates to minimize the effect of high temperature increase-induced effects.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: V

6

Develop contingency crop planning, keeping in view occurrence of extreme weather events and water availability in a region for various crops/ livestock. Promote perennial tree (orchards, timber, bamboo etc.) based farming systems for additional income and assurance against climate anomalies.

Responsibility: DAC&FW, ICAR, MoEFCC
Timeline: Short term
Refer Volume: V &VI

7

Monitor and forecast climatic extremes by creating virtual weather stations at micro-level; adopting Weather index based crop insurance; Value-added weather management services (include delineation of climate vulnerable zones at micro-level, real time agromet-advisories, climate predictions and pest & disease forewarning systems).

Responsibility: IMD
Timeline: Short term
Refer Volume: VI

8

Ensure capacity building for disaster management planning at the local level preparedness planning, vulnerability mapping while preparing the community level drought management plans, in livestock and dairy sectors, agromet-advisory services etc.

Responsibility: MoEFCC, IMD, NDMA, ICAR, DAC&FW
Timeline: Short term
Refer Volume: VI

9

The 'Varun Mitra' project in Karnataka, has demonstrated specific benefits to farmers receiving the meteorological advisory services. A study conducted on the impact of forecast technology generated date and its use by the farmers, has brought out that risk negotiation

was better and helped in reducing the losses relating to natural calamities and earn better profits as a result. This model may be suitably adopted by other States.

Responsibility: DAC&FW, IMD, ICAR
Timeline: Short term
Refer Volume: X

10

Develop convergence of national/state programmes/schemes for drought proofing at micro-level. As many as 151 districts have been identified as most vulnerable based on Vulnerable Assessment Studies by ICAR.

A roadmap for these districts may be prepared for time bound drought proofing of all these in a time-bound manner. This will make interventions holistic and add efficiency to government resources.

Responsibility: DAC&FW, DAHDF, ICAR, NRAA
Timeline: Short & Long terms
Refer Volume: VI

11

Based on IPCC's AR 4 parameters, 151 districts have been identified as highly vulnerable. However, based on the new parameters of vulnerability identified by IPCC, the number of highly/critically vulnerable districts in the country may go up. These additional districts will also have to be brought under the purview of drought proofing action plan of NRAA.

Responsibility: ICAR, DAC&FW
Timeline: Long term
Refer Volume: XIII

12

Improve the density of weather monitoring stations (humidity, barometric pressure, temperature), including at Gram Panchayat level. This can be allocated to Farmer Friends (under ATMA) at each village or done through private entrepreneurs. At each of the proposed Gramin Agricultural Markets (GrAM) centres also weather recording instruments and alert mechanism may be installed.

Responsibility: MoES, MoEFCC, DAC&FW
Timeline: Long term
Refer Volume: X

13

To manage weather related risks, spatially and temporally differentiated weather forecast of key phenomena with a 3 week lead-time can be further refined. Such information should also be directly communicated to State extension offices, with designated key triggers to activate pre-emptive contingency actions at district and block level.

Responsibility: MoES, MoEFCC, DAC&FW
Timeline: Short term
Refer Volume: X

14

Historic data on climate and weather can be linked to each GrAM (Gramin Agri-Market) by way of kiosks. This will facilitate on-demand access and evaluation at farmers' assembly

centres at village level. Using interactive telephony need to be widely adopted, in the language a farmer can comprehend, to make weather advisories readily accessible to farmers.

Responsibility: IMD, DAC&FW
Timeline: Short term
Refer Volume: X

15

Long term climate shifts should be disseminated with the dynamic or expected variations in boundaries climatic zones, so that scientists can apply the information to build relevant crop plans and crop varieties & technologies for focus regions.

Responsibility: MoES, MoEFCC, DAC&FW
Timeline: Short term
Refer Volume: X

Production, Marketing and Price related Risks

16

Risks to the biological set of activities stem from the dependence on weather based events. Irrigation and effective water management systems, especially in rainfed areas, form an important component of risk management. Greater focus on strategic development of irrigation facilities for most vulnerable farmers is necessary. This includes water harvesting through the small and micro-irrigation systems, as a source of protective irrigation at critical stage(s) of crop growth in the event of deviation in rainfall. Further, water use efficiency through adoption of micro-irrigation systems and crop alignment in tune with agro-climatic condition and availability of water are important.

Responsibility: DAC&FW, DoRD, MoWR, ICAR
Timeline: Long term
Refer Volume: X

17

Greater emphasis is required on developing varieties of crops and breed of animals/fish that are tolerant to various stresses relating to temperature, water and salinity levels. The agricultural R&D community may take on crop and region differentiated development to avoid duplication of efforts.

Responsibility: ICAR, DAC&FW, DAHDF
Timeline: Long term
Refer Volume: X

18

There is urgent need to bridge the gap in time taken and affordability, between lab and land. Technologies developed should be appropriately communicated to maximum number of farmers. One of the important factors, that can impact the level of adoption of new technology, is its ability to bring monetary gains to the farmers.

Responsibility: DAC&FW, DAHDF, ICAR
Timeline: Short term
Refer Volume: X

19

Adopt good agricultural practices like diversified cropping systems, conservation agriculture for carbon sequestration, water saving technologies, organic farming and integrated farming

systems, and afforestation to minimise human-induced risks in agriculture. Watershed based management of resources is a comprehensive and scientific approach to risk management.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: X

20

Build the concept of National Seed Reserve (NSR) for making seed available to the farmers at the time of re-sowing during risks. This would serve well in case of contingent situations. In order to incentivise the states to promote NSR, the losses, that may be suffered on reserves when not used as seeds should be compensated. A sinking fund/corpus fund may be created to meet such demands.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: X

21

Market risks mainly arise from market unpredictability and fluctuations. Hence, the critical intervention needed is to strengthen opportunities for optimal monetisation, comprising robust agri-logistics (storage & transportation), processing and value addition and, efficient marketing. The new market architecture described by retail agricultural markets (GrAMs), facilitative export markets and reformed wholesale markets (APMCs) would also help in normalising the wide fluctuations that the markets are exposed to.

For details Volumes III & IV may be referred to.

Responsibility: DAC&FW, DAHDF, DoRD
Timeline: Short term
Refer Volume: III, IV, X

22

Since agriculture markets cannot be perfect always, and will experience price volatility, a robust procurement mechanism based on notified MSPs will be necessary. In case of commodities for which MSPs are not notified, price support system under the 'Market Intervention Scheme (MIS)' should be deployed efficiently.

Responsibility: DAC&FW, DoPD
Timeline: Short term
Refer Volume: IV

23

An important price risk management tool is adoption of contract farming, where under pre-production price-agreements are contracted by the farmers with the sponsoring company.

The States and UTs should be motivated and supported to adopt the Model Contract Farming and Services Act, 2018. The states thereafter should take all steps to popularise the adoption of contract farming as a price risk negotiator

Responsibility: DAC&FW, DAHDF, ICAR, MoRD
Timeline: Short term
Refer Volume: IV, XII

24

Restructure the Directorate of Marketing & Inspection to take onus for market intelligence as the Directorate of Marketing and Intelligence. The mandate should be to provide technology backup to the institutional mechanism, to be set up for demand and price forecasting. A robust price and demand forecasting system should help the farmers in making a rational and market-led production decision prior to the sowing/planting seasons.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XIII

Insurance – crop and livestock

25

Timely implementation of crop insurance scheme is necessary and states should not seek extensions to cut-off dates for buying insurance. States should promote availing of crop insurance facility without waiting for completion of sowing. Policy enrolment cut-off dates can also be adjusted and kept flexible to suit cropping patterns and regional agro-climatic conditions. Similarly, release of claims can be adjusted to suit payment closure before next sowing season.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: X

26

Dedicated budget at state level should be created to avoid delays linked with premium subsidy, since some states are found to be faltering in timely release of premium subsidy, affecting both timely payment of claims and the solvency of insurers.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: X

27

Price discovery for crop insurance should consider adopting longer duration so as to benefit from more competitive rates and support farmers with lower insurance prices. The government or the National Technical Support Unit (NTSU) should issue detailed guidelines, to help stabilise insurance prices.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: X

28

Deploy technology for real time data on various parameters on a larger/universal scale, its transmission and computation with accuracy, interpretation and dissemination as an Advisory in quick speed. This can, therefore, become a powerful tool in the hands of the farmers to take rational decisions relating to production based on forecast-stimulus, precautions in response to 'Alerts and Early warning' etc.

Responsibility: DAC&FW & DARE
Timeline: Short term
Refer Volume: X

29

To resolve matters such as "Area Correction Factor" and time bound assessment and payment of insurance, technology such as digitising of land record on a GIS platform is recommended. Verification of actual sown individual insured land parcels can be done by taking high resolution impages of crops through Remote Sensing technology / Drones before harvest and superimposing on digitised land parcels to identify the mismatch. Land record digitisation will spawn multiple advantages beyond Pradhan Mantri Fasal Bima Yojana (PMFBY).

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: X

30

In order to enhance the penetration of PMFBY (Pradhan Mantri Fasal Bima Yojana) and make it more productive, efforts are needed to cover non-loanee farmers; as also notify larger number of crops for coverage. Efforts should be made to ease access to insurance by non-loanee farmers. All these changes/initiatives are needed to cover the risks of larger number of farmers, as also to increase the volume of business and drive down premium rates.

Involving at least three insurers in a given district to service non-loanee farmers is suggested. Suitable checks and balances, including portal based enrolment and centralised database, will mitigate apprehensions of duplicated insurance on same crop. Change Agents can be appointed to spread greater awareness and facilitate insurance uptake by farmers and as part of an insurance feedback mechanism.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: X

31

The perception among the farmers that the insurance companies are garnering undue profits at their cost, needs correction for their sustained interest in a market-driven scheme like PMFBY. It is hence suggested, that a system be adopted whereby a certain percentage of the windfall gain made by the insurance agencies during normal years is utilised to offset particularly the premium payments made by the farmers. It is further suggested, that this can be sustained if the insurance agencies create a Corpus Fund for depositing small percentages of their annual profits on yearly basis.

Responsibility: DAC&FW, NABARD
Timeline: Short term
Refer Volume: X

32

In order to increase coverage of non-loanee farmers, state governments may promote more than one insurance agency at the district level. It may also be considered to assign work order to L2 & L3 at L1 rates. These assignees can be tasked to enrol non-loanee farmers.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: X

33

All states should be encouraged to undertake a drive to identify and enrol tenant farmers, if necessary with adequate financial support to finance the premium, and they should resort to legal remedies to recognise sharecroppers, lessees etc.

Responsibility: NITI Aayog, DAC&FW
Timeline: Short term
Refer Volume: X

34

The proposed Model Land Cultivators License Act should be brought out by NITI Aayog at the earliest, so that the states/UTs can legislate appropriately. In the alternate the Model Land Lease Act already rolled out by NITI Aayog may be amended to include the intended provisions of the Land Cultivators License Act.

The amended Model Land Lease Act may to cater to the credit eligibility of such a category of lessees, sharecroppers etc. and who by virtue of a loan sanction get automatically covered under PMFBY.

Responsibility: NITI Aayog, DAC&FW
Timeline: Short term
Refer Volume: X

35

Create awareness to promote insurance programmes which come with a 'top-up' cover for paying losses of 'localised risks', like hailstorm, landslide, inundation and post-harvest losses on individual farm basis. This may differentiate index to use 'yield index' for deciding losses of widespread calamities and 'farm yield' for assessing losses of localised perils / calamities.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: X

36

Since PMFBY is limited by the status of historical yield data which is not available in case of all crops, it would be necessary to develop and move towards weather based insurance viz yield based insurance as in RWCIS (Restructured Weather Based Crop Insurance Scheme). In order to promote this scheme prerequisite infrastructure is universally spread Telemetric Weather Gauges (TWGs) etc. which can generate data on various parameters like temperature, relative humidity, wind speed and others, at fixed regular intervals. This entails roll out of a policy that would attract investments including from the private sector.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: X

37

Technology suit comprising remote sensing, drones, sensors, smart phones and computation would help in imparting greater creditability to the data on estimation of yield & loss among different stakeholders. This is essential for sustaining a market-driven scheme like PMFBY.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: X

38

Since PMFBY is limited by the status of historical yield data which is not available in case of all crops, it would be necessary to develop and move towards weather based insurance viz yield based insurance as in RWCIS (Restructured Weather Based Crop Insurance Scheme). In order to promote this scheme prerequisite infrastructure is universally spread Telemetric Weather Gauges (TWGs) etc. which can generate data on various parameters like temperature, relative humidity, wind speed and others, at fixed regular intervals. This entails roll out of a policy that would attract investments including from the private sector.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: X

39

A technology suit comprising remote sensing, drones, sensors, smart phones and computation would help in imparting greater creditability to the data on estimation of yield & loss among different stakeholders. This is essential for sustaining a market-driven scheme like the PMFBY.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: X

40

Unified Package Insurance Scheme (UPIS) must be made robust as it offers various advantages, including welfare packages, which more appropriately cover the secondary risks that arise from primary crop failure.

Responsibility: DAC&FW
Timeline: Short & Long terms
Refer Volume: X

41

The "Livestock Insurance Scheme (LIS)", though operational since 2004, has very poor penetration, covering only 7 per cent of eligible animal population. Greater efforts need to be made on promoting this scheme, on lines of the PMFBY. The scheme needs to support farmers to cope with economic losses from all kinds of livestock and can be made more robust, as a market led and farmer-friendly programme. Currently the support under the scheme is restricted to primarily cover death of the animal and not the risks that may arise from disability and other hazards.

Responsibility: DAHD
Timeline: Short term
Refer Volume: X

42

An online enrolment portal, like in case of PMFBY, should be developed for LIS so that livestock owners, including small ruminants' owners also have easy access to LIS.

Responsibility: DAHDF, NIC
Timeline: Short term
Refer Volume: X

43

Livestock insurance limited as it is in its coverage is as yet mostly confined to cattle, though various species are allowed to be cover. It needs to be made more encompassing so as to cater

to other animals including sheep, goat, camel, pig, buffalo, bullock, etc. This will happen provided the premium rates are more farmer-friendly and there is no restriction on the number of animals to be insured as is the case now.

The penetration across the country is also circumscribed by the limited number of states opting for the schemes. The scheme needs to be made more acceptable by all the states.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: X

44

Livestock insurance should not be limited only to death of the animal, but also cover permanent total disability (PTD). Currently, this is only a 'top-up' facility available to the farmer who pays additional premium on his own. It is necessary to cover this risk as it is very common in animals.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: X

45

The LIS should also be designed such as to promote resilient livestock rearing and also to encourage farmers to rear high yielding milch animals, practice artificial insemination (AI) for breed improvement and avail of cattle health and nutrition support programme by government. This can be on similar lines as in PMBFY which encourages adoption of innovative practices.

Responsibility: DAHD
Timeline: Short term
Refer Volume: X

46

In discovering the premium rates, the state is considered at a single unit. This is keeping out many players, particularly the smaller ones from participating in the tender, discouraging thereby competitive price discovery to the disadvantage of the farmers.

Responsibility: DAHDF
Timeline: Short term
Refer Volume: X

47

There is need to generate data on the risk characteristics of animals with health status document, without which it is tough to come up with pricing model and deciding on premium of livestock insurance products

Responsibility: DAHDF
Timeline: Short term
Refer Volume: X

48

Extensive use of IT and ICT systems is recommended to support management of insured assets. This will include technologies for remote/automated crop surveys, ID tagging of livestock, health monitoring, etc.

A robust system of creating a unique identity based on technologies like RFID, microchips, etc. is critical to enhance the extent of coverage.

