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STANDING COMMITTEE ON AGRICULTURE, ANIMAL HUSBANDRY AND FOOD PROCESSING

(2023-24)

SEVENTEENTH LOK SABHA

MINISTRY OF AGRICULTURE AND FARMERS WELFARE

(DEPARTMENT OF AGRICULTURE AND FARMERS WELFARE)

'PROMOTION OF CLIMATE RESILIENT FARMING'

SIXTY- EIGHTH REPORT

LOK SABHA SECRETARIAT
NEW DELHI

FEBRUARY, 2024 /MAGHA 1945 (SAKA)

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Presented to Lok Sabha on	07.02.2024
Laid on the Table of Rajya Sabha on	07.02.2024

LOK SABHA SECRETARIAT

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MEMBERS

LOK SABHA

2. Shri Horen Sing Bey
3. Shri A. Ganeshamurthi
4. Shri Kanakmal Katara
5. Shri Abu Taher Khan
6. Shri Ram Mohan Naidu Kinjarapu
7. Shri Mohan Mandavi
8. Shri Devji Mansingram Patel
9. Smt. Sharda Anilkumar Patel
10. Shri Bheemrao Baswanthrao Patil
11. Shri Shriniwas Dadasaheb Patil
12. Shri Vinayak Bhaurao Raut
13. Shri Pocha Brahmananda Reddy
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15. Mohammad Sadique
16. Shri Devendra Singh *alias* Bhole Singh
17. Shri Virendra Singh
18. Shri V.K. Sreekandan
19. Shri Ram Kripal Yadav
20. *VACANT*[#]
21. *VACANT*[*]

RAJYA SABHA

22. Smt. Ramilaben Becharbhai Bara
23. Shri Masthan Rao Beeda
24. Dr. Anil Sukhdeorao Bonde
25. Shri S. Kalyanasundaram
26. Shri Surendra Singh Nagar
27. Shri Kailash Soni
28. Shri Randeep Singh Surjewala
29. Shri Ram Nath Thakur
30. Shri Vaiko
31. Shri Harnath Singh Yadav

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[*] *Vacant w.e.f. 10.10.2022 due to demise of Shri Mulayam Singh Yadav on 10.10.2022 - Bulletin-Part II, Para No. 5316 dated 14.10.2022.*

[#] *Vacant w.e.f.29.04.2023 due to disqualification of Shri Afzal Ansari from Lok Sabha Membership from the date of his conviction in terms of the provision of Article 102(1)(e) of the Constitution of India read with Section 8 of the Representation of the People Act, 1951.*

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Shri P.C. Gaddigoudar- Chairperson

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29. Shri Vijay Pal Singh Tomar*
30. Shri Vaiko
31. Shri Harnath Singh Yadav

* Shri Vijay Pal Singh Tomar, MP, Rajya Sabha has been nominated to the Committee *vide* Bulletin Part-II, Para No. 7523 dated 29.09.2023 *vice* Shri Surendra Singh Nagar *w.e.f.* 26.09.2023

SECRETARIAT

1.	Shri Shiv Kumar Wadhawan	-	Additional Secretary
2.	Shri Uttam Chand Bharadwaj	-	Director
3.	Shri Sanjeev Kumar	-	Executive Officer

INTRODUCTION

I, the Chairperson, Standing Committee on Agriculture, Animal Husbandry and Food Processing (2023-24), having been authorized by the Committee to submit the Report on their behalf, present this Sixty-Eighth Report on the Subject 'Promotion of Climate Resilient Farming' pertaining to the Ministry of Agriculture and Farmers Welfare (Department of Agriculture and Farmers Welfare).

2. The Standing Committee on Agriculture, Animal Husbandry and Food Processing had selected the Subject for examination during 2022-23. Briefing on the Subject by the representatives of the Ministry of Agriculture and Farmers Welfare (Department of Agriculture and Farmers Welfare) was held at their Sitting on 31.01.2023. As the examination of the Subject could not be completed during 2022-23, the Subject was again selected for examination by the Committee during 2023-24. Evidence on the Subject was held at their Sitting on 24.08.2023.

3. The Report was considered and adopted by the Committee at their Sitting held on 06.02.2024.

4. For facility of reference and convenience, the Observations/ Recommendations of the Committee have been printed in bold at Part-II of the Report.

5. The Committee wish to express their thanks to the representatives of the Ministry of Agriculture and Farmers Welfare (Department of Agriculture and Farmers Welfare), Indian Council of Agricultural Research (ICAR), Ministry of Environment, Forests & Climate Change and Agrometeorological Advisory Services for appearing before the Committee and furnishing requisite information in connection with the examination of the Subject.

6. The Committee would also like to place on record their deep sense appreciation for the invaluable assistance rendered to them by the officials of Lok Sabha Secretariat attached to the Committee.

NEW DELHI;
06 February, 2024
17 Magha, 1945 (Saka)

P.C. GADDIGOUDAR
Chairperson,
Standing Committee on Agriculture,
Animal Husbandry and Food Processing

ABBREVIATIONS

AF	Adaptation Fund
AR	Assessment Report
ATMA	Agriculture Technology Management Agency
BBF	Broad Bred and Furrow
BOQCLs	Bio-Fertilizer/Organic Fertilizer Quality Control Labs
BPKP	Bharatiya Prakritik Krishi Paddhati Programme
BSMA	Broad Subject Matter Committee
CCEs	Crop Cutting Experiments
CHC	Custom Hiring Centers
CMIP5	Coupled Model Inter-comparison Project Phase 5
CMLs	Commercial Microwave Links
CRIDA	Central Research Institute for Dryland Agriculture
CROPIC	Collection of Real-time Photos and Observation of Crops
CRPS	Climate Resilient Pen System
CRTs	Climate Resilient Technologies
CSS	Centrally Sponsored Scheme
CTGC	CO_2 Temperature Gradient Chambers
DA&FW	Department of Agriculture & Farmers Welfare
DACP	District Agriculture Contingency Plans
DASD	Directorate of Arecanut and Spices Development
DEA	Dehydrogenase Enzyme Activity
DPI	Digital Public Infrastructure
DSR	Direct Seeded Rice
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization
FAPs	Farmers' Awareness Programmes
FATE	Free Air Temperature Enrichment facility
FIGs	Farmers Interest Groups
FPCs	Farmers Producer Companies
FPOs	Farmer Producer Organizations
FQCLs	Fertilizer Quality Control Labs
FYM	Farmyard Manure
GCF	Green Climate Fund
GEF	Global Environmental Facility
GHG	Greenhouse Gases
GKMS	Gramin Krishi Mausam Seva
GVA	Gross Value Added
GWP	Global Warming Potential

HKH	Hindu Kush Himalayas
HVYs	High Yielding Varieties
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
ICDS	Integrated Child Development Services
IMD	Indian Meteorological Department
INM	Integrated Nutrient Management
IOT	Internet of Things
IPCC	Inter-Governmental Panel on Climate Change
IYM	International Year of Millets
KDSS	Krishi Decision Support System
KVKs	Krishi Vigyan Kendras
LiFE	Lifestyle for the Environment
LULC	Land Use And Land Cover
MCs	Meteorological Centres
MIDH	Mission for Integrated Development of Horticulture
MNRE	Ministry of New and Renewable Energy
MoEFCC	Ministry of Environment, Forests and Climate Change
MoES	Ministry of Earth Sciences
MoU	Memorandum of Understanding
MOVCDNER	Mission on Organic Value Chain Development for North Eastern Region
NAFED	National Agricultural Cooperative Marketing Federation of India
NAPCC	National Action Plan for Climate Change
NAREES	National Agricultural Research and Education and Extension System
NARP	National Agricultural Research Project
NABM	National Agroforestry and Bamboo Mission
NBM	National Bamboo Mission
NBSS&LUP	National Bureau of Soil Survey & Land Use Planning
NCAER	National Council of Applied Economic Research
NCIP	National Crop Insurance Portal
NDC	Nationally Determined Contribution
NeGPA	National e-Governance Plan in Agriculture
NFSM	National Food Security Mission
NICRA	National Innovations in Climate Resilient Agriculture
NMAE&T	National Mission for Agricultural Extension & Technology
NMSA	National Mission for Sustainable Agriculture
NPCA	National Plan for Conservation of Aquatic Ecosystems
NPMCR	National Policy for Management of Crop Residues

NRM	Natural Resource Management
NWFC	National Weather Forecasting Centre
ODOP	One District One Product
OHC	Ocean Heat Content
PGS	Participatory Guarantee Scheme
OFWM	On Farm Water Management
PDMC	Per Drop More Crop Scheme
PKVY	Pramparagat Krishi VikasYojana
PLISMBP	Production Linked Incentive Scheme for Food Processing Industry for Millet-based products
PMFME	Pradhan Mantri Formalization of Micro Food Processing Enterprises
PMMSY	Pradhan Mantri Matsya Sampada Yojana
PPP	Public Private Partnership
PPR	Pesti-des Petits Ruminants
RAD	Rainfed Area Development
RAS	Re-Circulating Aquaculture System
RCP	Representative Concentration Pathway
RKVY	Rashtriya Krishi Vikas Yojana
RWCIS	Restructured Weather Based Crop Insurance Scheme
RMCs	Regional Meteorological Centres
SAPCC	State Action Plans on Climate Change
SAU	State Agricultural Universities
SDG	Sustainable Development Goal
SHC	Soil Health Card
SHM	Soil Health Management
SMAF	Sub Mission on Agroforestry
SMAM	Sub Mission on Agricultural Mechanization
SMBC	Soil Microbial Biomass Carbon
SOC	Soil Organic Carbon
SRI	System of Rice Intensification
SST	Sea Surface Temperature
STLs	Soil Testing Labs
TDC	Technology Demonstration Component
TPDS	Targeted Public Distribution System
UFSI	Unified Farmer Service Interface
UNFCCC	United Nations Framework Convention/Conference on Climate Change
VCRMC	Village Level Climate Risk Management Committees
WINDS	Weather Information Network Data System
YESTECH	Yield Estimation through Technology

PART-I

Climate Resilient Farming - An introduction

Climate Change is currently one of the most significant challenges that humanity is confronting in the present era. The alterations in the Earth's climate, which have shown a remarkable increase in the previous few decades, have had a profound impact on all aspects of life and economic endeavors globally, including the sphere of Agriculture. In the realm of India, a nation that stands as one of the world's most rapidly developing economies, Agriculture assumes a crucial role, with a staggering 54.6% of the overall labour force engaged in it and its Allied Sectors, as indicated by the 2011 Census. Furthermore, the Agricultural Sector contributes a noteworthy 18.6% to India's Gross Value Added (GVA) at the present prices during the period of 2021-22. Recently, Indian Agriculture has encountered extraordinary tribulations due to the ramifications of Climate Change. This conundrum not only poses a threat to food production but also imperils the domains of mainly Livestock, Fisheries, and Horticulture.

1.2 Climate Change is a worldwide occurrence that has disrupted phenological patterns in all nations to some extent, as indicated by the Assessment Report (AR-6) for the year 2021 of the Inter-Governmental Panel on Climate Change (IPCC), which outlines the challenges posed by global warming. Nations are establishing international partnerships and alliances to mobilize resources for the purpose of mitigating the impact of Climate Change. The occurrence of Climate Change has necessitated the demand for the adoption of new practices, particularly in the field of Agriculture, as well as an increased need for research and innovations. These measures are not only aimed at preventing loss of yield and income in the Agrarian Sector, but also at ensuring the long-term well-being of society and the economy.

A. Changes Observed in Global Climate

1.3 The observed alterations in the Earth's Climate on a Global Scale have been documented. Specifically, the average temperature of the Oceans has experienced an increase of approximately 1 degree Celsius since the time before industrialization. This significant and rapid change in temperature cannot be solely attributed to natural fluctuations, but rather must take into consideration the influence of human activities. The release of greenhouse gases, the presence of aerosols in the atmosphere, and modifications to the utilization and coverage of land during the industrial era have all had a substantial impact on the composition of the atmosphere and, consequently, the equilibrium of energy within the Planet. As a result, these factors are primarily responsible for the current state of Climate Change. Moreover, the warming trend that has been observed since the 1950s has already had a notable effect on the occurrence of extreme weather events and climatic irregularities on a global scale. Examples of these consequences include heat waves, droughts, heavy rainfall, and intense cyclones. Additionally, alterations in precipitation patterns and shifts in global monsoon systems have been observed. The warming trend has also contributed to the acidification and warning of the Earth's oceans, the melting of sea ice and glaciers, the rise in sea levels, and changes in both the Marine and Terrestrial Ecosystems.