Responsibility: DAHDF, NIC
Timeline: Short term
Refer Volume: X

49

Since PMFBY is limited by the status of historical yield data which is not available in case of all crops, it would be necessary to develop and move towards weather based insurance viz yield based insurance as in RWCIS (Restructured Weather Based Crop Insurance Scheme). In order to promote this scheme prerequisite infrastructure is universally spread Telemetric Weather Gauges (TWGs) etc. which can generate data on various parameters like temperature, relative humidity, wind speed and others, at fixed regular intervals. This entails roll out of a policy that would attract investments including from the private sector.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: X

Other Risks including vertebrate Pests

50

The farm risks also come from vertebrate pests like rodents, depredatory birds and higher vertebrates like wild boar, elephants, nilgai, gaur, deer, etc. The management of these pests require a more sensitive approach than that deployed in non-vertebrate pest management.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: X

51

Before adopting direct control action involving the use of traps and or poison, it will help to assess alternative ways by which the animals can be managed. These include adopting physical barriers, biological barriers and technologies like bioacoustics it is important to managing the vertebrates, animal welfare is not compromised.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: X

52

Other management options suggested are elimination of harbourage, clearing dense vegetation removing rubbish around the structures, fencing, scare devices (scare-crows, hanging flashes, flags and balloons) etc. These are preventive actions in nature.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: X

53

There is need for a community approach along with active involvement of Agricultural and Forest Departments, farmers and other stakeholders for protecting the loss from larger vertebrates like *elephant, nilgai and wild boar*. Create awareness, among extension officers and farmers, about suitable technologies for vertebrate pest management so as to minimise

the increasing occurrences of human-wildlife conflict. Adopt technologies and strategies that preferably help in repelling/deterring animals from the cropped areas instead of those that cause harm or death of the wildlife. Various physical and biological barriers such as thorny plants, trenching, stone walls, etc. can be created to suit the requirements.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: X

Other aspects and agricultural credit to manage risks

54

i. The Committee suggests that all state governments take up digitization of land records on a "Mission Mode" to enable the farmers / banks to have easy access to land records for extending hassle-free and timely loans to farmers. Similar is the need for urgent improvements in cultivators' records, wherein, the real cultivator is recorded and such data made accessible to banks too.

ii. The legal framework and lease land market are imperfect and devoid of uniformity across the states. Hence, a legalisation mechanism that protects the interests of both tenants and land owners, along the lines of AP Licensed Cultivators Act and NITI Aayog's Model Land Lease Act, with appropriate improvements to both, or integrating them into a single & more comprehensive piece of legislation, may be put in place by state governments. In Andhra Pradesh, the revenue authorities issue Loan Eligibility Cards to Tenant Farmers (under 'Andhra Pradesh Land Licensed Cultivators Act No 18 of 2011). Such tenancy /lease certificates, while protecting the owner's rights, would enable real cultivators to obtain loans. Government of India may develop a Model Act for this purpose. This, accompanied by a new proposed mechanism of a Credit Guarantee Fund, should be able to bring more such farmers into the ambit of institutional credit.

iii. With a view to making credit available to large number of eligible and willing small & marginal farmers, it is suggested that all banks endeavour to achieve an annual increase of 10 per cent in number of small and marginal farmers (SMF) accounts. Kisan Credit Cards (KCCs) may be issued to all eligible farmers.

iv. The sources of farmers' income also include dairy, livestock, fishery and aquaculture. Hence production loans at interest subvention (on the lines of crop loans) should also be available for these activities. It would be advisable to delineate a certain percentage within the cumulative production loan volume to be mandatorily provided to the above mentioned activities. Concomitantly, a system of scales of finance will also need to be developed, by the District Technical Committees.

v. Due to factors like high dependence of agriculture on monsoon, vagaries of nature, poor information availability in rural centres and occasional loan waivers, banks may have higher perceived risks in lending to small and marginal farmers. As the agricultural credit to the small and marginal farmers should rise substantially, and should simultaneously be ensured that stressed assets in this sector do not arise, it is suggested that Government of India may consider establishment of an Agriculture Credit Risk Guarantee Fund (ACRGF). (For details, see volume XIII).

vi. Government of India may consider introducing interest subvention for Agriculture Term Loans to increase the magnitude of investment loans and scale up Gross Capital Formation in Agriculture. An interest subvention of 2 per cent, supported by an additional 1 per cent for timely and prompt repayment is suggested. Greater focus is needed on promoting

consumption of Term Loans in all sub-sectors of agriculture including livestock, fishery and aquaculture.

vii. The share of rural co-operatives in the total agricultural credit disbursements has been declining over the years. Considering, that these cooperative credit institutions play an important role in largely providing agricultural credit to farmers, especially the small and marginal, there is an urgent need to strengthen the Short & Long terms cooperative credit structure. The potentially viable PACSs (Primary Agricultural Cooperative Societies) should be computerised within a defined timeframe of three years and integrated with CBS (Core Banking System) of DCCBs (District Central Cooperative Banks). The LTCCS (Long Term Credit Cooperative Structure) should also be reformed and revitalised through a comprehensive package of legal, financial, information and communication technology and skill upgradation of cooperative personnel.

viii. The collective strength of farmers could enable them to increase their competitiveness through easier access to credit and technology, reducing costs of distribution and providing greater marketing power and negotiation capacity for better price realisation. Farmer Producer Organisations (FPOs) could emerge as one of the most effective pathways to address agricultural challenges. FPOs in agriculture should be actively promoted to aggregate farm produce, get efficient and improve access to credit. Through adequate policy and infrastructure support, these aggregators can become the 'connective tissue', linking supply and demand, bridging a major missing link. Policy support in the form of establishing multi-tier federations to form a National Farmers Development Board (NFDB) on the lines of NDDB could be necessary. It may be examined whether SFAC can be restructured & re-mandated to play this crucial role. This requires an immediate policy initiative of tax exemptions, including income tax exemption to all such FPOs including the Farmer Producer Companies (FPCs).

ix. For the purpose of efficient credit planning, review and monitoring of agriculture credit, it is desirable that sector-wise, sub-sector wise, activity/purpose- wise, borrower category- wise (including gender disaggregated), bank- wise and state- wise granular data is extracted directly from the CBS of banks and made available to all the forums like SLBC/DLCC/BLBC etc,.

x. The current irrigation level in agriculture at 45 per cent of GCA (Gross Cropped Areas) needs to be enhanced to 60 per cent in 5 years. The deficit states need to draw up necessary action plan to enhance irrigation potential through suitable investments under RIDF (Rural Infrastructure Development Fund), LTIF (Long term Irrigation Fund) and (MIF) Micro-Irrigation Fund etc. Government of India support to these Corpus Funds will have to be continued. However, irrigation potential created (IPC) needs to be optimally utilised by focussing on command area development and water use efficiency. As of now, the gap between IPC and Irrigation Potential Used (IPU) is as high as 23 million ha and needs to be bridged.

xi. Financing a basket of activities: Banks and Financial Institutions can promote and finance farming system models which integrate crop production with dairy, poultry, fisheries, dryland horticulture, sheepery, goatery, non-farm sector loans, etc., depending upon the resources/potential available in a particular locality.

xii. In association with the State Extension agencies, Banks & Financial Institutions can promote financing of high value agriculture infrastructure like shade net, polyhouse, etc., especially for horticultural crops, vegetable and floriculture.

xiii. Customised Extension: With availability of varied technologies competing with each other, there is a need to shift from general extension to customized extension services to suit

the individual requirement of the farmers which can maximize the income of the farmers, particularly the small/marginal farmer.

xiv. Most of the cooperative banks (whether LTCCS or STCCS) lack skill sets for term lending and hence, have low share in this segment. There is a need for massive scale reskilling of cooperative personnel for handling LT lending activity. The Ministry of Agriculture & Farmers' Welfare may like to support these capacity building measures for cooperative credit structure appropriately.

xv. At present, many farmers are not able to avail themselves of agriculture loan for want of Record of Rights (RoRs) or non-issue of ROR for sub-divided land holdings. State Governments may issue Land Pattas/Record of Rights to all farmers who have inherited land through subdivision of their family property, irrespective of the size of the landholding inherited by them. This will help farmers to avail loan for agriculture (ST/LT) without any administrative hurdles.

xvi. In order to provide market access & better prices to farmers, Government of India may encourage formation of large number of FPOs including Farmers Producer Companies (FPCs). Based on the experience of "PRODUCE" Fund, GoI may create a Fund in NABARD with appropriate corpus to encourage grassroots efforts for formation of FPOs/FPCs and nurture them for a period of 5 years.

xvii. All Banks viz. Cooperatives, RRBs, CBs should be encouraged to lend to FPCs, with credit guarantee cover from SFAC both for their working capital & block capital.

xviii. Many of the FPOs/FPCs struggle to establish and start their business in the initial years. During this period, some of the problems that these FPOs face are: banks not coming forward to sanction loans, as the equity is very low; non-existence of physical assets that can be offered as collateral security; and non-availability of audited balance sheets etc. This is the critical period, when if no business is started, members may lose faith in the efficacy of the FPOs. Many a time, farmers get motivated only after seeing the benefits accruing to those farmers who have already joined as members. Therefore, all state governments may come out with a scheme, to extend equity support of at least upto Rs. 10 lakh to all those FPOs/FPCs which are registered and plan to take up business activity.

xix. To ensure that specified allocations meant for farmers and within this category-small and marginal farmers, reach them, the distinction between direct and indirect lending should be explicitly brought back, and 8 per cent of the direct lending target of 13.5 per cent should be achieved by lending to small and marginal farmers.

xx. Given that the banks and financial institutions are normally reluctant to offer investment loans to farmers, particularly those belonging to small and marginal categories, the Committee recommends that the Agriculture Credit Risk Guarantee Fund (ACRGF) also covers term loans. In case of cooperatives, the fund can be operated by NCDC.

Responsibility: DAC&FW, MoF
Timeline: Short term
Refer Volume: V,VI

For full context and other details, the linked domain specific Volumes of the DFI Report may be referred to.

Chapter 8
Secondary Agricultural Activities

Agricultural production is not the sole output from the rural economy. Agriculture in turn, sets off other near-farm and non-farm economic activities in the rural landscape. The overall well-being of the rural population therefore depends on agriculture as a primary sector, and various associated secondary and tertiary sector activities that either support agriculture or are supported by agriculture. A village is, in fact, a microcosm of the wider human civilization, which also found cause, birth and sustenance from agriculture.

A typical farming household if relying solely on income from agricultural output, would be subject to associated unsteady, unpredictable and irregular income, owing to the seasonal nature of agricultural output which is further subject to other externalities. As part of the DFI strategy, the farming household should be empowered, not only to capture the maximum value from all that is produced off the farms, but also from other near-farm economic activities. The secondary sources of income help mitigate some of the risks associated with agriculture and allows for shared income sources in a household.

The share of rural areas in the economy's secondary sector (manufacturing) output has doubled in sixty years, but happened without the associated increase in share in the workforce. It is seen, that as new manufacturing sector develops in rural areas (and in modernisation of old industry), the industrialist progressively invests in technologies that automate operations and minimises the need for manpower. The fact is, that manufacturing systems are no longer manpower intensive and the same is increasingly seen in the services sector. Therefore, current development trends may not satisfactorily address the goal of employment generation for the rural work-force. As projected, even by 2050, more than 50 per cent of India's population will stay rural. There is the need to strategically promote the right kind of secondary agricultural activities, that will generate rural growth.

In the opinion of the DFI Committee, secondary agriculture should be described, first as an activity that can be considered as a cottage industry as a family based activity and also as a village level enterprise at a scale that contributes to the economic well-being of the village communities and secondly as a large enterprise that is integrated into its neighbourhood in terms of input resources, either for its raw material or for its manpower. Hence, Secondary Agriculture is defined as a productive activity at enterprise level that,

i. utilises as raw material the primary product and by-products of agriculture and other biological resources available locally in its rural agrarian neighbourhood; and/or

ii. deploys locally available skills or a high level of rural manpower, to operate/manage/ maintain the production of goods and services; and

iii. can be categorised appropriately under the Micro, Small or Medium Enterprises Development (MSMED) Act 2006; and under the Khadi and Village Industries Act.

There is need to promote secondary agriculture activities whose outputs can be in the nature of either value added goods or services, that help the primary sector actors to capture more value from its primary produce (grain, fruit, vegetable, milk, fish, fibre etc.) and/or from the by-products (straw, stalk, bio-mass etc.).

The DFI Committee brings focus on various such farm-linked activities in the backdrop of the importance of income generation in the rural areas, especially activities that are farm-related and the various options that are available to increase the efficiency of factors of production (land, labour and capital) that are currently deployed in India's agriculture. The provision of alternative means of livelihoods in rural areas, especially when these are directly linked to the core activity of agriculture, will not only supplement the existing income levels of farming households, but also abet and enhance the value captured from agriculture itself.

1

Considering that farm income on an average is 60 per cent of the total farmers' income, and that the farm families are engaged in agriculture operations for about 185 days in a year, there is scope & necessity to design opportunities for additional productive jobs, using the farm resources that are now not used for capture of value.

Responsibility: DAC&FW, DAHDF, ICAR, DoRD, MSME, MoFPI
Timeline: Short term
Refer Volume: IX, XIII

2

Farm-linked economic activities, at near-farm locations need to be promoted, especially those that are simple to deploy, easy to replicate, and readily serviceable.

The secondary agriculture systems should ensure that secondary income (non-farm income) growth is intrinsically linked, complements and supports the community's on-farm incomes.

Responsibility: DAC&FW, DAHDF, ICAR, DoRD, MSME, MoFPI
Timeline: Short term
Refer Volume: IX, XIII

3

The agriculture input industry is skill and capital intensive, and the products manufactured elsewhere are moving to rural areas with a net capital drain out of rural areas. This calls for promotion of agriculture input production activity as enterprises in the rural areas.

Further, partnerships between Research & Development agencies with FPOs and local manufacturing clusters to promote enterprises working in the agricultural inputs area should be promoted.

Responsibility: DAC&FW, DAHDF, ICAR, DoRD, MSME
Timeline: Short term
Refer Volume: IX

4

Primary Rural (grameen) Agricultural Markets (PRAMs/GrAMs) are market platforms – where produce gets pre-conditioned and prepared for transfer to markets. This productive activity not only helps farmers capture greater value, but also provides employment to the local populace and their development must be fast tracked.

State governments should identify and develop time bound plans for co-hosting GrAMs at the rural *haats* and train rural youth, especially women, to run the retail market linked initiatives

– aggregation & packaging of produce; sale-purchase transaction; operating of online connectivity, managing of agri-logistics, etc.

Responsibility: DAC&FW, DoRD
Timeline: Short term
Refer Volume: IV, IX

5

Agricultural field residue and handling waste at market platforms and processing units, can be composted or converted into other valuable by-products. Such activities hold large scope of employment and income generation, and may be accorded special attention by exemption or low GST rates, special category financing; and linkages with Swatch Bharat Abhiyan.

Responsibility: DAC&FW, DAHDF, ICAR, DoRD, MSME
Timeline: Short term
Refer Volume: IX

6

Pre-processing units at family/village level, to feed the larger secondary processing factories, should be promoted as a cottage scale or village level activity. Priority support should be given to micro-enterprises promoted by women and by FPO/VPOs. The high tech processing industry must be promoted to source their raw material from Indian agriculture.

Responsibility: DAC&FW, DAHDF, ICAR, DoRD, MSME, MoFPI
Timeline: Short term
Refer Volume: IX, XIII

7

The secondary agriculture enterprises may be categorised depending on level of capital, organisation, technology and business risks. Three broad categories are proposed –

a. Household level enterprise
b. Village level enterprise
c. Small and medium scale industry

Responsibility: MSME, DAC&FW, DAHDF
Timeline: Short term
Refer Volume: IX

8

Secondary agriculture may be considered for special support, such as-

a. Priority sector status for institutional credit.
b. Low cost skilling and knowledge based exposure.
c. Specialised extension services for enterprises owned by women.
d. Priority under rural electrification schemes.
e. Fast track benefits under ongoing central sector and centrally supported schemes.
f. Geographical Indicator labels to products from village scale secondary production.

Responsibility: DAC&FW, DAHDF, DoRD, MSME
Timeline: Short term
Refer Volume: IX, XIII

9

Various means of secondary agriculture that can complement the income from primary agriculture, need to be established and promoted. The indicative secondary avenues that complement primary income can be broadly categorised as –

A. Value addition to primary agriculture production systems
B. Alternative Enterprises
C. Enterprises that use residue and wastes of primary agriculture.

These categories cover value added services (activities such as preparing planting material, post-production preconditioning for market, mechanisation, feed and fodder production etc.), value adding to produce (primary processing at village level, paste, powder, pickling, etc.), allied rural vocations (bee-keeping, venom farming, breeding, rural tourism, coir products, sericulture enterprises, etc.), and value recovery from residuals (rice straw to fibre board and urea enriched fodder, cotton stalk products, fibre extraction and products, dung logs, bio-gas, etc.). Properly categorised, these activities that allow farming community to capture more value out of every ounce, grain and drop of farm output should be actively promoted.

Responsibility: DAC&FW, DAHDF, DoRD, MSME
Timeline: Short term
Refer Volume: IX

10

Secondary agricultural micro-enterprises are a window for women to develop income opportunities. Women rural entrepreneurs should be provided special support to organise their existing activities into micro-enterprises, through special capacity building, training and access to credit. Accordingly, a basket of enterprise that are most suitable for such development may be identified and promoted.

Responsibility: MSME, DAHDF, DAC&FW, ICAR
Timeline: Short term
Refer Volume: IX

11

Household level cottage industry and village producer organisations can support large scale industries by providing primary processing services. Industry can strategically deploy vendor development budgets to train the village community for taking up such activities.

The agricultural allied industries (food and non-food processing, medicinal), should be promoted to specifically develop sources for primary processed material, through secondary agricultural units at village level. The proposed national Agri-Value System Platform is an opportunity for large industries to develop a supply chain that integrates village level enterprises as organised and committed suppliers.

Responsibility: MoFPI, Ministry of Textiles, DIPP, DAHDF, DAC&FW, ICAR, others.
Timeline: Short & Long terms
Refer Volume: IX

12

On the lines of Pradhan Mantri Fasal Bima Yojna (PMFBY) for crops, accord special status to the rural income generation activities that are dependent on agricultural production, and design an insurance for secondary agriculture so as to cover business risks. Further, there is the need

to promote partnerships between agricultural departments, insurance agencies and NBFCs/MFIs for last mile insurance literacy and extension.