Projected Changes in Global Climate

1.4 Global Climate Models forecast a continuation of Climate Change caused by human activities throughout the twenty-first century and beyond. If the current emission rates of greenhouse gases (GHG) persist, it is highly likely that the average global temperature will increase by approximately 5 degrees Celsius, and potentially even more, by the conclusion of the twenty-first century. Even if all the commitments made under the 2015 Paris agreement, known as the "Nationally Determined Contributions," are fulfilled, it is projected that global warming will surpass 3 degrees Celsius by the end of the century. Nevertheless, the rise in temperature will not occur uniformly across the globe; certain regions will experience greater warming compared to the global average. These substantial temperature changes will significantly expedite other ongoing alterations in the climate system, such as shifts in rainfall patterns and an escalation in extreme temperatures.

B. Climate Change in India: Observed and Projected Changes

(a) Increase in Temperature in India

1.5 The average temperature in India has witnessed an elevation of approximately 0.7 degrees Celsius between 1901 and 2018. This temperature rise is predominantly attributed to the warming effect caused by Green House Gases emissions, although it is partially offset by the impact of anthropogenic aerosols and alterations in land use and land cover (LULC).

(b) Warming of the Indian Ocean

1.6 The average Sea Surface Temperature (SST) of the tropical Indian Ocean has experienced a rise of 1 Degree Celsius during the period from 1951 to 2015, which is significantly higher than the global average SST warming of 0.7 degrees Celsius over the same time frame. Furthermore, the upper 700 metres of the Tropical Indian Ocean, known as the ocean heat content (OHC700), has displayed an upward trend over the past six decades (1955-2015), with the most recent two decades (1998-2015) witnessing a particularly abrupt increase.

(c) Changes in Rainfall

1.7 The precipitation during the summer monsoon season in India, which occurs from June to September, has experienced a decline of approximately 6% between the years 1951 and 2015. This decrease is particularly noticeable over the Indo-Gangetic Plains and the Western Ghats. Multiple datasets and simulations using climate models have led to a growing consensus that the radiative effects of anthropogenic aerosol in the Northern Hemisphere have counteracted the anticipated increase in precipitation due to greenhouse gas warming. As a result, this has contributed to the observed decline in Summer Monsoon precipitation.

1.8 In recent years, there has been a notable shift towards more frequent dry spells, with a 27% increase during the period of 1981-2011 compared to 1951-1980. Additionally, there have been more intense wet spells during the summer monsoon

season. This increase in localized heavy precipitation occurrences is a global phenomenon in response to the higher moisture content in the atmosphere. Specifically, in Central India, the frequency of daily precipitation extremes with rainfall intensities exceeding 150 mm per day has risen by approximately 75% between 1950 and 2015.

1.9 Based on the projections from the Coupled Model Inter-comparison Project Phase 5 (CMIP5) models, continued global warming combined with expected reductions in anthropogenic aerosol emissions in the future will likely lead to an increase in both the average and variability of monsoon precipitation by the end of the twenty-first century. These models also suggest significant increases in daily precipitation extremes.

(d) Droughts

1.10 The decrease in the seasonal Summer Monsoon rainfall over the past 6-7 decades has resulted in a higher susceptibility to droughts in India. Both the frequency and spatial extent of droughts have significantly increased between 1951 and 2016. Specifically, regions such as Central India, the South West coast, the Southern Peninsula, and North-Eastern India have experienced an average of more than 2 droughts per decade during this period. Furthermore, the area affected by drought has increased by 1.3% per decade during the same time frame.

1.11 Climate Model Projections indicate a strong likelihood of increased frequency, intensity, and spatial coverage of drought conditions in India by the end of the twenty-first century under the Representative Concentration Pathway (RCP) 8.5 scenario. This is expected due to the greater variability of monsoon precipitation and the increased demand for water vapor in a warmer atmosphere.

(e) Rise in Sea Levels

1.12 The global rise in sea levels is attributed to the melting of continental ice and the expansion of ocean water due to global warming. In the North Indian Ocean (NIO), the rate of sea-level rise was 1.06-1.75 mm per year from 1874 to 2004, but it has accelerated to 3.3 mm per year in the last 25 years (1993-2017), which is comparable to the current global mean sea-level rise.

1.13 According to projections, by the end of the twenty-first century, the steric sea level in the North Indian Ocean, which accounts for changes in ocean thermal expansion and salinity variations, is expected to rise by approximately 300 mm compared to the average from 1986 to 2005 under the RCP4.5 scenario. The corresponding projection for the global mean rise is approximately 180 mm.

(f) Tropical Cyclones

1.14 In the NIO basin, there has been a significant decrease in the annual frequency of tropical cyclones since the mid-twentieth century (1951-2018). However, the frequency of very severe cyclonic storms during the post-monsoon season has shown a significant increase of one event per decade in the last two decades (2000-2018).

Despite this, there is currently no clear evidence of anthropogenic influence on these trends.

Climate models predict an increase in the intensity of tropical cyclones in the NIO basin during the twenty-first century.

(g) Changes in the Himalayas

1.15 The Hindu Kush Himalayas (HKH) have experienced a temperature increase of approximately 1.3 degrees Celsius from 1951 to 2014. Some areas in the HKH region have observed a decline in snowfall and glacial retreat in recent decades. However, the high-elevation Karakoram Himalayas have experienced higher winter snowfall, which has helped protect the region from glacier shrinkage.

1.16 On being asked by the Committee to provide an overview of the Projected Climate Change for India for the next two-three decades and the reasons for increase in frequency of extreme Climactic events and to also enumerate steps/Standard Operating Procedures (SoPs) being taken / followed by the Department to tackle the after effects in this regard, the Department of Agriculture and Farmers Welfare submitted:

> "Ministry of Earth Sciences presents the projected climate change over India. Relative to the recent past (1976-2005), the annual mean temperatures are projected to increase by up to 2.03 ± 0.28℃ for the period 2040-2069 in the RCP4.5 (Representative Concentration Pathway- an intermediate stabilization pathway that results in a Radiative Forcing of 4.5 W/m2 in 2100) scenario. Multi-model mean change suggests wetter condition over India in near and far future on average. Models projected an increase of 6% rainfall over India under RCP4.5 scenario. From 1950 onwards, the number of extreme precipitation events over Indian landmass has also become more significant than it before.
> Emissions of greenhouse gases (GHGs), aerosols and changes in land use and land cover (LULC) during the industrial period have substantially altered the atmospheric composition, and consequently the planetary energy balance, and are thus primarily responsible for the present-day climate change. Observational data from India Meteorological Department indicate that over the past 122 years (1901-2022), annual mean temperature has tended to increase (trend of 0.64°C/100 years). This rise in temperature is largely on account of GHG-induced warming, partially offset by forcing due to anthropogenic aerosols and changes in land use and land cover (LULC).
>
> Further, the Ministry of Earth Sciences (MoES) has also brought out a web based online "Climate Hazard & Vulnerability Atlas of India" prepared for the thirteen most hazardous meteorological events, which cause extensive damages, economic, human, and animal losses. Further information may be obtained from the Ministry of Earth Sciences/ IMD at https://imdpune.gov.in/hazardatlas/atlas_summary.html. The Department of Science and technology has also prepared a report titled 'Climate Vulnerability Assessment for Adaptation Planning in India Using a Common Framework', which identifies the most vulnerable states and districts in India with respect to current climate risk and key drivers of vulnerability.

In context of reasons for increase in frequency of extreme climactic events, it is submitted that IPCC report 'Climate Change 2013: The Physical Science Basis' *inter-alia* mentions that human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes. It further mentions that continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system.

The Government has launched many schemes and programs to scale up India's action on both, the adaptation and mitigation. Appropriate measures are being taken under these schemes and programs across many sectors including water, Agriculture, forest, energy and enterprise, sustainability mobility and housing, waste management, circular economy and resource efficiency, etc. India's National Action Plan for Climate Change (NAPCC) provides the overarching policy framework for climate change mitigation and adaptation through its National Missions in specific areas of solar energy, energy efficiency, water, sustainable, Agriculture, health, Himalayan ecosystem, sustainable habitat, green India and strategic knowledge for climate change. The NAPCC represents multipronged, long term and integrated strategies for achieving key goals in the context of climate change. Thirty-four States /Union Territories (UTs) have prepared and some have updated their State Action Plans on Climate Change (SAPCCs) in line with NAPCC taking into account the State-specific issues relating to climate change. These SAPCCs outline are sector-specific and cross-sectoral priority actions, including adaptation**.**"

C. Risk and Vulnerability of Indian Agriculture to Climate Change

1.17 The assessment of risk and vulnerability in Indian Agriculture to climate change is conducted by taking into account the emerging conceptual and analytical methods, as well as relevant climatic (using IPCC AR-5 CMIP 5 climatic projections) and non-climatic information. The selected indicators are classified into different forms of capital endowments that determine the system's ability to cope with hazards. Consequently, fifteen indicators associated with five distinct dimensions of capital endowment - natural (such as annual rainfall, degraded and waste land, available water holding capacity of soil, groundwater availability, and livestock density), human (literacy), social (gender gap and self-help groups), physical (net irrigated area, road connectivity, rural electrification, market access, and fertilizer use), and financial (income and income inequity) - are chosen to capture vulnerability. The five indicators chosen to represent exposure include net sown area, rural population density, small and marginal farmers, SC/ST population, and cross-bred cattle. The three indicators selected for hazards are drought proneness, flood proneness, and cyclone proneness. Risk is the outcome of the interaction among exposure, vulnerability, and hazard. The document provides information on the relative position of districts in the country in terms of Climate Change risk and various determinants such as exposure, vulnerability, and hazard. The study revealed that out of the 573 districts, 109 were classified as very high risk prone and 201 as highly prone. In the future, the risk and vulnerability assessment will be updated to incorporate the latest CMIP 6 climatic projections as and when they become available from Inter Governmental Panel on Climate Change (IPCC).

1.18 Climate Resilient Farming is imperative given the susceptibility of Indian Agriculture to climate change. Approximately 51 percent of the cultivated area in India relies on rainfed conditions, rendering it highly vulnerable. The occurrence of frequent extreme weather events across different parts of the country has resulted in significant losses in crop yield and income for farmers at a micro level, as well as negatively impacting the nation's economy at a macroeconomic level. The latest Assessment Report (AR-6) by the Inter Governmental Panel on Climate Change (IPCC) highlights the potential challenges that lie ahead for Sustainable Agriculture. These challenges include an increase in rainfall, heightened inter annual variability, intensified and frequent heat waves, and a projected temperature rise of 1.5 to 4.0 Degrees Celsius. Additionally, a rise in sea level by 300 mm is anticipated. In light of these findings, it is crucial to prioritize accelerated research in the development of resilient and intelligent technologies that can be implemented to combat climate change. These technologies should be mainstreamed through adaptation mechanisms to facilitate upscaling. Consequently, the Government of India has placed great importance on Research and Development (R&D) efforts aimed at addressing Climate Change, with a specific focus on the Agricultural Sector.

D. Climate Resilient Villages

1.19 Location-specific Climate Resilient Technologies (CRTs) were showcased to address climate variability in vulnerable districts, with the aim of raising awareness and enhancing the capacity of farmers and other stakeholders. These efforts also sought to establish innovative institutional mechanisms at the village level in order to enable communities to effectively respond to climate stresses. The interventions were categorized into four modules, namely natural resource management, crop production, livestock, and fisheries. To support and sustain these activities, various innovative Institutional interventions were implemented in the NICRA villages, including the establishment of Village Climate Risk Management Committees (VCRMCs), Custom Hiring Centers (CHCs) for farm implements, seed and fodder production systems, establishment of commodity groups, water sharing groups, community nurseries, and the initiation of collective marketing through value chains. These initiatives were aimed at facilitating and expanding the interventions. Demonstrations of location-specific climate resilient technologies have been carried out in 151 climatically vulnerable districts, with the goal of enhancing adaptive capacity and resilience against climatic variability. This has been achieved through the participation of Krishi Vigyan Kendras (KVKs) and farmer engagement, focusing on addressing climate vulnerabilities such as droughts, floods, cyclones, heat waves, high temperature stress, cold waves, and frost. The selection of interventions is based on the vulnerability of the district to climate change, prevailing farming conditions, and the available resources in the village.