Responsibility: DAC&FW supported by DAHDF
Timeline: Short term
Refer Volume: IX

13

The prices and volumes of secondary agricultural commodities be listed and tracked on agmark.nic.in and other such price display portals. The now in operation Market Intervention Scheme (MIS) and Price Support Scheme (PSS) can integrate some of the secondary agriculture trade into agricultural markets. Such integration can be transferred to the newly recommended schemes like MAS and PPSS.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IX

14

Various secondary agriculture options such as 'Micro-Irrigation Technicians', 'Barefoot Engineers' and the like be accorded special status and promoted through separate funding streams, with specific focus on 96 deprived irrigation districts, given the Union Government's emphasis on 'Har Khet ko Pani'.

Responsibility: DAC&FW, ICAR
Timeline: Short term
Refer Volume: IX

15

The PMKSY scheme may be connected to water user associations (WUAs) created through various government programmes to rejuvenate dysfunctional aspects of their command area irrigation systems and also improve Participatory Irrigation Management (PIM) through facilitating support by private and not-for profit agencies working in collaboration with agriculture departments.

Responsibility: DAC&FW, MoWR
Timeline: Short term
Refer Volume: IX

16

RKVY-RAFTAAR scheme can promote integrated farming activities as one of the principal vehicles of Secondary Agriculture. Special emphasis be laid on avenues that have a more direct bearing on the farmers' income from the primary agriculture output.

Collective or cooperative integrated farming should be promoted and DAC&FW may consider assigning a nodal entity (eg. NCDC) with the purpose to encourage the model in cooperatives.

Responsibility: DAC&FW, NCDC
Timeline: Short term
Refer Volume: IX, XIII

17

Production of bio-fertilisers and bio-pesticides should be recognised as an emerging avenue of income generation; and as sunrise secondary agriculture opportunity, for sustainable

agricultural practices. The process of registration and licensing will need to be simplified for such small units.

	Responsibility: DAC&FW
	Timeline: Short term
	Refer Volume: IX

18

Undertake promotion of village level micro-enterprises to develop the market for bio-pesticides and bio-fertilizes; and various clusters to be identified across the country, that can support production of inputs for organic cultivation. For example, States / Districts with large animal husbandry; fruit and vegetable production offer sufficient ground to produce bio-pesticides and bio-fertilisers at commercial scale.

	Responsibility: DAC&FW, MSME, DoRD
	Timeline: Short term
	Refer Volume: IX

19

Scale up successful production-aggregation-marketing models that involve the farming community in their operations, in each agro-climatic zone as a value based supply chain driver.

	Responsibility: DAC&FW, DAHDF
	Timeline: Short term
	Refer Volume: IX

20

Soil testing may be taken up as a Secondary Agricultural activity and promote viable models that generate self-employment by creating an eco-system for privately driven soil health card system. It will also be appropriate to link this to water testing services at village level.

	Responsibility: DAC&FW, ICAR
	Timeline: Short term
	Refer Volume: IX

21

A separate cell may be created under the aegis of Secondary Agriculture under Pandit Deendayal Upadhyay Unnat Krishi Shiksha Scheme to promote value addition on wastes and residues (like from coconut and banana). In this cell, special emphasis may be provided to development of products, their marketing and building consumer awareness towards promotion of relevant cottage industries in rural areas.

	Responsibility: DAC&FW supported by DAHDF, ICAR, MSME
	Timeline: Short term
	Refer Volume: IX

22

Deendayal Upadhyay Swaniyojan Yojana (DUSY) may make separate allocations (proportion based) for avenues of 'Secondary Agriculture, given the immense scope that exists for creating self-employment for rural population. Secondary Agriculture can also be a vehicle to achieve the objectives of Deendayal Upadhyay Grameen Kaushal Yojana (DUGKY). Hence, this category be included in the scheme guidelines.

	Responsibility: DoRD
	Timeline: Short term
	Refer Volume: IX

23

Secondary Agriculture be given special status in the National Project of Agro-forestry. Support may be given to both farmers FPOs and interventions that help in creating self-employment.

Income generation from agro-forestry be tightly linked to the ecosystem benefits of interventions funded under Agro-forestry. Special emphasis may also be given to income generation activities that support the agro-forestry programmes.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IX

24

Projects that focus on aggregating the agro-forestry produce, given the dispersed nature of their production, that connect with buyers be given special emphasis. Pharmaceutical, beauty and wellness industries can be targeted, given the oleo-resin and similar extracts feasible from agro-forestry plantations.

Responsibility: DAC&FW, MSME, Aayush
Timeline: Short term
Refer Volume: IX

25

The National Mission on Horticulture may give special emphasis on fruit, vegetable and agro-forestry nurseries as secondary agriculture activity, in backdrop of creating income in addition to the income from primary agriculture and well as quality planting material.

Specific interventions that use technologies or institutions (FPOs) for commodity aggregation and connecting them to the Business to Business, Business to Consumers and Farmers to Consumer platforms, may be encouraged. The same may be clearly stated in its guidelines to encourage different stakeholders to submit the proposal on the subject.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IX

26

Specific skilling targets need to be allocated for avenues of Secondary Agriculture. Convergence among the schemes of NSDM, MSME, other entrepreneurship centred schemes and Priority Sector Lending (PSL) facility be promoted through a special purpose cell established for the purpose. There is also need to focus on establishing linkages between NSDM and various incubators (in leading academic and research institutions), that support technology / innovation start-ups.

Responsibility: MSDE, DAC&FW, DAHDF, ICAR
Timeline: Short term
Refer Volume: IX

27

National Apprenticeship Promotion Scheme (NAPS) be extended to 'Secondary Agriculture' avenues considering their scope for creating enterprises and employment opportunities.

Responsibility: MSDE supported by DAC&FW, DAHDF
Timeline: Short term
Refer Volume: IX

28

Secondary Agriculture be recognized as an important domain of research pursuit in INSPIRE (Innovation In Science Pursuit For Inspired Research Program).

Responsibility: DST supported by ICAR
Timeline: Short term
Refer Volume: IX

29

MSME status for Secondary Agriculture may be provided, so that it can be supported under the ambit of the MSME Market Development Assistance scheme.

Responsibility: MSME supported by DAC&FW, DAHDF
Timeline: Short term
Refer Volume: IX

30

The Small Farmers' Agri-Business Consortium (SFAC) and National Cooperatives Development Corporation (NCDC) may include Secondary Agriculture in their Guidelines and give emphasis on developing such avenues at village scale.

The potential list of micro-enterprises may be converted into bankable projects, so that subsidy and credit linked support can be given to the farm families.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: IX

31

Energy saving and sustainable technologies require operational support. Operation & Maintenance (O&M) models such as for 'solar water pump', 'waste digester & composting', 'thermal energy banks', 'dung log making', etc. for farmer groups may be considered for funding under the Sustainable Finance Scheme of SIDBI (Small Industries Development Bank of India).

Responsibility: MSME, SIDBI
Timeline: Short term
Refer Volume: IX

32

A total corpus of about Rs. 10,000 crore is set up for the Fisheries and Aquaculture Infrastructure Development Fund (FAIDF) and the Animal Husbandry Infrastructure Development Fund (AHIDF) for financing infrastructure requirements.

In order to utilise the funds most efficiently the department may like appoint agencies to study the requirements and gaps and list the priorities.

Responsibility: DAHDF supported by NABARD
Timeline: Short term
Refer Volume: IX

33

Promotion of Secondary Agriculture will require recognising it as an important and independent mandate, for the creation of additional job opportunities for income generation and to enhance farm incomes. In this context, it requires:

a. special emphasis, mention and budget allocation to be made for the avenues of secondary agriculture, independently as also under various ongoing schemes. A budget head may be created for this purpose.
b. recognition of Secondary Agriculture activities as priority sector and as sunrise sector of rural industrialisation
c. convergence with enterprise promotion, incubation facilities and credit linkage
d. consideration of incomes thereof as farm income and exemption from income tax.

Responsibility: DAC&FW, DAHDF, DoRD, MSME, DIPP
Timeline: Short term
Refer Volume: IX

34

At the field level, the farm families will require handholding. Hence, dedicated extension will be necessary. At the block level, a team of Extension Officer (from the departments of agriculture, animal husbandry, fisheries etc.) and Industrial Promotion Officer-IPO (from the department of industries) will need to be created with responsibility for promotion of secondary agriculture and outcome based targets. This team should get technical backstopping from State Agricultural Universities (SAUs), ICAR institutes, KVKs, District Industry Centres (DICs), State Khadi and Village Industries Boards (KVIBs), Textile and Sericulture departments etc.

Responsibility: DAC&FW, DAHDF, ICAR, DoRD, MSME
Timeline: Short term
Refer Volume: IX

35

Secondary Agriculture is an independent and important field of work that bridges primary agriculture with other economic sectors. All three Departments of the Ministry of Agriculture & Farmers Welfare may create a Division on secondary agriculture.

Further, there should be a common institutional platform for all these three Departments to coordinate the activities in regards to secondary agriculture.

Responsibility: DAC&FW, DAHDF, DARE-ICAR
Timeline: Short term
Refer Volume: IX, XIII

For full context and other details, the linked domain specific Volumes of the DFI Report may be referred to.

Chapter 9
Extension and Knowledge Diffusion

Agricultural extension has been understood as an important techno-social enabler that supports farmers in their endeavours to produce more. If extension is to serve the purpose of effecting a paradigm shift in agriculture from production-centricity to income centricity it deserves to be redefined. Accordingly, the DFI Committee redefines Agricultural Extension as follows:

> *"A system of empowering farmers with information, knowledge, technology, skills, risk and farm management practices, across agricultural sub-sectors and along all aspects of the agricultural supply chain, so as to enable the farmers to realise higher net income from their enterprise on a sustainable basis".*

The new definition covers not only the cropping systems, but also other sub-systems including horticulture, animal husbandry, fisheries, etc. emphasising thereby the importance of diversification and farming system approach. More importantly, an agri-value system (supply chain that integrates multiple value chain actors) approach is inherent in the definition making farmer a legitimate and active stakeholder at every single stage of value addition. It thereby envisages, two principal outcomes from the extension process, namely, higher income to the farmer and sustainability of the same.

It is no gainsaying, that the extension system was an important pillar in the success of green revolution. It helped reach out and connect farmers with new technologies, management practices, area expansion initiatives and policy based benefits with the objective to increase productivity and production. However, the extension system cannot remain time warped as the farming system undergoes changes across all regions of the country. While there remain pockets in the country that will benefit from intensive agricultural practices, a larger section of the farmers require extension support, beyond such dedicated focus on cultivation, for the next level of strategic development of their prowess in post-harvest management, marketing, sustainability and for optimising on monetisation of produce. This will require differentiated capacity of extension manpower, and modernisation of the extension system by deploying appropriate ICT systems and the skills to use such systems. Attracting suitable talent into the extension system, and providing such talent with a suitable career roadmap, will be essential to maintain agricultural extension services as a value-adding service to farming.

In current day context, the extension system faces severe structural weaknesses, ranging from manpower shortage, a non-harmonised & narrow range of activities, poor targeting of farmers, weak monitoring mechanism and insufficient out-reach into regions. These varied shortfalls need to be corrected, for continued support of extension for doubling farmers income.

The role of private sector and non-governmental sector in extension activities has increased in recent decades. This has been supported through financial and fiscal incentives by the government. However, there is little uniformity in the knowledge and skill dissemination, and it is observed that on many occasions, the public (government) extension machinery and the other extension works are working at cross purposes. At times, the same set of farmers are repeatedly accessed by multiple extension functionaries, which can also lead to contradictions and confusion. Improvements in the structure and governance of extension system, keeping in perspective the proposed shift from traditional agriculture to enterprise based agriculture, while leveraging ICT systems, is part of the recommendations proposed. There is scope to develop a

mechanism to converge all the private extension efforts onto a single platform, integrate it with public extension efforts, and achieve the much needed coordination to serve larger areas and an increased number of activities. Synergy in effort by the two systems will benefit the farmers better. This will become an example of public-private platform of extension machinery.

Currently, the agricultural extension services are available on a pluralistic platform. DFI Committee proposes to transform agriculture extension as an important engine for doubling the farmers' income.

1

Adopt the new definition of the agricultural extension, to extend a techno-social system of supporting farmers for achieving increases in incomes from farm, off-farm and non-farm activities in a sustainable manner, covering not only the cropping systems, but also other sub-systems encompassing horticulture, animal husbandry, fisheries etc., thus emphasising the farming system approach.

Extension services should aim to empower farmers across all agricultural sub-sectors, all along the agricultural supply chain, with information, knowledge and skills, so as to enable them to realise higher net income from their enterprise on a sustainable basis.

Responsibility: DAC&FW, DAHDF, DARE
Timeline: Short term
Refer Volume: XI

2

In the light of the experience with the country's agricultural extension system so far, and with reference to the targeted paradigm shift in agriculture what is most critical is to **Extend the Extension** in multiple directions. Extension has to get more wholesome to cater to extension needs of all the agricultural sub-systems including field crops, horticultural crops, dairy & livestock, fisheries & aquaculture, as also the secondary agriculture.

Further, the extension system in contrast to its present dominant engagement with production activities must be extended to post-production activities, with particular focus on agricultural marketing. Additionally, the agricultural extension system also needs to take on the responsibility of meeting the requirements along the agri-value system, which means that its capabilities need to be upgraded at pre-production, production and post production stage of agricultural activities.

For example, the Extension Officers must be able to understand the basic technologies relating to new systems of production like green houses, polyhouses etc. They will need training in these aspects.

Responsibility: DAC&FW, DAHDF, DARE
Timeline: Short term
Refer Volume: XI

3

The government extension system suffers from deficit human capacity, while the non-government sectors have increased their role in agricultural extension. There is hence scope to enhance and further co-opt the private sector and the 'not-for-profit' development sector in agricultural extension.

It is recommended to formulate situation specific and region specific protocols for introducing greater transparency and trust into the partnership with private extension services known for their aggressive marketing strategies vis-a-vis the public extension, to avoid conflicts of interest. Such partnerships and protocols should focus on blending the strengths of the production led public extension system (PES) with the more market oriented private extension services, with a view to ending the exploitation of farmers by middle men, whether in sourcing inputs for production or in realising prices by marketing their farm produce.

	Responsibility: DAC&FW, DAHDF
	Timeline: Short term
	Refer Volume: XI

4

To suitably support the various extension efforts and to converge such efforts with the mandate of doubling farmers' income, the extension systems need to be harmonised. To begin with, it is recommended to develop a comprehensive database on agricultural extension functionaries available with private sector and the 'not-for-profit' development sector and document the extension approaches adopted by them across diverse product value chains, in various agro-climatic settings.

The majority of farmers are small & marginal, and therefore need to be a priority of the public extension system (PES). Such small farmers are typically bypassed by the extension system, as also by the private sector extension. It is understandable, that private sector extension, which is a paid service by passes those who cannot afford to pay.

To that extent, the public extension system needs to therefore focus on meeting the needs of the majority. The profit-centric private extension system, can be provided greater space to render services that address the needs of farmers, who can pay for the services, so that PES is left with more space for focussing on small & marginal farmers.

Greater synergy and partnership between the public and private extension efforts can meet the extension needs of all farmers. Differentiation at production stage (where public system possesses better strength) and post-production stage (private actors can play a bigger role) can be assessed and developed at state level. A value system based platform at the district level, led by the private sector, can be promoted in partnership with the government led ATMA platform, thereby addressing the end to end needs of many more in the agricultural sectors.

	Responsibility: DAC&FW, DAHDF, DARE
	Timeline: Short & Long terms
	Refer Volume: XI

5

To bring greater convergence in extension services, a common national platform deserves to be provided so that all public and private agriculture research and development (R&D) institutions can share their technologies on a real time basis. Such a dedicated platform, created at the national level, would serve as the Electronic National Bank for Agricultural Technologies (e-NBAT). This will help provide transparent access to approved and current technologies, not only to the extension machinery, but also to recipients and other researchers if so desired.

	Responsibility: DAC&FW, DAHDF, DARE, ICAR, SAUs
	Timeline: Short & Long terms

Refer Volume: XI

6

The Agriculture Technology Management Agency (ATMA) was initiated as a multi-agency platform with emphasis on procedural as well as institutional reforms, leading to effective extension delivery. Notwithstanding ATMA's advocacy for decentralised decision making, in the more expansive phase of its implementation, the top down method of decision making has continued to prevail in the field.

The ATMA strategic planning system has become ritualistic, largely bypassing allied agricultural departments. As such ATMA has come to be practised as any other scheme, rather than as a dynamic platform to promote reforms, practice convergence and adopt market linkages. Nevertheless, ATMA has brought about desirable results in gender mainstreaming through increased participation of women in extension activities.

ATMA is a well-conceived extension delivery mechanism that aims at public-public-partnership and simultaneously public-private-partnership. The concept remains relevant and it is necessary to rejuvenate ATMA by refreshing the institutional mechanism and implementation procedures to harvest the advantages of a platform of convergence. Certain autonomy is essential to capacitate and make the services more dynamic, need based and comprehensive in outcome.