1.20 Upon this, the Committee desired to know about the State wise and district wise risk-prone areas in the country. The Department of Agriculture and Farmers Welfare, in its reply, submitted as under:

> "Climate change risk and vulnerability is an essential and initial step in developing the effective adaptation and mitigation policies for Agriculture sector. Districts with different levels of climate change risk were identified following the framework given

by IPCC in its Fifth Assessment Report. Addressing the source of risk is a better way of risk reduction and resilience building. As many as 310 districts categorized under risk-prone in the country, of which 109 districts are 'very high' risk and 201 districts are 'high' risk. List of districts that are at high risk due to climate change as per the risk and vulnerability assessment is as follows -

State	District	Risk Category
Andhra Pradesh	Anantapur	Very High
	Srikakulam, East Godavari, Kurnool	High
Arunachal Pradesh	Upper Siang	Very High
	Tawang , Lower Subansiri West Siang, East Siang, Lohit, Dibang valley	High
Assam	Nalbari, Darrang	Very High
	Kokrajhar, Dhubri, Barpeta, Morigaon, Dhemaji	High
Bihar	Sitamarhi, Madhubani Supaul, Kishanganj, Katihar, Saharsa, Darbhanga, Lakhisarai, Sheikhpura, Nalanda	Very High
	Champaran(West), Champaran(East), Purnea Madhepura, Gopalganj, Siwan, Samastipur, Begusarai, Khagaria, Bhagalpur, Patna, Bhojpur, Buxom	High
Chhattisgarh	Jashpur, Raigadh, Korba, Durg, Mahasamund, Kanker	High
Gujarat	Panchmahal, Dahod	Very High
	Banaskantha Patan, Anand, Kheda, Narmada, Dang	High
Haryana	Fatehabad, Bhiwani, Mahendragarh	Very High
	Kaithal, Jind, Sirsa Hissar, Rohtak, Jhajjar, Rewari, Gurgaon	High
Himachal Pradesh	Chamba, Mandi	Very High
	Kangra, Kullu, Hamirpur, Bilaspur, Shimla, Kinnaur	High
Jammu &	Leh (Ladakh), Poonch, Kathua	Very High

Kashmir	Baramulla, Budgam Anantnag, Kargil, Doda, Udhampur, Rajouri	High
Jharkhand	Garhwa, Godda, Sahibganj, Pakur, Gumla West Singbhum	High
Karnataka	Bagalkot, Gulbarga, Bidar, Koppal, Dharwad, Bellary, TumkurKolar, Bangalore (Rural), Hassan, Mysore, Chamarajanagar	High
Kerala	Kasaragod, Kozhikode, Ernakulam, Kottayam, Alappuzha, Pathanamthitta, Kollam, Thiruvanathapuram	Very High
	Kannur, Wayanad, Malappuram, Palakkad, Thrissur	High
Madhya Pradesh	Bhind, Jhabua	Very High
	Morena, Datia, Tikamgarh, Chhatarpur, Panna, Rewa, Shahdol, Sidhi, Mandsaur, Ratlam, Barwani, Betul, Dindori, Mandla	High
Maharashtra	Nanded, Need	Very High
	Nandurbar, Akola, Washim, Wardha, Chandrapur, Hingoli, Parbhani, Jalna, Ahmednagar, Latur, Osmanabad	High
Manipur	Senapati, Churachandpur, Thoubal, Imphal East, Ukhrul, Chandel	
Meghalaya	West Garo Hills, East Garo Hills, South Garo Hills, West Khasi Hills, East Khasi Hills, Jaintia Hills	Very High
	Ri-Bhoi	High
Mizoram	Lawngtlai, Saiha	Very High
	Kolasib, Aizawl, Champhai, Serchhip, Lunglei	High
Nagaland	Tuensang	Very High
	Mon, Mokokchung, Zunheboto, Wokha, Phek	High

Odisha	Baragarh, Mayurbhanj, Bhadrak, Dhenkanal, Nayagarh, Khurda, Ganjam, Gajapati, Bolangir, Nuapada, Kalahandi, Rayagada, Nabarangpur	High
Punjab	Gurdaspur, Jalandhar, Moga, Faridkot, Bathinda	Very High
	Firozpur, Muktsar, Mansa, Sangrur	High
Rajasthan	Ganganagar, Hanumangarh, Churu, Jhunjhunu, Alwar, Karauli, Dausa, Sikar, Nagaur, Jodhpur, Jaisalmer, Barmer, Jalore, Pali, Bhilwara, Dungarpur, Banswara	Very High
	Bikaner, Bharatpur, Dholpur, Jaipur, Sirohi, Ajmer, Tonk, Bundi, Rajsamand, Udaipur	High
Sikkim	South	Very High
	North, West, East	High
Tamil Nadu	Dharmapuri, Villupuram, Coimbatore, Perambalur, Ramanathapuram	High
Telangana	Adilabad, Mahabubnagar	High
Uttar Pradesh	Bagpat, Unnao, Kannauj, Etawah, Auraiya, Kanpur (Dehat), Jalaun, Jhansi, Hamirpur, Mahoba, Banda, Chitrakut, Fatehpur, Kaushambi, Allahabad, Bahraich, Shravasti, Balrampur, Gonda, Basti, Jaunpur, Sant Ravidas Nagar	Very High
	Saharanpur, Rampur, Jyotiba Phule Nagar, Aligarh, Hathras, Mathura, Agra, Budaun, Pilibhit, Shahjahanpur, Sitapur, Rae-Bareily, Farrukhabad, Kanpur City, Lalitpur, Pratapgarh, Ambedkar Nagar, Siddharth Nagar, Sant Kabir Nagar, Maharajganj, Gorakhpur, Kushi Nagar, Deoria, Varanasi, Mirzapur, Sonbhadra	High
Uttarakhand	Uttarkashi, Rudraprayag, Tehri Garwal, Pithoragarh, Bageshwar, Almora, Champawat	Very High
	Chamoli, Pauri Garhwal	High

West Bengal	Malda, 24-Paraganas (North), 24-Paraganas (South)	Very High
	Darjeeling, Jalpaiguri, Cooch Behar, Dinajpur (Uttar), Dinajpur (Dakshin), Murshidabad, Birbhum, Nadia, Purulia, Howrah, Midnapore	High

1.21 On being asked to enlist the benefits of Climate Resilient Villages (CRVs) and the technologies currently being used & to elaborate its effects in different climactic conditions, the Department submitted as under:

"The benefits of climate resilient villages are as given below:

- Establishment of Climate Resilient Villages (CRV) is a comprehensive approach to manage climatic risks with the involvement of communities in the village and by establishment of village institutions.
- CRVs essentially aim at enhancing the capacity of the system to cope up the climate risks such as drought, floods, heat wave, cold wave, uneven rains, dry weather, frost, cyclones and hailstorms *etc.* and minimize the impact by building the capacity of the farmers for quick recovery. The Climate Resilient Villages involve scaling and adoption of multiple technologies representing natural resource management, crops and livestock.
- The CRVs involve adoption of portfolio of interventions that cover the full spectrum of farm activities for adapting to climate change and variability and to minimize greenhouse gas emissions wherever possible. Adoption of technologies resulted in significant improvement in yield and income.
- CRVs principally focus on minimizing the impact of climatic change and variability in less resource endowed regions where variability in rainfall seriously impacts the crop growth and production and aims at minimizing the impact of such events so that communities can realize acceptable yields and sustain livelihoods. Aims at achieving resilience by prioritizing and scaling promising location specific practices and also through livelihood diversification.
- Development of CRVs enables establishment of a host of enabling mechanisms such as custom hiring centers, seed systems and fodder production systems and village institutions to mobilize and empower communities in the decision-making process to manage and recover from climate risks in a continuous manner even after the withdrawal of the project.
- CRVs of low rainfall regions, crop based resilient practices are relatively promising for achieving resilience whereas CRVs of medium to high rainfall regions, *in-situ* coupled with water harvesting and its utilization are key to minimize the impact of drought and to enhance the cropping intensity during favorable seasons. Creation of water storage potential lead to multiple benefits by way of diversification and cropping intensification and income gains.

- Scaling of location specific promising technologies which are having mitigation co-benefits leads to enhancement of sinks and reduction of the sources leading to carbon neutral villages."

1.21(a) Some of the location-specific climate resilient technologies which proved as a game changer are:

- Zero till planting of wheat has advanced the wheat sowing than conventional planting in Punjab and Haryana. Demonstrations of wheat sowing with "happy seeder" helped farmers to get convinced about the germination and crop stand with the machine and resulted in significant adoption in NICRA villages.
- Location specific *in-situ* moisture conservation measures such as broad bred and furrow (BBF) in soybean, compartmental bunding in pearl millet, tied ridging in sorghum, conservation furrows in finger millet + pigeon pea intercropping system at several locations produced higher yield (up to 63%) compared to flat method of sowing.
- Crop diversification from water-intensive paddy to alternative crops like pulses, oilseeds, maize, cotton and to agroforestry plantation. Through NICRA project, shift from rice-rice to rice-pulse (green gram/ black gram) cropping system is promoted in eastern India (specifically in Odisha).
- Integration of crop residues with reduced use of synthetic fertilizers provide climate resilient management and increase nitrogen use efficiency. For rice-wheat systems of Indo Gangetic Plain, cutting down inorganic fertilizers to almost half and supplementing with Sesbania-based green manuring or with grain legume cropping and incorporation of its biomass into the soil at harvest proved to be the best strategy.

1.22 The Committee desired to know the tentative schedule by which the Department of Agriculture and Farmers Welfare plan to ensure that all the villages across the country shall be able to adopt Climate Resilient Practices and also whether additional funds have been earmarked for the same or not. The Department, in its reply submitted:

"The National Mission for Sustainable Agriculture (NMSA) is one of the 8 Missions launched under the National Action Plan on Climate Change (NAPCC) in 2008. The Mission aims to evolve and implement strategies to make Indian Agriculture resilient to climate change. The NMSA document was approved by the Prime Minister's Council on Climate Change in September, 2010 with an outlay of Rs.1, 08,000 crore for six years. During XII Plan, important activities taken up were Rainfed Area Development, Soil Health Management, (soil testing, Bio fertilizers *etc*.) and On Farm Water Management (SRI, Precision irrigation etc.). Remaining Mission deliverables were accommodated under other Missions and schemes taken up by DAHD&F and DARE.

- The Government is taking several steps to promote climate resilient farming in

the country through several schemes aligned to meet the challenges of climate change under NMSA. National Mission for Sustainable Agriculture (NMSA) being implemented by Ministry of Agriculture and Farmers Welfare is one of the Missions within the National Action Plan on Climate Change (NAPCC). Under NMSA, Per Drop More Crop (PDMC) scheme was launched during 2015-16 to increase water use efficiency at the farm level through Micro Irrigation technologies *i.e.* drip and sprinkler irrigation systems. Till date an area of 78.48 lakh hectare has been covered under Micro irrigation through the PDMC scheme from the year 2015-16.Rainfed Area Development (RAD)scheme is being implemented as a component under National Mission for Sustainable Agriculture (NMSA) from 2014-15 in the country. RAD focuses on Integrated Farming System (IFS) for enhancing productivity and minimizing risks associated with climatic variability. Till date an area of 7.11 lakh hectares has been covered under RAD programme from the year 2014-15.The restructured National Bamboo Mission (NBM) was launched during 2018-19 as a Centrally Sponsored Scheme (CSS) subsequent to the historical amendment of the Indian Forest Act during 2017 to exclude bamboo from the definition of tree. During the year 2022-23 the NBM has been merged with Mission for Integrated Development of Horticulture (MIDH) scheme. Soil Health Card (SHC) / Soil Health Management (SHM) scheme is operational through the State Governments under National Project on Management of Soil Health & Fertility. Now, this scheme has been merged as Soil Health Component of Rashtriya Krishi Vikas Yojana (RKVY) from the year 2022-23. The main objective of the scheme is to assist states in promoting Integrated Nutrient Management (INM) through judicious use of chemical fertilizers including secondary and micro nutrients in conjunction with organic manures & bio-fertilizers for improving soil health and its productivity. Soil Health Card provides information to farmers on soil nutrient status of their soil and recommendation on appropriate dosage of nutrients to be applied for improving soil health and its fertility. So far 22.71 crore grid based soil health cards have been distributed to farmers under the scheme. For promoting organic farming, under Mission Organic Value Chain Development in North East Region (MOVCDNER), 379 Farmer Producer Companies have been formed comprising of 1.89 lakh farmers and covering an area of 1.73 lakh ha. Mission for Integrated Development of Horticulture (MIDH) is being implemented in which an area of 11.26 lakh ha has been covered. Paramparagat Krishi Vikas Yojana (PKVY) was initiated to promote organic farming in the country and so far 11.80 lakh ha area has been covered. Government is also promoting natural farming since 2019-2020 through a sub-scheme namely Bharatiya Prakritik Krishi Paddhati (BPKP) under Paramparagat Krishi Vikas Yojana (PKVY). So far 4.09 lakh ha area has been brought under natural farming in 8 states *viz.* Andhra Pradesh, Chhattisgarh, Kerala, Himachal Pradesh, Jharkhand, Odisha, Madhya Pradesh and Tamil Nadu under BPKP."