Responsibility: DAC&FW, DAHDF, DARE-ICAR
Timeline: Short term
Refer Volume: XI

7

The role of the extension system needs to change to suit the current realities faced by the recipients. Even issues that were less controversial until recent years, such as disposal of farm residue, agro-biodiversity conservation, disposal of agro-chemical wastes, etc., are now threatening the farming eco-system. This is in the backdrop of changed dynamics in the agricultural system. Majority of the farmers have successfully shifted from subsistence agriculture to where they now generate larger marketable surplus and larger residuals.

The extension system should build capacity on recovering value from all residual output, safe disposal of chemicals and conserving the agro-biodiversity.

Responsibility: DAC&FW, DAHDF, DARE-ICAR
Timeline: Short term
Refer Volume: XI

8

The success of farmers in generating larger marketable surplus, makes them increasingly seek market oriented information such as market preference for crop and variety, market demand and prices on real time basis, details on buyers, availability of logistics (aggregation, transport, storage facility, etc.) and the like. These constitute business enabling information, which has not been traditionally addressed by public extension. In a way, this has remained a structural weakness which needs to be attended to, so as to reorient and build capacity of extension system to take these to the farmers.

Extension system should develop greater market orientation, provide understanding on agricultural reforms such as, new market architecture [GrAM - Gramin Agricultural Market,

competitive wholesale markets (eNAM, Export Markets), Model APLM Act 2017, Model Contract Farming & Services Act 2018, warehouse based post-harvest pledge loans, etc.] so that changed concepts are also extended to farmers and to facilitate thought leadership among farmers themselves. Doubling the farmers' income is possible when agriculture comes to be treated as an agri-business.

A comprehensive programme of capacity building be designed for extension functionaries, on the principles of 'agri-business extension', in contrast to the production-centric extension practised hitherto. Managerial competence in aspects such as judicious resource use, labour management, finance management, etc. are listed in Volume XI. There is need to revisit the knowledge and capacity of extension officials who then can spearhead this required change. Various institutes like MANAGE, EEIs and SAMETIs should assume such responsibility including re-skilling the extension personnel at all levels to hone their capacity and skills for mobilising and formation of producer groups; linking groups to post-production activities that allow small farmers to transact directly with terminal wholesale; and extract maximum value.

Since MANAGE under the DAC&FW is the nodal institution for generation of new knowledge and capacity building of the extension system across the country it would be necessary to build a team at MANAGE specialised in marketing extension linked to all the agricultural sub-systems, like livestock, dairying, fisheries, horticulture, apart from field crops. The transfer of knowledge in this regard to the State extension machineries should include dimensions of the farmers' value system, such as agri-logistics, elements of village level processing, retail and wholesale marketing, trade and export, online marketing, futures and commodities, etc. Presently the state extension machinery is weak in these aspects, while these are the new requirements in the context of income-based agriculture.

Responsibility: DAC&FW, DAHDF, DARE
Timeline: Short term
Refer Volume: XI

9

To make extension more relevant and meaningful, there is need to develop an HRD policy for the extension officers in the locally relevant agricultural sub-sectors, along the value system, comprising pre-production, production and post-production stages. DFI Committee recommends that all extension service providers should undergo mandatory need based and diagnostic-skill based training, to prepare themselves for the changing agricultural environment.

The training could be for about 2 to 3 months, and would require training not only on communication skills but also include courses on men and material management. This training should optimally result in a certificate as a qualified resource in extension. The extension officer can also be provided the option to select specific subjects that he or she prefers to specialise in, based on self-assessed aptitude and past qualifications.

Extension functionaries should also undergo a short term refresher course, periodically or once every two years. Such training or refresher courses may be linked to the extension professional certification and also be mandatory to continue to perform in the field. The subjects chosen for refresher courses can be designed to suit the desired career progression path of the extension functionary. Similarly, regular assessment of capacity of institutions may be incorporated as a

process. Such institutional assessment for extension can be assigned to MANAGE a premier national institute dedicated to agricultural extension.

Responsibility: DAC&FW, DAHDF, DARE
Timeline: Short term
Refer Volume: XI

10

Constitute a Central Board of Studies at the national level to review and regulate changes in curriculum across all the 77 Agriculture Universities of the country, so that the standards and content of education in agriculture address the field level problems of farmers, with special focus to orient them towards enhancement of farmers income, along all six of the seven sources of income growth discussed in Volume II of this Report.

Responsibility: DARE
Timeline: Short term
Refer Volume: XI

11

Krishi Vigyan Kendra (KVK) has facilities and hires Subject Matter Specialists (SMS) to actively implement mandated activities i.e. technology assessment, refinement and frontline extension.

The Subject Matter Specialists (SMS) based in the KVKs must be oriented to integrate their research agenda and front line extension plans with the Block Action Plans (BAPs) developed by the ATMAs.

Responsibility: DARE-ICAR, DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XI

12

Each KVK is in possession of about 50 acres of land. This provides ample opportunity for Agri-business activities on a Public Private Partnership (PPP) mode, supported by KVK by providing space and technical support, whereas production, processing and marketing are done by Agri-preneurs. This can also form a platform for extension delivery in PPP mode.

There is therefore scope to promote Public Private Partnership (PPP) mode through KVKs, aligned with the guiding principles of ATMAs that provides for promotion of PPPs in Agricultural Extension delivery with suitable allocation of funds for such initiative.

Responsibility: DARE-ICAR, DAC&FW, DAHDF
Timeline: Short & Long terms
Refer Volume: XI

13

Strengthen the role of the Directorate of Extension (DOE) in the DAC&FW for it to play a more pro-active role in providing technical backstopping to the Department's Extension Division in execution of various extension initiatives. The DOE can function as a promoter and propagator of innovations in agricultural extension programs executed by both central & state governments, as also private sector & NGOs. It can also undertake concurrent monitoring and evaluation of these programmes. This is possible if DOE is offered greater autonomy and concurrent flexibility in deciding and implementing its activities.

DOE can be required to provide appropriate feedback to the Ministry for policy formulation, monitor the related programme implementation and serve as a link between the Ministry and Extension systems in the country. The two institutes, namely, DOE & MANAGE will need to work in tandem to help enhance the delivery capacity of the agricultural extension system across the country.

An Expert Committee may be setup to redefine the role of Directorate of Extension to address the contemporary challenges in extension, particularly in the context of income approach.

Responsibility: DAC&FW
Timeline: Long term
Refer Volume: XI

14

The National Institute of Agricultural Extension Management (MANAGE) is an autonomous organisation under the DAC&FW. It is mandated to assist state and central governments in strengthening of agricultural extension management through policy formulation, training, research, extension, consultancy, documentation and dissemination of knowledge in the field of agriculture extension management and policy advocacy.

In addition, MANAGE can now be entrusted to own and manage the proposed single window technology and knowledge platform, namely, e-National Bank for Agricultural Technologies (e-NBAT). MANAGE can function as a "concept nursery" in agricultural extension management, based on national and international learnings for the benefit of Indian farmers. A strategic prioritisation of time and resource allocation is proposed for MANAGE, between mentoring of program implementation (50 per cent), e-NBAT (25 per cent) and other activities.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XI

15

It is recommended to put in place a National Level Ranking Frame Work (NLRFW) for Extension Service Providers (Public and Private) to facilitate formation of healthy and functional PPPs at the operational levels of KVKs and ATMAs.

Responsibility: DAC&FW supported by DAHDF, DARE
Timeline: Short term
Refer Volume: XI

16

The State Agricultural Management and Extension Training Institutes (SAMETI) are expected to function as extension arms of MANAGE in the states. Therefore, the regional Extension Education Institutes (EEIs) need to move beyond their traditional role and differentiate themselves as institutions of higher value addition by developing a niche set of competencies, not currently available in the national extension system.

The EEIs should be developed into Centres of Excellence, each specialising in areas relevant to their locational priorities and agro-climatic conditions and don two responsibilities on behalf of MANAGE, namely, feedback and feed forward agents.

In order that the four EEIs develop the new competencies as recommended, they may be taken through a visioning exercise. This should help them identify location – appropriate extension

priorities, with reference to field crops; horticulture & plantation; livestock & dairy; fishery, piggery & poultry, etc. Enhancement of farmers' income has to describe the new sharpness of their extension competence.

Responsibility: DAC&FW supported by DAHDF
Timeline: Short term
Refer Volume: XI

17

National Institute of Agricultural Extension Management (MANAGE) should evolve an institutional mechanism for mentoring activities of EEIs and SAMETIs, especially in identification of training priorities, preparation of training modules, aligning its training calendar and TOT component with capacity building needs of EEIs / SAMETI faculty, training evaluation etc., thereby reorienting the reforms process in the States towards enhancing the farm incomes. MANAGE should assume the responsibility for creating Downstream Institutional Linkages with the EEIs and SAMETIS.

The emerging structure would comprise MANAGE as a national level knowledge resource for extension; the SAMETIs as delivery channels of both traditional and market driven knowledge products; and the EEIs serving as the 'eyes and ears' of MANAGE in pushing the frontiers of new extension knowledge, to serve as a higher order knowledge loop to pilot innovative and bold knowledge experiments.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XI

18

It is neither desirable nor feasible for the Extension Directorate of the SAUs to participate in direct extension. The field interface of SAUs can at best be to organise frontline demonstrations (FLDs) so as to validate new technologies and provide technical backstopping and capacity building support to mainstream extension.

SAUS should be expected to be the research system linkage with SAMETI at state level. As was the previous practice under Training and Visit (T&V) system of extension, the State Agriculture Universities (SAUs) should be tasked to undertake fixed interval orientation and training programmes for the senior officers of all the departments of agriculture & allied sectors, ATMA, Subject Matter Specialists, as also those in the private sector and NGOs, in alignment with the requirements of the following production & marketing seasons. This pool of senior management with new knowledge can then train the Extension Officers of their respective organisations. This will trigger the earlier system of "Training of Trainers (ToTs)'.

Responsibility: DARE-ICAR, DAC&FW
Timeline: Short term
Refer Volume: XI

19

For SAUs to become more effective and field relevant, as a source of new knowledge and technologies, they should go beyond their limited basket of recommendations and source relevant technologies and practices from other SAUs, CAUs, ICAR institutions, private sector etc. from within and outside the state. The technologies pooled from outside may be tested for adaptation under the agro-climatic conditions within their service area, and then disseminated into the mainstream state extension system.

To enable the SAUs to fulfil this mandate, it is advisable to establish "e-State Bank for Agricultural Technologies" (e-SBAT) at the SAMETIS, on the lines of e-NBAT.

Responsibility: DARE-ICAR, DAC&FW
Timeline: Short term
Refer Volume: XI

20

SAMETIs may need to go beyond capacity building of State Extension Functionaries and take up extension management issues like group led extension, ICT in extension, PPP and gender mainstreaming, guide ATMAs in implementing reforms, and others as listed in Volume XI. The SAMETIs are provided varying manpower strength on the basis of Blocks in a State. The existing ratios need to be re-examined since in some large states, the number of blocks are less compared to their geography and extent of cultivated area.

There is need to ensure manpower competence and quality. SAMETIs should be enabled to draw good faculty from a common resource pool developed and certified by MANAGE, including experts from different agricultural science disciplines with proven contribution in extension management. Such an inventory of certified faculty resources may be updated and maintained by MANAGE at the national level and shared with the States.

Responsibility: DAC&FW supported by DARE-ICAR
Timeline: Short term
Refer Volume: XI

21

The State Agriculture and Allied Sector Departments need to ensure that funds earmarked for training, extension, HRD/capacity building activities be placed at the disposal of ATMA well before the cropping seasons duly matching with Annual Action Plan prepared by ATMA and consistent with Farmer-Charter. At least 10 per cent of the ATMA Fund, may be essentially operated through PPP mode and come in synch with Govt. of India (GOI) Guideline. This should essentially be on a cost sharing basis to promote private sector investment, rather than through outsourcing or paying service charge to a provider.

The Chairman, ATMA Governing Body (GB), may ensure initiation and operationalisation of at least five Corporate Social Responsibility (CSR) projects in a year in district. To accomplish implementation of at least 10 per cent of Extension activities in PPP mode, it is also suggested that the selection of PPP partner be delegated to ATMA GB coupled with requisite flexibility and powers to signing of Memorandum of Understanding (MoU) at district level.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XI

22

A robust ICT enabled Monitoring, Evaluation and Learning (MEAL) mechanism may have to be established at all levels i.e. Centre, State and District. The MEAL system shall be adequately supported with participatory tools of social assessments involving all stakeholders – Farmers Advisory Committees, Civil Society Groups, representatives of Line Departments and peer institutions with adequate manpower, infrastructure and funds.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XI

23

Agriculture development programmes and related ones of other departments like Rural Development, Panchayat Raj, Social Welfare, Tribal Development, Water Resources etc., generally operate in vertical silos, with very little or no horizontal convergence, especially at the block level and below. There are alternate district level plans, prepared by various ministries/departments with different subjects/themes as their core. These include SREP of ATMA, C-DAP of RKVY, PLP of NABARD, NICRA of ICAR, District Irrigation Plan (DIP) of Ministry of Water Resources (MoWR) and DAC&FW, etc. All these impact agriculture in different ways. Hence, field level convergence is one of the major challenges existing today across the departments.

A convergence matrix may be designed, tested and adopted for implementation covering all the schemes of agriculture and allied departments to ensure convergence and implementation on "gap filling" mode. Formulation of convergence matrix may be made mandatory while seeking approvals for all work plans at Block, District and State levels.

The extension machinery should reconcile the different interventions, such as to channelize the manpower, efforts and resources towards the strategy of doubling of farmers' income by 2022-23. Effective enforcement of guidelines for coordination and convergence of extension work with research, line departments, private sector, NGOs at state and district levels be ensured, duly reflecting the role and relationship with District and State Administrations.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XI

24

ATMA should be the platform for convergence and service delivery of all schemes and programmes of agricultural development at the district level and below. ATMA governing structure be enlarged to provide representation to various organisations and stakeholders involved in CDAP, including those from National Resources Management (NRM), Water Resources, Power, MGNREGA, Rural Livelihood Mission, Tourism etc. All committees implementing Ministry of Agriculture schemes shall be subsumed in ATMA Governing Board and Management Committee.

Resources of Panchayati Raj Institutions (PRI) need to be fully leveraged and provided a prominent role in planning and implementation of extension programmes. They should become the fulcrum of governance in case of agriculture and allied sectors.

Responsibility: DAC&FW, DoPR
Timeline: Short term
Refer Volume: XI

25

There are about 700 Krishi Vigyan Kendras (KVKs) and their activities include conducting of on-farm trials (OFTs), frontline demonstrations (FLDs), and skill-oriented training for farmers, farm women, rural youth and extension personnel. KVKs have to reorient their focus on acclimatisation of technologies to the local situations, rather than mainstream extension work, and on priority to provide technical backstopping support to public and private extension functionaries of the district.

Convergence between agricultural research and extension, as agreed to between the DAC&FW and DARE (June, 2015 Convergence circular) must be ensured in letter and spirit.

The Commissioners/Directors of Agriculture and Allied Departments of the State and the senior representatives of the Private sector may be brought on the Management and Research Advisory Committees of ATARIs, to address demand-driven agenda for KVKs and ATMA.

Responsibility: DAC&FW supported by DARE, DAHDF
Timeline: Short term
Refer Volume: XI

26

There is need to reintroduce fortnightly training schedule of Extension functionaries by Subject Matter Specialists. For this purpose, it is also recommended to provide a one-time, need based Catch-Up Grant to about 2000 training institutions (KVKs, ATMAs, SAMETIs, AUs (State and Central as also their constituent and affiliated Colleges, EEIs, ICAR Institutes, private organisations, etc.), for up-gradation of their training infrastructure. This one time up-gradation at an estimated financial support of Rs. 200 crore, will help improve physical infrastructure, IT infrastructure furniture and fixtures, training aids and equipments. However, the need identification has to be based on proper diagnostics of the current status and the gap to be bridged to meet the desired standards.

Appropriate accreditation protocols, procedures and institutionalisation may be suggested by MANAGE, in collaboration with Institutions of International Excellence.

Responsibility: DAC&FW supported by ICAR
Timeline: Short term
Refer Volume: XI

27

Extension services network can be extended by utilising network of rural banks, input dealers, and a blend of ICT systems. Agri Input Dealers, numbering more than 3 lakhs, Common Service Centres numbering 1.57 lakhs, Milk Cooperatives numbering 1.73 lakhs and Primary Agril. Credit Societies (PACs) numbering about 63,000, may be effectively used as Extension Delivery Points. These have regular footfall of farmers and can be platforms for displaying the literature related to schemes and programmes of both central and state governments, new technologies and extension messages including weather and market information.

National level and location specific agricultural extension information, based on the content produced from institutions like KVKs, SAUs, ICAR centres and others, can be shared through these delivery points.