1.23 Department of Agriculture and Farmers Welfare was asked to furnish budget for previous three years for Promotion of Climate Resilient Farming and to also share details of funds allocated to various Institutes/Bodies/ Schemes/Programmes for the last three years for the same on yearly basis & to state whether the desired

objectives/targets have been met and if not, the reasons therefor. In response, the Department stated as under -

"Expenditure made by the Department for Promotion of Climate Resilient Farming for the last three years is given below:

Schemes	Expenditure (Rs. Crore)		
	2020-21	2021-22	2022-23
Pramparagat Krishi VikasYojana (PKVY)	500.00	450.00	469.34
Mission on Organic Value Chain Development for North Eastern Region (MOVCDNER)	175.00	200.00	198.00
Crops Diversification	120.00	120.00	95.00
National Food Security Mission (NFSM)	1213.12	810.97	900.00
Rainfed Area Development (RAD)	202.50	180.00	100.00
Per Drop More Crop (PDMC) Scheme	2563.00	1796.00	1901.00
Mission for Integrated Development of Horticulture (MIDH)	1511.92	1509.76	1100.00
National Bamboo Mission (NBM)	94.00	70.00	
National Innovations in Climate Resilient Agriculture (NICRA)	44.74	46.06	40.87

1.24 On being asked to list the Programmes being implemented in ecologically fragile Areas/Districts and the impact made thereof, the Department submitted:

"District level risk and vulnerability assessment of Indian Agriculture to climate change has been revised as per IPCC AR-5 guidelines by ICAR-NICRA and is widely used by policy makers and research managers for prioritization of resources related to climate change action plans. Agricultural contingency plans are ready for 650 districts and updated for 386 districts.

- Location specific technologies developed under the National Agricultural Research System (NARS) which can build resilience against climatic vulnerability are being demonstrated in 151 climatically vulnerable districts/ clusters covering 454 villages.
- Village level institutional mechanisms such as Village Level Climate Risk Management Committees (VCRMC), custom hiring centers are established for managing infrastructure created and to improve the timeliness of operations during the limited window periods of moisture availability in rainfed areas and to promote small farm mechanization for adoption of climate resilient practices. These interventions helped farmers to reduce the yield losses and enhanced their adaptive capacity against climatic variability.
- In fragile regions of North-Eastern states and Western Himalayan states like Himachal Pradesh, Uttarakhand and UTs of J&K and Ladakh, Mission Organic Value Chain Development for North Eastern Region (MOVCDNER) and Paramparagat Krishi Vikas Yojna (PKVY) are implemented on cluster basis for promotion of organic farming. This has resulted in bringing 1.73 lakh ha area in 8 states of NER under the

chemical free organic farming. Similarly, area covered under organic farming is 17700 ha in Himachal Pradesh,140, 540 ha in Uttarakhand, 10000 ha in Ladakh and 560 ha in J&K.

- A large-scale capacity building program on climate resilient Agriculture is being undertaken with more than 1200 scientists, 874 research scholars and 160s of doctoral and post graduate students are involved on climate change research and dissemination of climate resilient technology across the country. These resilient practices are being adopted by communities and spreading beyond NICRA villages. In the past ten years 16,958 training programs were conducted throughout the country under NICRA project to educate stakeholders on various aspects of climate change and resilient technologies, covering 5,14,816 stakeholders so as to enable wider adoption of climate resilient technologies and increase in yields."

1.25 On being asked that given India's diverse spectrum of meteorological entities, steps taken to preserve Natural Capital in Agriculture at national and regional level and convergence of Schematic interventions across different Departments/Ministries such as that of Rashtriya Krishi Vikas Yojana (RKVY), Pradhan Mantri Matsya Sampada Yojana (PMMSY), Integrated Development of Horticulture etc. to prevent vulnerabilities of Farmers and develop a sustainable income pattern beside creating a low carbon path for the Farming community be furnished, the Department submitted:-

"Several schemes have been initiated by the Government of India to prevent vulnerabilities of Farmers and develop a sustainable income pattern besides creating a low carbon path for the Farming community**.** The Rainfed Area Development (RAD) program under National Mission on Sustainable Agriculture (NMSA) aims to make rainfed Agriculture more productive, sustainable, remunerative and climate resilient. The sub-mission on Agroforestry aims to increase tree cover in non-forest areas for higher carbon sequestration. The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) aims to improve on-farm water use efficiency, enhance the adoption of precision irrigation and other water saving technologies (more crop per drop) and enhance recharge of aquifers. The Pradhan Mantri Fasal Bima Yojana (PMFBY) initiated to provide the full insured amount on crop losses due to natural calamities. In addition, programs like Paramparagat Krishi Vikas Yojana (PKVY) aims to improvement of soil health. The scheme Bharatiya Prakritik Krishi Paddhati Programme (BPKP) aims to promote traditional indigenous practices and to create awareness and capacity building of farmers. National Horticulture Mission, National Agroforestry & Bamboo Mission (NABM) and National Policy for Management of Crop Residues (NPMCR) also aim to increase climate resilience.

Indian Council of Agricultural Research (ICAR) has launched a flagship network project ‘National Innovations in Climate Resilient Agriculture’ (NICRA) in 2011 with an aim to develop and promote climate resilient technologies in Agriculture which will address vulnerable areas of the country. The outputs of the project will help the districts and regions to cope with extreme weather conditions like droughts, floods, cyclone, frost, heat waves etc. Contingency planning is one of the major strategies

of preparedness for tackling aberrant weather events. In the face of increasing climate variability, adoption and implementation of the District Level Contingency Plans (DACP) is a priority for many state governments. ICAR prepared DACPs for 650 districts of the country recommending location specific climate resilient crops and varieties and management practices for use by the state departments of Agriculture and farmers.