Responsibility: DAC&FW supported by DAHDF, ICAR
Timeline: Short term
Refer Volume: XI

28

Agricultural credit extension service is necessary and a module on farm credit in all training programs for both private and public extension functionaries needs to be considered. NABARD and the ICAR / SDA Systems to come together and design the proposed module and set its delivery mechanism and take it forward through State Level Bankers Committees (SLBCs), District Level Bankers Committees (DLBCs) and Cooperative banks. Banks also have potential as extension providers and the involvement of Banks in close coordination with

ATMA and Agri-business Companies, Farmer Producer Organisations and CSCs in Agricultural Credit Extension Services, needs to be promoted and strengthened.

A unified interface, as a mobile app or website, to provide financial information and services for farm credit is recommended. This will inform on the availability of institutional credit, and simultaneously help farmers to be more prepared when accessing the same.

	Responsibility: DAC&FW, NABARD
	Timeline: Short term
	Refer Volume: XI

29

Extension and technology flow to farmers, needs to be market led. The end outcome of improved monetisation of farm produce, needs to be the overriding factor of consideration when undertaking technology transfer. The current focus of extension is mainly on production enhancement led by productivity gains. However, the extension needs to expand beyond production, and work on (i) reducing the cost of cultivation/production, (ii) aggregating the farm produce; (iii) reducing the number of marketing intermediaries; (iv) value addition to produce, or the value adding activities that realise better farm gate prices. Extending technology that does not result in growth in economic productivity (market linked) will tend to dissuade farmers from adopting better systems.

Thrust on market-led extension is emphasised as the new approach to extension services. In order to implement the desired approach of **"Market-led Extension"**, the extension functionaries have to undertake farmer orientation and sensitisation by providing them information on advantages of online trade platform like e-NAM and other alternate marketing channels, direct marketing of produce to terminal markets, primary village level processing, becoming contracted supplier in the existing value chain of an agro-processor, the positive aspects of warehouse based pledge loan facility, etc.

To promote market-led extension, at least 25 per cent of the District Extension manpower should be earmarked for this purpose.

	Responsibility: DAC&FW, DAHDF, NABARD
	Timeline: Short term
	Refer Volume: XI

30

Indian extension is dominated by public extension. As agriculture is a state subject, majority of the extension functionaries come from agriculture and allied departments of the state. To strengthen ATMA, additional manpower is provided to states by the central government. In the year 2012-13, as against 13.83 crore operational farm holdings, the agricultural extension manpower in position in the country was 1,19,048, which worked out to 1162 operational holdings served by one extension functionary.

All vacancies in the centrally sponsored extension projects as well as states must be filled up on priority, and at least 50 per cent of the regular positions should be filled up with women extension functionaries at the District and Block levels. Agricultural Extension Service should be given a special status, considering it as both an economic and educational activity and no vacancies allowed to linger on.

	Responsibility: DAC&FW
	Timeline: Short term

Refer Volume: XI

31

Past developments, globalisation and climate change are changing the character of agriculture. Correspondingly, there is need to address the changed aspirations of farmers, mitigate diverse ecological concerns, negotiate the capital intensity in modern agriculture and bring enduring income security to the farmers. These present day concepts require broadening the extension perspective, as the contemporary need is to emphasise on not only agriculture as before, but also service more intensely other sub-sectors, namely, horticulture, dairy & livestock management, poultry, fishery and farm linked on-farm and off-farm activities. The extension system also needs to be cost-effective, real time in nature, while being location and domain specific. This strategy is possible with use of modern ICT technologies, to communicate the information and knowledge to as many farmers as possible.

Based on optimal blending of manpower and ICT, for extension services to be effective, it is advised to revisit and adopt an optimal ratio between extension manpower to farming family. The recommended geography-wise minimum ratios are: Hilly areas-1:400; Irrigated areas-1:750; Rainfed areas 1:1000.

Responsibility: DAC&FW supported by DAHDF, ICAR
Timeline: Short term
Refer Volume: XI

32

Extension functionaries largely comprise those engaged under ATMA scheme and those serving on state government strengths in regular capacities. The current recruitment strategy, involving short term contract based manpower in ATMA has led to several functional, administrative and legal issues, compromising the functioning of ATMA.

The salary structure of personnel on short term contract is sub-par compared with those in regular employment and should be made more attractive with a stable contract period. A revised manpower recruitment strategy, such as longer contract periods, offering preference to contract staff during regular recruitment, reserving seats in higher education for ATMA contracted staff, education loans, etc., (see full list of recommended incentives in section 4.3.2. Volume XI) may be implemented. This will attract suitable manpower and mitigate attrition of personnel involved in knowledge dissemination. MANAGE may coordinate HRD activity of ATMA manpower including induction of newly recruited extension functionaries with State/UT governments as required.

It is suggested, that number of direct seats at the PG and Ph.D levels may be reduced, and substantive numbers reserved for candidates with service in State Extension and ATMA. It graduates of agricultural science enter ATMA as contract staff and serve for 2-3 years and then join PG courses, the field extension will benefit from young enthusiastic resources.

Responsibility: DAC&FW, DARE
Timeline: Short term
Refer Volume: XI

33

It will be a good strategy to develop outcome based benefits to extension field functionaries, so as to enthuse their personal involvement when serving the farmers and to accelerate the momentum. A performance linked incentive system is recommended based on three broad

parameters. These include increase in productivity in the designated area, reduction in yield gap between lab and field, and growth in net income generated per unit area or livestock.

The first element will ensure that, extension functionaries pay attention to the farmers who have otherwise lagged behind in a region, possibly due to various socio-economic reasons. The second factor will develop benchmark for flow of technology in their area and strive to make laboratory productivity equal field productivity. The third parameter will drive efforts towards improving produce quality at lowered cost, capturing value from residual output and for market-led extension. The third factor is particularly significant in case of non-food crops as well and can be given a higher weightage.

Responsibility: DAC&FW, DAHDF, DARE
Timeline: Short term
Refer Volume: XI

34

In order to provide interaction and extension interface with the farming community, an institution of Farmer Friend (FF) is already in place at the rate of one for every two villages. To make this institution more effective, the concept of 'One village-One farmer friend' is proposed. Presence of farmer friends should be doubled to achieve one in every village (about 6.5 lakh), and their monthly remuneration doubled from the existing Rs. 500/-.

Further, to effectively reach out to women farmers, who contribute significantly to farming system and family income, it is recommended that 50 per cent (3.25 lakh) of the farmer friends across the country be reserved for women. The changed ratio will be in the larger interest of farming, as farm women play a major role in agriculture including dairy, poultry, etc. In addition fifty per cent of the farmer friends across the country should be women.

Responsibility: DAC&FW supported DAHDF, DARE
Timeline: Short term
Refer Volume: XI

35

A National and State e-Agriculture policy be formulated to explore and outline the various possibilities of utilising ICT for agricultural extension in order to provide extension delivery in a cost effective manner, by optimally blending manpower with ICT equipment. The broad set of suggestions with purpose to promote greater use of ICT in agricultural extension is listed in section 5.6 in Vol XI.

Responsibility: DAC&FW, DAHDF, MEITY
Timeline: Short term
Refer Volume: XI

36

Rural women are mainly engaged in agricultural activities, as cultivators, managers or labourers, depending on the socio-economic status of their family and regional factors. Women lack formal ownership to land or hold insecure tenures, which continues to be a major obstacle to increasing their contributions and benefits. Both farmers and women are unable to register themselves as such, unless they have land records in their name. This situation effectively ignores the reality of women farmers, disallowing adequate extension support to the women.

The recognition of a farmer has to be de-linked from land ownership and alternate "Know Your Farmer" (KYF) norms are suggested to recognise, as also grant the status of a farmer to

the farming women, even when they do not own land, and are therefore, not barred from consequent entitlements. The extension system needs to adopt such norms and help farming women. Besides knowledge dissemination, extension services play an important role in social reform and in empowering the disenfranchised.

Responsibility: DAC&FW, DAHDF, DARE
Timeline: Short term
Refer Volume: XI

37

Farm women may be recorded as cultivator in revenue records making them eligible for all privileges received by farmers. This will bring in gender parity, and also ensure that the farm family continues to have access to various government services, even when the male-farmer is absent. The extension system should facilitate such enrolment of women farmer into a proposed farmer database (see Vol XIII).

Policy measures may also be initiated to empower women with joint *pattas* (ownership) for both homestead and agricultural land, speedy issue of Kisan Credit Cards, and such other gender friendly measures. In addition, development of women owned individual land holdings be undertaken in convergence with MGNREGA, watershed development and natural resources management programmes, with special focus on tribal areas where women-farmers have acquired land ownership under the Forest Rights Act, to give more impetus to gender equity.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XI, XIII

38

It is estimated that 33 per cent of the agricultural labour force and about 48 per cent of self-employed farmers comprise women. As per NSSO reports, about 18 per cent of farm families in India are headed by women. An egalitarian approach to gender based concerns is required. Some of these matters are being addressed by earmarking 30 per cent of funds for women under various major schemes/programmes and development interventions, introducing 'pro-women initiatives' and focussing on formation of women Self Help Groups (SHGs), Women Federations and Farm Women Producer Organisations/Companies, among some others. However, the Gender Budget Statement (Statement 20) of the Ministry of Agriculture & Farmers' Welfare (MoAFW) for the financial year 2017-18, indicates that out of the total budget size of Rs.51,026 crore, the Gender Budget allocation for various schemes together works out to just Rs.4,388 crore, or little more than 8.6 per cent of the total budget. This does not reflect the proportionate size of farming women.

There is also a need for special schemes that are meant to exclusively address the challenges of women farmers in difficult conditions (e.g., rainfed agriculture) across the country. Other recommendations for empowering women in farming are listed in Chapter 6 of Vol XI.

Responsibility: DAC&FW supported by NITI Aayog
Timeline: Short term
Refer Volume: XI

39

The seven sources of income growth (Chapter 6, Volume II) need to be integrated in the job chart of extension functionaries, delivery mechanism of extension system and extension policy frame work. Extension system may also promote new generation farmer collectives such as,

Commodity Interest Groups (CIGs), Village Produce Organisations (VPOs) and Farmer Producer Organisations (FPOs) including Farmer Producer Companies (FPCs).

Accordingly, these aspects may be reflected as integral to ICT based monitoring system. A unified dashboard on the desired outcomes, is recommended.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XI

40

Every village can be facilitated by an agri-clinic & agri-business centre (AC&ABC), which will offer doorstep service to the farmers, and the spin-off effect is generation of 45 lakh number of jobs in the rural areas. These AC&ABC can also be converged at the proposed primary rural or Gramin Agri-markets (GrAMs), which will function as markets and service platforms at the village level.

Responsibility: DAC&FW
Timeline: Long term
Refer Volume: XI

41

Mass media is an important channel to diffuse information to a larger number of farmers. Besides information and knowledge shared by extension professionals, there is scope to include farm journalism as an integral part of the agricultural extension system. There is a growing market for agricultural journalists and broadcasters having formal education in agricultural journalism and agricultural communication skills**.**

Very few universities/institutes offer courses on agricultural journalism in India. It is recommended that Extension Education Institutes offer agricultural journalism courses at PG degree and diploma levels.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XI

42

There is need for developing Operational Guidelines for implementing individual social responsibility (ISRs) initiatives in public and private institutions. The Guidelines may highlight policy support and incentivise them by offering leave provision, transport allowance and nominal expenses required for implementing individually committed ISR activities. Initially, ISR activities may be made voluntary, and later based on learnings from the initial pilots, some can be made mandatory or conditional for taking up other activities. Thus, even with adoption of individual farmer-family or a village, large number of professionals will be mentoring the farmers to become more professional and entrepreneurial.

Specific ISR activities can be identified for students and such service may be given preferred weightage in case of candidates applying for higher studies, other entrance exams and government services. Such students can become an agent of change by helping their adopted farmers to accept new technology & farm management practices. Even students who join the Agricultural University may be encouraged to adopt a few farm families, during the first year and guide them through their academic progress at the college.

Responsibility: DAC&FW, DAHDF, DARE-ICAR

Timeline: Short term
Refer Volume: XI

43

The delivery competence of extension organisations and extension personnel be supplemented with ICT tools, with a view to achieving efficiency and effectiveness of delivery, besides cost rationalisation. All sub-sectors of agriculture must be covered. Large scale e-Literacy Campaign may be organised to educate farmers and extension functionaries in usage of ICT tools in extension.

Responsibility: DAC&FW, DAHDF, DARE-ICAR
Timeline: Short term
Refer Volume: XI

44

The Rural Area Work Experience (RAWE) programme (now an integral part of curriculum of SAUs) may be made more meaningful by training the students, in interventions which yield enhanced income from farming.

Responsibility: DARE-ICAR
Timeline: Short term
Refer Volume: XI

45

Farmers who have hands-on experience in agriculture and allied areas but are without any formal education in agriculture & allied sciences should also be provided training under the AC&ABC scheme, and encouraged to start agri-ventures and join the process of information dissemination.

Responsibility: DAC&FW
Timeline: Short term
Refer Volume: XI

46

Post-graduate research in agricultural sciences can be rationalised to be solution centric of the existing field level problems received from different stakeholders.

Responsibility: DARE
Timeline: Short term
Refer Volume: XI

For full context and other details, the linked domain specific Volumes of the DFI Report may be referred to.

Chapter 10
Research & Development

India's vast production base in a variety or agricultural commodities, clearly depicts the impact of agriculture research system in imparting food security to the nation and benefitting the farmer with better output. The national agricultural research and development system aided by several organisations and institutes takes up many activities to develop and demonstrate new technologies for strengthening agricultural farming including dairy, livestock and fisheries in the country. The science and technology-led development in agricultural farming, resulted in the ability of Indian agriculture to match the pace of growth in demand over the years. Today, the agricultural and allied sectors are facing new challenges like the reducing availability of quality water, nutrient deficiency in soils, climate change, farm energy availability, loss of bio-diversity, emergence of new pests and diseases, rural-urban migration, besides globalisation of agri-food markets and trade regulations and these need to be addressed during the years to come.

In this context, the agenda of research and development needs to widen its scope from production enhancing technologies to those that mitigate sustainability concerns and promote farmers income. The seriousness of the problems, will require the system to marshal efforts, including through active private sector partnership, to converge on certain priority issues, to focus on 'Demand-Driven Innovation', to design, develop and deliver relevant income centric solutions. The core to this approach is compressing the time to deliver technology and knowledge at scale and to ensure the desired outcomes are achieved.

1

The research system has normally followed a production-centric approach, aligned with food security agenda. However, it henceforth needs to adopt a farm income-centric approach in its activities. This income-centric approach must be matched with proactive knowledge transfer mechanisms that promote rapid cycle innovation, and effectively translate the 'Science of Discovery into Science of Delivery'.

	Responsibility: DARE-ICAR, DAC&FW, DAHDF
	Timeline: Short term
	Refer Volume: XII

2

In directing a transition from 'production for food security' to 'production for income', the R&D should address multiple issues in a package, from food, nutrition, resource use efficiency, income growth and sustainability. The outcome of R&D should therefore be facilitative of 'production for food security, nutrition sufficiency, resource-use efficiency and income optimisation'.

	Responsibility: DARE-ICAR, DAC&FW, DAHDF
	Timeline: Short term
	Refer Volume: XII

3

It is necessary to build on the success of Green Revolution and adopt a more comprehensive and wholesome transformation of agriculture. The next phase in India's agriculture could be more appropriately called the 'Income Revolution', and this too should ride on the back of

science and technology (S&T). In keeping perspective of doubling farmers' income, there is a need to prioritise efforts in S&T and may be categorised to cover subjects such as:

i. Strengthening knowledge dissemination and improving extension services. These will include aspects of crop planning & diversification, secondary agricultural activities, harmonised information repository, credit and investment, etc.

ii. Risk mitigation, including those that arise from markets, besides traditional risks such as animal and crop health, weather, pests, etc., and insurance related strategies.

iii. Post-production interventions in agri-logistics and agri-marketing. These include traceability, value assaying technologies, transparency in price discovery and exchange process, packaging and transportation systems, minimising produce losses, technologies that convert residue waste into usable commodities, value-addition where form of produce is changed, and similar.

iv. Resource use optimisation at every level in the agricultural eco-system. This may include convergence in initiatives taken for soil health, water health, quality of planting material, livestock feed and other farm inputs.

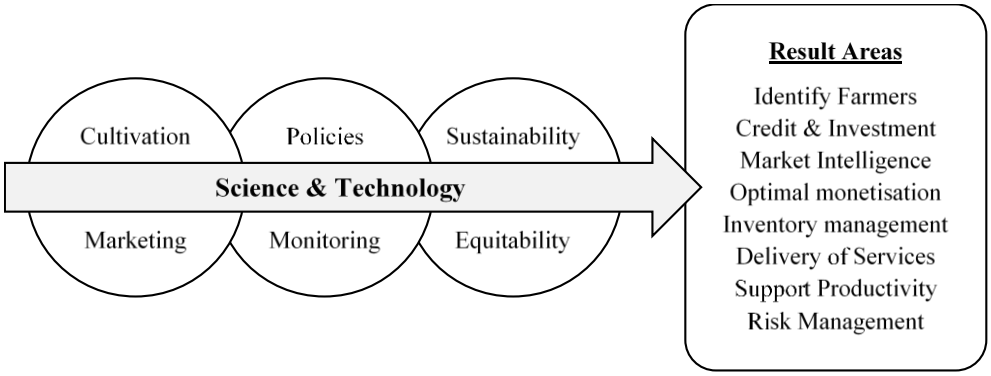
v. Energy use efficiency in agricultural activities, including in the use of fuel and electricity, automation to reduce indiscriminate use of energy, systems that enhance output from employed labour, etc.

vi. New developments in technologies and associated knowledge in relation to varieties, breeds, climate resilience, etc.

vii. Agricultural governance systems, to identify and build a database of farmers (landed and otherwise), monitoring yields, transparency in delivery mechanism, facilitating the unified national agricultural market, dashboard systems, etc.

Science and technology essentially has had an underlying role across the complete agricultural eco-system, and directly impacts various result areas. A reprioritisation to meet the current day context is required.

Responsibility: DAC&FW, DAHDF supported by ICAR, SAUs
Timeline: Short term
Refer Volume: XII



4

Considering the high degree of Infant Mortality Rate (IMR), Maternal Mortality Rate (MMR), stunted growth and wastage among children, marasmus and kwashiorkor, anaemia in women

of reproductive age, etc., it is important that R&D should focus and deliver on achieving nutrition density and nutrition delivery.

While R&D can work to increase the nutritive content of the existing varieties and releasing fortified varieties, it can also design agro-climatic based cropping patterns to multiple objectives. For example, rice substitution by nutrient-rich and water-efficient cereals would result in considerable increase in the production of iron (27 per cent), zinc (13 per cent) and marginal increase of 1 per cent of protein. By adopting pulses as substituents, the protein output can be increased considerably.

Responsibility: DARE-ICAR supported by DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XII

5

The long research-into-use pathway needs to be compressed and a more impactful method to be planned and implemented. This can include leveraging participatory research, coupled with ICT to provide real-time feedback on farmer and consumer acceptance of new products and services, so that they can be adapted and then adopted quickly by farmers.

The first mile (discovery) needs to have the last mile (delivery) in mind. In this regard, the National Agricultural Research System (NARS) should be committed to restructuring and re-organics its protocols so as to drastically reduce the time for discovery science to reach farmers' fields.

Responsibility: DARE-ICAR supported by DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XII

6

The expenditure in Agri-R&D have been averaging around 0.3-0.4 per cent of the Agri-GDP. It is recommended that the expenditure on agricultural research should be raised upto at least 1 per cent of Agri-GDP with pragmatic and outcome oriented allocations that focus on the identified growth engines. Importantly, the higher investments in research should be supplemented with extension services and institutional reforms to enable wider dissemination of research outcomes to the farmers. Successful outcomes can be awarded to promote the Science of Delivery.

Responsibility: DARE-ICAR supported by MoF
Timeline: Short term
Refer Volume: XII

7

The R&D system must also actively address the need for science based interventions to develop products and practices that will support an aggressive export strategy. Export market-led research and development, on varieties/commodities in demand, for compliance with packaging, traceability and food safety, require urgent attention.

The R&D system should develop and action plan for primary ten export markets with the objective to capture trade and expand on existing market presence in those export markets.

Responsibility: DARE-ICAR supported by DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XII

8

Agricultural research system must not be circumscribed by crops and commodities it has previously focused on. It should be pluralistic in its attention and resource allocations, to have an appropriate spread across all geographies, agro-climatic conditions and secular across various sub-sectors - agriculture, horticulture, dairy & livestock, fishery and aquaculture; as also across the cafeteria of crops, animals and birds within each of these domains.

Responsibility: DARE-ICAR supported by DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XII

9

Agricultural scientific community supports increase in productivity across various production systems. These efforts should be based on low input use and resource use efficiency to impart economic efficiency and sustainability. R&D, as also policy, approach should become more wholesome in dealing with resource use efficiency. This requires building capacity and interest in helping famers move towards a more sustainable crop production system, which depends less on external and costly inputs.

Responsibility: DARE-ICAR supported by DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XII

10

Now that India is largely food secure, the erstwhile emphasis on production should shift focus to nutritional security. Hence, the measure of yield to be delivered by agricultural R&D should be nutritional yield per ha or per animal or bird or water body. The annual production measures should include and rate the nutritional output and not just quantum of output.

This may further be reflected into per capita nutrition delivered and not per capita availability.

Responsibility: DARE-ICAR, DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XII

11

One of the weaknesses has been the neglect of social sciences in agricultural education & research and post-harvest management. Both aspects are vital to the farmers' income-centric approach and necessary to advance agriculture from mere cultivation mindsets focused on outputs, into enterprise mode with focus on outcomes (income and social change).

NARS should take urgent steps to reorient and adopt a systems approach so as to include post-harvest management and monetisation, and support farming as an enterprise and farmers as entrepreneurs.

Responsibility: DARE-ICAR
Timeline: Short term
Refer Volume: XII

12

The majority of the research-led interventions have been seen to largely recommend new fertilisers, varieties or agronomic practices, but without considering the status of resource availability, farmers' specific interests and capacities. Therefore, scientists and research practitioners should undertake situation & need assessment and adopt policy of market-led

'advice on demand'. The scientific inputs should be combined with demonstration of new technologies for showcasing the suitability, sustainability and profitability.

Some of the research gaps, including in SRR, VRR, rainfed ecosystems, hill and costal agriculture, etc. are listed in chapter 3 (3.3) of Volume XII.

	Responsibility: DARE-ICAR supported by DAC&FW, DAHDF
	Timeline: Short term
	Refer Volume: XII

13

Efficacy of all other agricultural inputs, such as fertilizers, pesticides and irrigation, etc., as well as impact of agro-climatic conditions on the crop, is largely determined by the quality of the seed used. So, there is need to further strengthen the seed sector in partnership with private players for sufficient, high quality and timely supply of seeds of demand led varieties at reasonable price.

Innovative models on seed systems that leverage participatory variety selection with farmer producer organisations (FPOs) and state seed corporations (SSCs) may be developed.

	Responsibility: DARE-ICAR, DAC&FW
	Timeline: Short term
	Refer Volume: XII

14

There is a wide gap between initial discovery or proof of concept and final impact of technologies. In many cases the technology is no longer relevant on field as newer ones emerge. There is need adopt concept 'Research for Development', which should incorporate close partnering with the extension system and maintain a time-bound program. The service of extension system should be developed and used to ensure larger reach to as many farmers.

	Responsibility: DARE-ICAR, DAC&FW, DAHDF
	Timeline: Short term
	Refer Volume: XII

15

Lab-to-land development is key to bringing research into economically gainful use. Developmental gaps exist due to various reasons, including lack of soft skills, sufficient ICT enablers, insufficient demonstration and conflicting scientific information, to effect the appropriate knowledge transfer. These and other developmental gaps are listed in chapter 3 (3.4) of Volume XII, need to be addressed so that there is wider adoption and impact from research efforts.

	Responsibility: DARE-ICAR, DAC&FW, DAHDF
	Timeline: Short term
	Refer Volume: XII

16

Future of research and development in agriculture will include focus on natural resources management, crops, seeds, horticultural requirements, research in livestock and fishery systems, and building global competitiveness and genetic engineering. A systems based approach to science & technology may be adopted, in contrast to one that was crop & commodity-centric

Chapter 4 and 5 of Volume XII enumerates recommended Short & Long terms research and development in the future. These aspects may be developed further and implemented.

Responsibility: DARE-ICAR supported by DAC&FW, DAHDF
Timeline: Short & Long terms
Refer Volume: XII

17

There remains a dichotomy in India's agricultural development as the production-centric green revolution technology by-passed certain regions in the country. The farmers therein, still require core research and technology innovations, to scale up their production. Therefore, the NARS should strategically address the differentiated needs by categorising regions on the basis of their current status in agricultural development.

Responsibility: DARE-ICAR supported by DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XII

18

Climate change impact has added to existing uncertainties in agriculture, putting farmers' income at greater risk. Integration of traditional agriculture with other agricultural activities (agriculture, horticulture, livestock production and dairy farming systems) make for a more resilient and sustainable system. Such integrated farming activities at farm level are normally subsistence scale having a limited impact. When undertaken at a large scale, encompassing entire village communities, this will have a long lasting and larger scale impact.

R&D should focus efforts on technologies to build large degree integrated farming systems, so as to support entire village communities in developing and establishing multiple and co-related activities, as Village Produce Organisations (VPOs), building sustainability and resilience at village scale.

Responsibility: DARE-ICAR, DAC&FW, DAHDF
Timeline: Long term
Refer Volume: XII

19

In view of climate change and other ecologically diverse changes that have occurred, there is a need to revisit and map anew the climatic zones and agro-ecological regions in the country. This will help provide fresh direction in respect of all other sustainable strategies and practices.

Responsibility: DARE-ICAR
Timeline: Short & Long terms
Refer Volume: V, VI

20

Comprehensive information on farmers' income is not readily available nor monitored by researchers. There is need to capture and monitor farmers' income, savings and investments over time, to facilitate periodic monitoring, for evidence-based appropriate policy formulation and interim corrections in implementation, if any is indicated. A research and analytics cell may be set-up for this purpose.

Building of a centralised farmers database, qualified and cross-tabbed with minimum information including name, age, gender, education, family, land size (owned or leased), other assets (livestock, etc.), non-farm sources of income, total income, welfare coverage, etc. is

recommended. This database will be appropriate to provide specific and relevant support, including extension services, to a specified target audience, bringing greater efficiency in governance and support systems.

Responsibility: DARE-ICAR supported by DAC&FW, DAHDF
Timeline: Short term
Refer Volume: I, XII, XIII

21

Increased capital intensity has been recommended, focused in rainfed areas and less endowed states, in irrigation and infrastructure. There is need for concomitant emphasis by agricultural research and extension in these areas. This is recommended so as to fast track the desired results through increase in crop production, productivity and allied activities, including post-harvest management technologies.

Responsibility: DARE-ICAR
Timeline: Short term
Refer Volume: II, XII, XIII

22

Due regard is given to food safety apprehensions expressed in reference to GM (Genetically Modified) based food crops. However, the mandate of Agriculture as redefined in Vol XIII, warrants that this primary sector looks beyond food production and also find growth in serving the raw material requirements of the industrial sector. In this context, it is suggested that transgenic technology be used more vigorously in case of non-food crops. GM technologies can be developed and used on priority for crop improvement in non-food production.

Responsibility: DARE-ICAR
Timeline: Short term
Refer Volume: XII, XIII

23

R&D into medicinal and other biomaterial applications of various by-products, such as from sericulture, agro-forestry, crops traditional to India needs to be promoted. Private corporate sector participation in such R&D can be incentivised and DARE-ICAR may adopt suitable policy for this purpose.

Responsibility: DARE-ICAR
Timeline: Short term
Refer Volume: XII

24

It is recognised that market information and intelligence are crucial to enable informed decisions on the choice of crops and their monetisation. There is need to regularly research and disseminate information such as demand, production and prices which will also aid in harmonising the functioning of markets, and in unifying them into a national agricultural marketing system.

This requires appropriate attention in developing and piloting a comprehensive system and should be initiated at the domestic level and further expanded to research on export markets.

Responsibility: DARE-ICAR
Timeline: Short term
Refer Volume: IV, XII

25

Vast amount of disaggregated data is generated from agricultural system. There are several touch points along the agri-value system and each stage in this supply chain holds critical information. Big Data has the potential to add value across each of the touch points starting from selection of right agri-inputs, to monitoring the soil moisture, to tracking prices of markets, to controlling irrigations, tracing the movement to markets, losses incurred, finding the right selling point and till getting monetised.

Data collection and big data analytics should be brought into use for drawing relevant inferences and policies. For example, this can initially be done in the PMFBY, to juxtapose existing data of sown area in a region with crop insurance statistics, to analyse reasons for over or under insurance. Similarly, patterns are available in data relating to milk production and supply, in case of fisheries, etc.

Responsibility: DARE-ICAR supported by DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XII

26

There is the need to operationalise and strengthen various 'Digital Informatics Network for Farmers (DNF)' like AGMARKNET, AGRISNET, FISHNET, APHNET, NADRS, PPIN, VISTARNET, AgRIS, FERTNET, CoopNet, etc.

Furthermore, it will be beneficial to undertake seamless integration of e-NAM with AGMARKNET portal to reduce the market information asymmetry. This should also be integrated with a logistics portal that will attract services to meet the physical transport and storage needs generated at the electronic market platforms.

Responsibility: DARE-ICAR, DAC&FW, DAHDF
Timeline: Short term
Refer Volume: III, IV, XII

27

Develop and establish a Digitalised Agricultural Risk Intelligence Framework for assessing risk, and risk profiling at farm level, regional level, with an ICT enabled process to realise Agricultural Crop Insurance entitlements to farmers.

Responsibility: DARE-ICAR, DAC&FW
Timeline: Short term
Refer Volume: XII

28

It is recommended to formulate and finalise an Agricultural Drone Policy for collecting high resolution imageries for agricultural risk management and mitigation, of UAVs by public and private sector providers to support precision agriculture in India, by incorporating appropriate clause in the Draft National Geo-Spatial Policy (May) 2016; and also to facilitate Start-Ups to build high resolution imageries based advisory services.

The information generated may also be converged with satellite based assessments so as to mutually strengthen both methodologies.

Responsibility: MCA, MHA, supported by DAC&FW
Timeline: Short term
Refer Volume: XII

29

The national mandate on Doubling Farmers' Income (DFI) is an opportunity to drive convergence across Ministries (State and Union), schemes, local farmers, supply chain actors, value adding processes, and to accelerate the adoption of sustainable (economically, socially, and environmental) options to empower farmers and produce nutrition to a growing nation. In this context, the agenda of research and development needs to be changed to crowd in greater efforts on integrating research and development through active public-private partnerships that are demand-driven.

Introduce Private-Public-Partnership (PPP) initiatives to operationalise "technologies for agriculture" which are being developed in a fragmented manner, and are at various stages of development. Priority may be given to those start-ups that can demonstrate the appropriate use of ICT and other technologies to bring about resource use efficiency, capital use efficiency, marketing efficiency and greater agri-logistics effectiveness.

Responsibility: DARE-ICAR, DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XII

30

Research on gender issues in agriculture and allied sectors including technology refinement, designed keeping specific issues of women in mind has to be a continuous and an ongoing activity. The Directorate of Research for Women in Agriculture (DRWA), has been mandated to push research agenda by way of participatory action research in different technology based thematic areas involving rural women. It also works to catalyse and facilitate R&D institutions to bring in farm women's perspective in their programmes. Besides, a few All India Coordinated Projects on Home Science are also in operation with a view to developing a strong base for research and extension in State Agricultural Universities.

ICAR decided to rename the colleges of Home Science/Rural Home Science, set up under the SAUs as 'College of Community Development'. It is felt this will dilute the sharpness of attention that the farm women need. It is, therefore, suggested that ICAR may reconsider restoration of the name and may preferably call it as 'College of Farm Home Science', keeping focus on requirements specific to farming women.

Responsibility: DARE-ICAR
Timeline: Short term
Refer Volume: XI

31

Create mobile and web applications, for farmers to view location specific inventory of logistics capacity, availability and access, i.e. as warehousing, silos, cold stores, vehicles and rail, to plan their logistics requirements. This may be integrated with the e-NAM platform to ensure that the trade generated on e-NAM can be supported with required logistics services.

Responsibility: DAC&FW supported by, DAHDF
Timeline: Short term
Refer Volume: III, IV, XII

32

Generate site specific land resources inventory (LRI) and suitability using GIS and remote-sensing techniques for enabling the developmental departments in scientific land use planning

(planning, implementing, monitoring, reviewing and evaluating all the land based agricultural developmental projects) at the level of a watershed or a river basin.

A sound database is needed for land and water resources for integrated farm land and water management system. Similarly, geotagged database for agro-forestry should be done for a transparent and non-controversial operational system.

	Responsibility: DAC&FW supported by ICAR
	Timeline: Short term
	Refer Volume: VI, XII

33

Agriculture as a subject has remained restricted in its spread, and this situation does not contribute to related development of innovations in other domains.

It is recommended to conduct regular and frequent innovation competitions in non-agriculture universities across the country, to invite convergence of hardware and software technologies for use in agricultural eco-system. These can include application systems that use a combination of sensors, artificial intelligence, automation, drones, robotics, alternative technologies, etc. This will not only drive interest and new innovation in agriculture but also promote entrepreneurs.

	Responsibility: DARE-ICAR supported by DAC&FW, DAHDF
	Timeline: Short term
	Refer Volume: XII

34

The Indian Council of Agricultural Research (ICAR) 2025 Vision Document outlines various technology drivers and suggests the need to integrate research agenda o ICAR and National Agriculture Research & Education System (NARES). Cutting across the desired integration will require greater deployment of available information technology systems and the associated standardisation of information. This should be fast tracked.

	Responsibility: DARE-ICAR
	Timeline: Short term
	Refer Volume: XII

35

In adopting the target to double farmers' income by 2022, the Government of India as effectively fast tracked on the SDG (Sustainable Development Goal) to double agricultural productivity and incomes of small scale food producers, etc. This SDG originally had targeted the year 2030, but the DFI agenda has advanced this target by 8 years. Accordingly, all other action plans in relation to this SDG need to be fast tracked in tandem.

	Responsibility: DAC&FW, DAHDF, DARE-ICAR supported by other ministries/departments.
	Timeline: Short term
	Refer Volume: XII

36

Digital technologies will play an important role in how quickly and relevantly future science and agricultural technologies will influence the agricultural sector. A part of digital technology, ICT deployment also plays a vital role in making the right & relevant information available to farmers in real time. The ability to filter a multitude of information into the 'right

and relevant' will require extensive deploying of technologies such as artificial intelligence (AI). This will feed on big data from agriculture and rely on the internet of things (IOT) and a web of things (WOT) to connect between people-people, people-devices and devices-devices. Robots and intelligent sensors are already making a foray into the agricultural landscape. A sampling of technologies and the possible areas of use is listed in Chapter 7 and 8 of Volume XII.

A preliminary road map for modernising agriculture through digital technologies is provided in Chapter 10 of Volume XII. This may be referred for developing extensive models and uses of applications and systems for strengthening agricultural sector and making it future ready.

A national policy on digital technologies in agriculture may be developed by using NeGP-A as the basis. It may be kept it sufficiently dynamic to adjust with the fast paced development and upcoming requirements in these areas and in the agricultural sector.

Responsibility: DARE-ICAR, DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XII

37

The technology outcomes and their advocacy must infuse sustainability of resource use and throughput. The emphasis should be on small farms and small and marginal farmers, apart from validating the technology for larger farms.

Responsibility: ICAR supported by DAC&FW, DAHDF
Timeline: Short term
Refer Volume: XII

Other areas requiring research and development support are also enumerated in list of recommendations for resource use efficiency and productivity enhancement. For full context and other details, the linked domain specific Volumes of the DFI Report may be referred to.

Chapter 11
Top Line Recommendations

The enormity of changes that must be brought about, to transform the agricultural sector and emulate an enterprise based approach will naturally appear overwhelming. Daunting as the tasks are, the policy recommendations have been segregated into stages, for easier appreciation. At the first, stage-1 strategy recommendations are at the end of each chapter or/and volume. These obviously are more elaborate in relation to the subject matter and contain some operational details too. Penultimately, at stage-2, major policy recommendations based on the first 13 volumes have been presented in chapters 2 to 10 of this Volume XIV.

Finally, it is at stage-3, that some select top line recommendations are made hereunder.

It may be noted, that these recommendations do not follow any particular sequence, nor are they comprehensive at both individual or collective levels. The Committee identifies a few, that are felt to be vital and if implemented judiciously will bring about essential and positive results to the benefit of farmers.

1. It is time to recognize agriculture in India as an enterprise, that should be based on the principles of profit. Despite India ranking second in agricultural production globally, overtaking countries such as USA, Russia and Brazil, the farmers are yet to realise sustainable profits as seen from low average monthly income of the families. However, practising agriculture as an enterprise will call for optimal scales of operations at all the stages of the agricultural value system, which currently is challenged by structural weaknesses as manifest in atomisation of India's large arable geography into small and marginal farms. The answer to this lies in adopting all legal and organisational principles to enable pooling of land, mobilisation of farmers and aggregation of farmers' produce. In this context, the key recommendations are:

(i) Pursue adoption of NITI Aayog's Model Land Leasing Act by all the states and UTs in a time bound manner. A high percentage of cultivable land that now is rendered futile on account of both current and permanent fallows will come into much needed use for operational efficiency at both input and output management stages. Hence, promote -

- Farmers' groups – VPOs & FPOs (societies, cooperatives & companies); CIGs (Commodity Interest Groups); Farmers' Federations, and the like.
- Contract farming and services. In this regard:
  - ensure that the right, title and interest (RTI) of the landowner in his property is not compromised in any way
  - pursue with the states to adopt Model Contract Farming and Services Act, 2018.
  - draft and release Model Contract Farming and Services Rules.

(ii) Enable farm owners to transit from the status of cultivators to farm managers by outsourcing all possible farm operations, so as to achieve both resource use efficiency and effective outcome, besides realising reduced cost of cultivation. This entails encouraging a system of professional service providers (including the Original Equipment Manufacturers – OEMs) who will take over responsibility for one or more of cultivation services such as pest management, irrigation management and harvest management etc. The service area can be a few hundred or thousand acres outsourced by farmers against payment or entering into service contract under the provisions of an Act. Preferably the farmers should transact with the service providers as a Group – VPO, FPO and the like.

Such an engagement will also bring in precision farming or smart agriculture even in small & marginal farms, where investment capacity of these farmers is low. The scope for deployment of new technologies like GPS, Drones, GNCC (Global Navigation Satellite System) etc. both resource use and output come to be more controlled and accurate.

2. Redefine the mandate of agriculture so as to expand its horizon beyond the currently predominant deliverables – food and nutrition security. Agriculture should also be mandated to generate resources as raw materials to feed and support industrial enterprises – chemicals, construction, energy, fibre, food, medicinal, etc.

Such incorporation will provide greater elasticity to the markets now circumscribed by consumption as food and fodder.

3. Adopt a production strategy characterised by:

- From 'at any cost' to 'minimal cost'
- From 'any how approach' to 'sustainable approach'
- From 'supply-push' to 'demand-pull' production system

4. The production system may be re-prioritised by adopting a market-led crop geometry and product matrix guided by nutrition yielding, job creating and income generating crop and sector diversification. The following shift in focus/emphasis is suggested:

(i) from major cereals (paddy & wheat) to nutri-cereals

(ii) from only foodgrains (cereals + pulses) to fruits, vegetables and flowers

(iii) from carbohydrates only to proteins (pulses)

(iv) from only floral/vegetative proteins to floral + faunal/animal based proteins (eggs, milk, meat and fish)

(v) from field crops only to horticulture + dairy + livestock + fisheries, etc.

(vi) from only farm activities to farm + on-and-off farm activities (primary + secondary agriculture).

(vii) promotion of Secondary Agriculture (as defined by the Committee), is critical to impart vertical elasticity to the land, which is otherwise horizontally inelastic.

5. Amongst the inputs, water may be treated as the 'determining factor' of production. Hence, highest priority may be assigned to water management:

- Creation of additional sources of water – an addition of 8 to 9 million hectares under irrigation (AIBP, MGNREGA etc.) by 2022-23
- Efficient use of water – 2 to 2.5 million hectares under micro-irrigation per year
- Saving on ground water and its sustainability through recharge
- Crop alignment based on 'path of least resistance'. It implies in promoting agro-climate based cropping/production system, the best option need not be the one chosen. It can be an option that is more acceptable to the farmers.

6. Focus on productivity gains to enhance the needed gross output at the farmers' end by adopting the following approach:

- Bridge the yawning gaps that exist vis-a-vis the techno-economic potential of different crops.
  - One single intervention with total focus and diligent monitoring should be SEED
  - Ensure SRR (seed replacement rate) and VRR (varietal replacement rate) as per recommended package of practice.
- Aim to maximise yield/acre per annum and not per season. Adopt a cropping pattern, which facilitates a higher cropping intensity to result in maximum possible cumulative tonnage/acre/year.
- In the strategy for drought proofing of NICRA identified 151 districts, water-budget based crop alignment should be the core intervention.

7. Recognize land and farm manpower as the two most potent assets of the farm family and enable full utilization of these both through enhancing cropping intensity and promoting secondary agriculture.

- By increasing availability of irrigation & water use efficiency and promoting new technology aim to increase the cropping intensity that now stands at 149 per cent substantively.
- Secondary agriculture that promotes value addition activities by using the farm generated natural resources other than the principle yield should be taken up as one of

the mandates of Agriculture, so as to create gainful jobs for the idle manpower during off-seasons. Hence, define Agriculture, which is a primary sector activity of the economy, as one that includes primary and secondary agriculture.

8. As a basis to income led growth of agriculture and farmers' welfare, all policies and strategies must adopt 'Fork to Farm' approach, reversing the 'Farm to Fork' approach now accepted generally. Towards this:

- Adopt monetisation of produce as the basis for maximising the value capture for the farmers.
- Maximise monetisation possibilities by upgrading and harmonising the agri-logistics (storage & transportation), agro-processing and marketing.
- Adopt new market architecture comprising GrAMs, alternate Wholesale markets (APMCs - in private & public sectors) and Export market.
- The target in respect of market architecture by 2022 should be – at least 5000 GrAMs to be established; all states and UTs to adopt Model APLM Act, 2017 and Model APLM Rules; a minimum of 1500 APMCs/other wholesale markets on boarded onto online platforms including eNAM; agri-export of US$ 100 billion.
- Promote Agricultural Value System (AVS) as a link between farms and markets.

8.1. Marketing strategy should mean optimal monetisation by shifting:

- from 'sale forthwith' to 'sale at will'
- from 'intermediation' to 'dis-intermediation' in sale-purchase transaction
- from localised transactions to expand into cross geographical sales
- from sale of raw-harvests to primary processed or preconditioned harvests

9. However efficient the marketing system may be, the farmers will not be able to capture the optimal value from their produce unless they are facilitated to avoid/overcome distress sale. Hence, as a part of post-production strategy, the highest attention should be given to warehousing (both cold and dry), negotiable warehouse receipts and NWR linked post-harvest loans at interest subvention.

While marketing efficiency is a necessary condition, enabling the farmer to withhold his stock till he finds a remunerative price would alone be the sufficient condition and realising higher value returns on the farm output.

10. Recognize that agriculture is globally one of the riskiest of professions and is vulnerable to risks and uncertainties at all three of its major stages, namely, pre-production, production

and post-production. Hence, risk management strategies at all the stages of agriculture will require to be adopted, in the following way:

Pre-and Post-production stages:

- Replicate Meteorological Advisory Services across the country; on the lines of the technology platform adopted in Karnataka. The impact study of this initiative in Karnataka has shown that income losses linked to natural calamities reduce, if the farmers are offered advisories based on weather forecast.
- Coverage of farming under Pradhan Mantri Fasal Bima Yojana (PMFBY) should become a norm.
- Livestock insurance scheme needs to be restructured to cover both death and permanent damages; and made more farmer-friendly on the lines of PMFBY.

Market risks

- Adopt an institutional mechanism for price & demand forecasting
- Adopt an import-export duty structure, that helps domestic market sentiments to the advantage of farmer-producers.

11. Extension system in the country be revitalized and reinvigorated by optimally blending manpower and ICT. Further, the extension responsibility may transition from only government led delivery to partnership based delivery. The partners should include government agencies, NGOs, private agencies and farmers themselves. The states need to be financially supported to fill all vacancies under ATMA, conditional upon them filling up all vacant openings in the Extension Directorates.

Further, transfer at least 25 per cent of the Extension staff from the Directorate of Agriculture to undertake Marketing Extension, and are duly trained thereafter. They can be made responsible in integrating the farmers with GrAMs in particular.

12. Appreciate fully the positive correlation between capital investments (both 'In' and 'For' Agriculture) and growth rate. While fulfilling the recommended capital investments, attend to:

- Convergence of resources from various Ministries vis-a-vis the support infrastructure needed for agriculture
    - Maximise crowding in of funds under MGNREGA and PMGSY, without diluting their primary objectives
- Adopt policies that will crowd in private sector investments in agriculture.

13. The speed & quality of implementation deserve total attention, as it is the first and biggest casualty in the system. In this context:

- Adopt various structural reforms and governance framework discussed in Volume XIII of the Report.
- Set up an 'Empowered Committee' in the Ministry of Agriculture and Farmers' Welfare to operationalise the DFI strategy.
- Adopt the recommended 'Institutional Mechanism' for effective coordination & convergence of resources – manpower, material, money, time & efforts (Refer Chapter 10, Volume XIII).
- An ICT based 'Monitoring Dashboard' be adopted at district, state and national levels for a seamless review and monitoring of the progress of policies and field operations.

14. The Ministry of Agriculture has been predominantly production-centric. Contemporary and emerging challenges call for a correction. Hence, the Divisions within the two Departments of Agriculture, Cooperation and Farmers' Welfare (DAC&FW); and Animal Husbandry, Dairying and Fisheries (DAHDF) may be restructured and responsibilities reallocated, with the purpose to effect an enterprise mode and accordingly make the agricultural system market-led in its activities. There is the need to balance the production and post-production activities (agri-logistics, primary and/or secondary processing and marketing), and unravel inherent economic advantages.

As a corollary, ICAR may also reorient its approach, where the output of research and development is led by demand; and adopts a compelling agenda of optimal monetisability of the farmers' produce.

15. The implementation will happen through different States/UTs, ministries and departments, and there is always a probability of losing both focus and direction in this mission to transform the way agriculture is treated.

It is recommended to set up an Empowered Body, headed by a senior officer, of appropriate seniority within the Ministry of Agriculture & Farmers Welfare, to monitor the new set of activities, as they are operationalised. This Empowered Body or Authority, can also be mandated to develop guidelines, based on an implementation framework, and provide the needed support system to the principle stakeholders, namely DAC&FW, DAHDF, DARE, other Departments and Ministries. The suggested role of such an Empowered Body is listed in the final chapter of Volume XIII of this Report.

Chapter 12
Steps Taken towards Doubling Farmers Income

The laudable vision of doubling farmers' income is possible, though challenging given the tight seven year schedule of 2016-17 to 2022-23. The Committee on Doubling Farmers' Income constituted by the Government in April 2016 was given clear advice that it should make its recommendations concurrently as it worked on developing a comprehensive strategy, which obviously was bound to take time. In response to this, the Committee not only made several recommendations but also supported in rolling out several of them.

Over the last two years, some of the important recommendations that have been adopted and rolled out by the government are presented in this final chapter.

1.0 Addressing Investments

1.1. Increase in capital investments

In line with recommendations of the DFI Committee calling for higher growth rates in respect of both public and private investments, the positive trends are visible. Capital channelization into agriculture sector is picking up in following manner:

i. Higher Budgetary allocations. As seen in the table below, there is a consistently increasing budgetary support for the three departments under the Ministry of Agriculture and Farmers' Welfare.

Budgetary Allocation *(Rs. crore)*					
Name of Department	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**Grand Total (Last 4 years)**
DAC&FW	17,004.35	35,983.69	41,855.00	46,700.00	**1,41,543.04**
DARE	6,320.00	6,620.00	6,800.00	7,800.00	**27,540.00**
DAHDF	2,136.16	2431.51	2,921.00	3,580.00	**11,068.67**
Total	**25,460.51**	**45,035.20**	**51,576.00**	**58,080.00**	**1,80,151.71**

The allocation to Ministry of Food Processing Industries (MoFPI) has also been increased to Rs. 1400 crore for the year 2018-19 from Rs. 715.18 crores in 2017-18.

ii. Mobilisation of non-budgetary resources. In order to bring focus on certain priority interventions the government has created the following corpus funds-

- Long Term Irrigation Fund (LTIF) to complete long pending 99 irrigation projects and create an additional land of 7.6 million ha of irrigation by December 2019. The corpus size as already created is Rs. 40,000 crore (2016-17 and 2017-18).

The total investment is expected to be Rs. 80,000 crore (approx.) and corpus fund will expand accordingly.

- Micro Irrigation Fund for promoting water use efficiency as a supplement to budgetary allocations under PMKSY (Per Drop More Crop component) - Rs. 5,000 crore (2017-18).
- Dairy Infrastructure Development Fund, to modernize Dairy Cooperatives - Rs. 10,881 crore (2017-18)
- Fisheries and Aqua Culture Infrastructure Development Fund - Rs. 7,522.48 crore (2018-19)
- Animal Husbandry Infrastructure Development Fund – Rs. 2,450 crore (2018-19)
- Agri-Market Infrastructure Fund - Rs. 2,000 crore (2018-19).

iii. Increase in Institutional credit. There has been a consistent annual increase in the volume of institutional credit made available to the farmers as seen below-

FY	Budgetary allocation (Rs lakh crore)	Actuals (Rs. lakh crore)
2015-16	8.5	9.15
2016-17	9	10.70
2017-18	10	11.69
2018-19	11	2.17 *

*Upto 21.5.2018

As a norm, the total volume of institutional credit is utilised in a ratio of 2 : 1, in favour of seasonal production loans and long term capital investments. With increasing annual volumes in credit, there is obviously an increase at the same ratio in investments in capital formation in the agricultural sector.

Another positive development as regards the seasonal production loans is, the announcement in 2018-19 budget extending the availability of production loan to KCC holders engaged in allied activities like livestock, dairying, fisheries, etc. It was earlier available only for crop production.

iv. Incentivising corporate sector investments. As recommended by DFI Committee the ratio of corporate sector investments need to increase and this has to be achieved by adopting an encouraging policy framework. The following policy reforms already rolled out by the government are expected to trigger corporate sector investments-

a. The Model Agriculture Produce & Livestock Marketing (Promotion & Facilitation) Act 2017, which provides the opportunity for private sector to set up private

markets, alternate marketing channels, online market platforms etc. in both agriculture and livestock marketing.

b. The Model Agriculture Produce & Livestock Contract Farming & Services Act (Promotion & Facilitation) Act, 2018, which enables private sector investments by way of capital, technology and extension all along the value system.

c. Exemption to Farmer Producer Companies under Income Tax Act - the Budget 2018 has offered an IT exemption to all FPCs with a turnover of upto Rs 100 crore per annum, by considering their incomes as agricultural income. This will incentivise corporate sector to partner with farmers as FPCs.

d. 100 per cent FDI in food retail – this will encourage foreign investments in establishing appropriate post-production infrastructure to strengthen the food supply chains.

1.2 Additional capital investments in production and post-production activities

The government's new schemes and strengthening of ongoing schemes is bringing focus on needed backward and forward linkages. Some of these are as follows-

i. Pradhan Mantri Kisan Sampada Yojana – this scheme for agro/marine processing and development of agro-processing clusters was launched under Ministry of Food processing Industries with an allocation of Rs. 6000 crores over the period of 2016-17 to 2019-20. The SAMPADA is expected to leverage investment of Rs. 31,400 crore for handling of 334 lakh metric tons of agro-produce valued at Rs. 1,04,125 crore, benefiting 20 lakh farmers and generate 5,30,500 direct/indirect employment in the country by the year 2019-20.

ii. SAMPADA scheme also complements the ongoing infrastructure support programs of the Ministry of Agriculture & Farmers' Welfare, under Mission for Integrated Development for Horticulture (MIDH, comprising NHM, NHB, HMNEH, CDB, etc) and the Integrated Scheme for Agricultural Marketing (ISAM) which have a combined budgetary allocation of approximately Rs. 3,000 crore per annum.

2.0 Access to Agriculture Credit

The Committee took note of the special needs of the special credit needs of the small and marginal farmers. In recognising that they are generally served by primary agriculture cooperative societies (PACS), their computerisation was recommended. The government has already rolled out computerisation of all the 63,000 PACS in the country through NABARD. This task is targeted to be completed over a period of three years, beginning 2017-18.

3.0 Restructuring of existing schemes

An important recommendation of the DFI Committee has been restructuring of the RKVY, so

as to prioritise the flexible funds available under this scheme for strategic investments relating to infrastructure and enterprise promotion.

Accordingly, RKVY has been restructured as RKVY-RAFTAAR, which lays down that that a major share of allocation shall be apportioned for developing infrastructure namely (50 per cent for infrastructure and assets, 30 per cent for value-addition linked production projects, and rest 20 per cent to be used as flexi-funds). Thereby, both production and post-production related infrastructure get suitable focus. In addition, 10 per cent of the RKVY-RAFTAAR budget has been reserved for promoting enterprise and supplementary incubation facilities in various ICAR centres, KVKs, SAUs, etc.

4.0 Enhancing Production through Productivity

The DFI Committee has suggested focus on productivity based production gains, resource use efficiency and sustainable practices. In this regard it has specifically recommended focus on certain neglected crop domains like pulses, oilseeds and nutri-cereals (millets).

In consonance with these recommendations the government has taken following actions-

i. A five year road map (2016-17 to 2020-21) with a view to achieve domestic sufficiency in pulses. The DAC&FW has further decided to extend the roadmap by another year and stabilise production at sufficiency level by 2022-23.

ii. A roadmap for increasing area and production of nutri-cereals. The roadmap prepared targets an output of 20.88 million tonnes by 2022-23. The government has already notified a change in the name from "coarse cereals" to "nutri-cereals". The government has also notified the year 2018 as the year of nutri-cereals.

    The government has launched a sub-mission on nutri-cereals with an allocation of Rs. 300 crore for 2018-19.

iii. A roadmap for promoting oilseeds in order to bridge the deficit in domestic production of edible oils. The DFI Committee has suggested emphasis on increasing domestic production of oilseeds & oilpalm. In this regard the following action has been initiated-

    a. Roadmap (2018-19 to 2022-23) to increase the production of primary oilseeds from the current 32 million tons to 46 million tons.
    b. Government has targeted to bring an additional area of 1.25 lakh ha under oilpalm production and also achieve higher productivity of fresh fruit bunches.

5.0 Market Reforms

The DFI Committee has stressed on market reforms as a prerequisite to enable the farmers to

realise remunerative prices on their produce across a unified national market. The government has already taken the following action-

i. The Model APLM Act was shared with all the States/UTs in April 2017. Many states have already begun to adopt the same.

ii. The Model Contract Farming & Services Act was shared with all the States/UTs in July 2018. The states have begun to work on it.

iii. Adoption of GrAMs – the Committee has recommended a new market architecture comprising organically linked village retail agricultural markets, alternative primary wholesale markets and export markets. As a part of this the government has taken the following action-

   a. Establishment of 22,000 number of Gramin Agriculture Markets (GrAMS) as aggregation and direct sale platforms, outside the ambit of APMC.
   b. Alternate markets under Model APLM Act.
   c. The Ministry of Commerce, through APEDA is working on promoting agricultural exports, including development of export clusters, in association with DAC&FW.
   d. APEDA is drafting an Agri-Export Policy.
   e. DAC&FW has taken up with MEA to set up agri-trade cells in import export destinations.

   With the adoption of the new market architecture as above, along with promoting the new Market Act, a firm step has already been taken by the government to set up 30,000 agri-markets as recommended by the Committee.

iv. Creation of National Agriculture Market – an online platform known as e-NAM launched in 2016, has been proceeding as targeted and as recommended by the Committee the government has decided to on-board 400 more APMCs (in 2018-19 and 2019-20) beyond the 585 already on-boarded.

6.0 Other Market Interventions – Operation Greens

The DFI Committee had made recommendations for strengthening the supply chain for the sensitive trio, namely tomato, onion and potato crops. In this regard, the government has announced the initiation of 'Operation Greens', to develop and promote streamlined communication of the fresh produce (greens) from farm-gate to consumer. A budgetary allocation of Rs 500 crore has been made for 2018-19 for this purpose. MoFPI has begun the work for launching this initiative.

7.0 Price Support

The DFI Committee has identified that while market reforms are a prerequisite, price support schemes is also necessary since agricultural markets cannot be perfect always. In this connection the government has taken the following actions-

- Robust MSP policy – effective from kharif 2018, the government has adopted the new basis for notification of minimum support price for 25 commodities. In case of 14 kharif crops the MSPs notified are on the basis of cost of production plus a minimum 50 per cent as profit margin. As a consequence, in case of these 14 crops the margin has been in the range of 50 to 96 per cent over cost of production.

- Robust procurement policy – the government has announced its commitment in the Budget 2018 to broad base its procurement across both crops and geographic. The government has adopted a new umbrella scheme called "Pradhan Mantri Annadata Aay Sanrakshan Abhiyan" (PM-AASHA). The other existing schemes of Department of Food and Public Distribution (DFPD) for procurement of paddy, wheat and nutri-cereals/coarse grains and of Ministry of Textile for cotton and jute will be continued for providing MSP to farmers for these crops. Under this umbrella scheme, the following bouquet of options are now available to procure all notified pulses, oilseeds and nutri-cereals-

    - Price Support Scheme (PSS) for pulses, oilseeds and copra.
    - Price Deficiency & Payment Scheme (PDPS) for oilseeds
    - Private Procurement & Stockist Scheme (PPPS) for oilseeds
    - FCI procurements for nutri-cereals
    - Cotton Corporation of India (CCI) procurement operations for cotton.
    - Jute Corporation of India (JCI) procurement operations for jute.
    - FCI procurement operations for wheat and paddy

The DFI Committee has also recommended that remunerative prices on the produce can be ensured if markets are able to discover good prices in case of at least 60 per cent of the agri-produce and the remaining 40 per cent be managed through government supported procurement programs. In tune with this the government has already scaled up its procurement operations over the previous couple of years which can now be expected to climb robustly with the above initiatives. In the year 2017-18, the procurement of pulses went upto 6.5 million tonnes registering a high of 19 per cent of the production and 1.9 million tons of oilseeds registering a high of 6 per cent of the production.

8.0 Activities for Additional Farm Incomes

In order to strengthen farm incomes, the Committee has suggested allied farm activities. In this regard government's initiatives have been as follows-

i. National Bamboo Mission – the government has amended the Indian Forest Act 1927 and uncoupled the bamboo grown outside the forest area from the definition of 'trees'. With this farmers are free to grow bamboo on their farms for commercial utilisation. Further, the government has launched the restructure National Bamboo Mission effective from 2018-19 with an allocation of Rs. 1290 crore for the years 2018-19 and 2019-20.

ii. Sub-mission on Agro-Forestry – the government has launched this sub-mission to augment farmers' income. For this purpose, the government has identified specific forest species and advised the state governments to liberalise felling and transit of such species grown on farmers' fields under the initiative 'har medh par pedh'.

iii. Promotion of aromatics and medicinal plants – the Union Budget 2018-19 has allocated special funds of Rs. 250 crore to promote aromatic and medicinal plants. This scheme will be implemented by DAC&FW, Dept. of Aayush and MSME.

iv. Agricultural produce as industrial raw material – The Department of Food and Public Distribution (DoFPD) amended the Sugarcane (Control) Order, 1996 and permitted production of ethanol from B-heavy molasses and sugarcane juice. This will address the sugar glut, while supporting the farmers to grow sugarcane.

9.0 Promotion of Secondary Agriculture

i. In consonance with the DFI Committee's definition of secondary agriculture and its recommendations, the government has facilitated promotion of agri-enterprise under RKVY-RAFTAAR. A share of 10 per cent of its budgetary allocation has been assigned for this purpose. Further, support for incubation centres is supportive of agri-enterprises.

   The DAC&FW has also held an agri-tech challenge in December 2017, to promote start-ups in 12 identified segments.

ii. National Bee Board has been strengthened to promote bee-keeping as a complementary activity to farming and generate additional incomes.

10.0 Structural Reforms

In recognition of the need for efficient scales of operation, in the light of small and marginal farms dominating the agriculture structure, this Committee recommended farmer mobilisation and produce aggregation. In this context, government has taken the following initiatives-

i. Formation of village producer organisation (VPOs) and farmer producer organisations (FPOs) to promote organic farming in large clusters preferably of 1000 hectares each.

ii. The Model Land Lease Act developed by NITI Aayog has been shared with all the states. Further, government has been motivating and handholding the state governments to adopt this Act.

iii. The Union Budget 2018 has announced that NITI Aayog shall develop a Model Land Cultivators Licence Act to promote access to institutional credit to the lessees, share croppers and the like.

iv. To bring about convergence of resources and to channelise additional funds into agriculture sector, a Committee of Chief Ministers of Uttar Pradesh, Bihar and Gujarat has been constituted under the chairmanship of Chief Minister of Madhya Pradesh by the government, to study and recommend use of MGNREGA funds in agriculture without diluting the basic objectives of this national program.

11.0 Institutional Mechanisms

As a part of governance reforms, DFI Committee has made several recommendations. Some of these have already been acted upon and these are as follows:

i. In order to effect needed coordination and convergence around agriculture and farmers welfare, the government has issued advisory to all the states, to set up an institutional mechanism involving all ministries, departments and institutions at state and district levels. The composition of this mechanism is in in line with the recommendation of the DFI Committee. The advisory also includes the terms of references for the committees at these two levels. It has also been suggested that both the committees will work under chairmanship of people's representatives namely, the Minister in charge of the District at district level, and the Chief Minister at the state level.

ii. In order to provide farmers appropriate information to decide on the production plan the government has decided to set up an institutional mechanism for price and demand forecasting. To provide technical backstopping to this institution, the DAC&FW's Directorate of Marketing & Inspection is being restructured as the Directorate of Marketing & Intelligence. The work in this regard has begun.

iii. In order to streamline and liberalise agricultural trade, an inter-ministerial institutional mechanism on trade policy has been initiated by the government with the constitution of a committee of secretaries of DAC&FW, DoCA and DoFPD, with the latter as the chairman.

iv. Work has also begun to restructure the Divisions in DAC&FW to bring suitable focus on marketing, agri-logistics, agri-enterprises and associated private investments in agriculture.

12.0 Climate Resilience in Agriculture

The DFI Committee has made several recommendations in regard to promoting climate resilience. It has also brought attention to rainfed agricultural systems. In this connection some important steps as follows have already been initiated -

i. Decision on drought proofing of 151 districts identified as critically drought-prone. The government has assigned this task to National Rainfed Area Authority (NRAA) which has initiated work in 24 districts in the year 2018-19.

ii. Climate smart crops like nutri-cereals, pulses and oilseeds have been brought into focus. Roadmaps have been adopted to increase area coverage and production.

iii. In order to increase cultivated area under irrigation government has taken up the following projects:

- Completion of large number of incomplete medium and large irrigation projects in a time bound manner. Of the 156 such long pending projects government has identified 99 AIBP projects and initiated work in 2016-17 to complete them by December 2019. When completed and additional extent of 7.6 million hectares of net cultivated area will be brought under irrigation. For this purpose, a long term irrigation fund has been created with a corpus of Rs. 80,000 crore.

- By using MGNREGA funds government has been constructing large number of small irrigation structures like farm ponds, diversion weirs, etc. to provide protective irrigation to cultivation. The number of such structures under MNREGA have been steadily increasing from year to year, reaching a high of 9,34,441 irrigation works and 5,09,965 farm ponds in 2017-18.

iv. Crop residue management has been stressed upon by the DFI Committee. A special scheme has been launched in 2018-19 to support the state governments of Haryana, Punjab, Uttar Pradesh and the NCT of Delhi to address air pollution in the Delhi-NCR region by subsidising machinery required for in-situ management of crop residues.

13.0 Restructuring of Schemes of Ministry of Agriculture & Farmers' Welfare

Even before the government formally shared its vision of doubling farmers' income, it had already adopted farmers' welfare as its core concern. This had brought greater emphasis on enterprise approach to agriculture and accordingly the government had undertaken restructuring and reorientation of all the schemes beginning in 2014-15. Various initiatives

launched in 2014-15 and 2015-2016 promote resource use efficiency, higher productivity and reduction in cost of cultivation, and hence are in synch with the recommendations of the DFI Committee. These include, universal soil health card, use of neem coated urea, PMFBY, Rashtriya Gokul Mission, comprehensive scheme for organic farming, mission organic value chain development for north-east, etc. These schemes along with all other initiatives are being diligently monitored for effective implementation.

The above set of activities initiated by the government, symbolise the diligence and commitment to double the farmers income in a time bound manner. However, all other recommendations contained in the DFI Report will also need to be rolled out in accordance with the time frames suggested.

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Budget 2018-19: Highlights of various recommendations for doubling farmers' income and farmers' welfare announced in the Budget 2018. A paradigm shift is effected by adopting an enterprise approach for agricultural policies and programmes..

Farmer Producer Organisations (FPO) of less than Rs. 100 crore turnover exempted income tax for first five years - to encourage professionalism in post-harvest value addition.	Organic farming by Village Producer Organisations (VPO) and FPOs to be encouraged in large clusters, preferably of 1,000 hectares each.	Cluster based cultivation & development to achieve economy of scale in the horticultural supply chain though FPOs/VPOs.	Operation Greens on lines of operation flood with a focus on agri-logistics, processing & professional management. Total of Rs. 500 crore allocated.
Agri-Market Infrastructure fund of Rs. 2,000 crore to set up 22,000 GrAMs (rural level markets & aggregation hubs), and upgrade 585 APMCs.	Institutional mechanism to develop policies on price and demand forecasts, futures & options and Exim policies for agriculture.	Institutional credit for agriculture to be boosted by enhancing the target of credit tof Rs. 11 lakh crore.	Minimum Support Price (MSP) for unannounced kharif crops to be 1.5 times the cost of production.
Launch a restructured Bamboo mission with Rs 1,290 crore to promote the sector holistically. Bamboo is "green-gold".	Irrigation development (PMSY) allocation increased to Rs 2,600 crore. Focus on 96 districts where less than 30% land holding is with assured irrigation.	Fisheries & Aquaculture Infrastructure and Animal Husbandry Infrastructure Development Funds - total corpus of Rs 10,000 crore.	Allocation to Ministry of Food Processing Industries doubled to Rs. 1,400 crore. To promote agro-processing financial institutions for this.
Women Groups (SHGs) to be encouraged in organic agriculture under NRLM. Allocation to NRLM increased to Rs 5,750 crore	Govt. to spend Rs 14.34 lakh crore in rural areas for the creation of livelihood and infrastructure (roads, houses, toilets, etc.).	PM's Gram Sadak Yojna Phase-III to include road links to GrAMs, etc. GrAMs to also be on eNAM and exempt from APMC regulations.	Kisan Credit card opened to Fisheries and Animal Husbandry farmers to meet their working capital needs.

The Committee on Doubling Farmers' Income