The PMMSY envisages suitable linkages and convergence with various Central government schemes wherever feasible such as Sagarmala Programme, Pradhan Mantri Kisan Sampada Yojana, Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Rashtriya Krishi Vikas Yojana, National Rural Livelihoods Mission, Kisan Credit Card (KCC). PMMSY promotes Promotion of Fish Farmers Producer Organizations/Companies (FFPOs/Cs) to economically empower the fishers and fish farmers and enhance their bargaining power. Technology demonstration and Genetic improvement programmes for sustainable and climate resilient aquaculture is being promoted under PMMSY in collaboration with Department of Agricultural Research and Education (DARE) and Department of Commerce (MPEDA).PMMSY provides the flexibility to the State Governments to converge PMMSY with other schemes

To promote sustainability in fisheries and aquaculture, Department of Fisheries (DoF) has taken several initiatives under PMMSY including:

a. Promotion and support for sustainable fish production systems/methods with minimal environmental impacts (more crop per drop-RAS, Biofloc, Aquaponic), to develop eco-friendly diversified fishing practices for responsible and sustainable fishing and the development of islands fisheries in a sustainable and responsible manner. Under PMMSY the efforts are being made to design a fuel efficient fishing vessels using solar energy, LPG and LNG. Deep sea fishing vessels are being promoted to reduce the fishing pressure on coastal fisheries resources.

b. To promote sustainability of marine fisheries resources, focus areas have been identified such as sea ranching and artificial reefs, for replenishing and rejuvenating natural marine fish stocks in marine waters. Similarly, in case of inland fisheries, River ranching has been undertaken for replenishing fish stocks in major river systems namely Ganges and its tributaries, Brahmaputra & Barak rivers' tributaries, Mahanadi, Godavari, Cauvery, Narmada, and Indus.

c. For sustainable development of climate resilient aquaculture, efforts have been made for species diversification and genetic improvement programmes.

d. For the conservation and effective management of fishery resources and also for sea safety reason, the Ministry is also imposing a 61-days uniform ban on fishing by all fishing vessels in the Indian EEZ beyond territorial waters on the East Coast and West Coast."

E. National Action Plan on Climate Change (NAPCC)

1.26 The National Action Plan on Climate Change (NAPCC), formulated by the Prime Minister, has identified the National Mission on Sustainable Agriculture (NMSA) as one of the eight National Missions. Its aim is to address the challenges posed by the changing climate to domestic food production and contribute valuable insights on adaptation and mitigation in Agriculture on a global scale, particularly for forums such as the United Nations Framework Convention on Climate Change (UNFCCC). In February 2011, the Indian Council of Agricultural Research (ICAR) and the Ministry of Agriculture and Farmers Welfare, Government of India, launched a flagship project called the National Innovations in Climate Resilient Agriculture (NICRA). This project is primarily focused on enhancing the resilience of Indian Agriculture to climate variability and change through the application of improved technologies and new policies. Additionally, during the global brainstorming session of the COP26 Climate Summit in Glasgow, Scotland (2021), the Government of India announced five commitments (known as *Panchamrit*) to address the challenges of Climate Change -

- To raise the non-fossil fuel-based energy capacity of the country to 500 GW by 2030.
- By 2030, 50 % of the country's energy requirements would be met using renewable energy sources.
- The country will reduce the total projected carbon emission by one billion tonnes between now and the year 2030.
- The carbon intensity of the economy would be reduced to less than 45% by 2030 as compared to that of 2005.
- India to become carbon neutral and achieve net zero emissions by the year 2070.

1.27 The Working Group II (WG II) Report of the Intergovernmental Panel on Climate Change (IPCC) AR 6 has indicated that Climate Change is expected to cause significant damages, surpassing initial expectations. Regions and populations facing development constraints are particularly vulnerable to these adverse effects. One such vulnerable hotspot is South Asia, where the impact of climate change intensifies the pressure on food production and access to it. The report highlights that climate change will increasingly strain food production and accessibility, particularly in regions already at risk, thereby undermining food security, nutrition, and exacerbating the problem of malnutrition (IPCC, 2022). The frequency, intensity, and severity of droughts, floods, heat waves, and rising sea levels are projected to escalate, posing greater risks to food security. Moreover, the report forecasts a gradual deterioration in soil health, resulting in diminished soil carbon and nitrogen levels, leading to ecosystem degradation. This degradation would affect pollination, increase susceptibility to pests and diseases, and further reduce water availability for agricultural purposes. Within the Indian region, it is anticipated that maize yields could decrease by 20% to 30% without adaptation measures, while impacts on wheat, soyabean, and rice will vary. Nonetheless, the report emphasizes that implementing appropriate adaptations can significantly mitigate the adverse impacts. Cultivar improvements, agroforestry, community-based adaptation, farm and landscape diversification, urban Agriculture, on-farm water

management, water storage, soil moisture conservation, and irrigation are among the most commonly recommended adaptation responses. These adaptations not only reduce vulnerability but also offer economic, institutional, and ecological benefits.

1.28 On being asked regarding the plan to finance for Climate Change initiatives relating to Agriculture Sector, the Department submitted:-

"The Government is taking several steps to address the challenges of Climate Change and promote crop diversity in the country. National Action Plan on Climate Change (NAPCC) was launched by the Government in 2008 which provides an overarching policy framework for climate action in the country. National Mission for Sustainable Agriculture (NMSA) being implemented by Ministry of Agriculture and Farmers Welfare is one of the Missions within the National Action Plan on Climate Change (NAPCC). The Mission aims to evolve and implement strategies to make Indian Agriculture more resilient to the changing climate. NMSA was approved for three major components *i.e.* Rainfed Area Development (RAD); On Farm Water Management (OFWM); and Soil Health Management (SHM). Subsequently, new programmes such as namely Soil Health Card (SHC), Paramparagat Krishi Vikas Yojana (PKVY), Mission Organic Value Chain Development in North Eastern Region (MOVCDNER), Per Drop More Crop, National Bamboo Mission (NBM) *etc*. were also included."

The details of scheme-wise allocations made in the agricultural budget to address the challenges of climate change and promote crop diversity in the country are given below:

Pramparagat Krishi Vikas Yojana (PKVY)	469.85
Mission on Organic Value Chain Development for North Eastern Region (MOVCDNER)	200.00
Crops Diversification	95.00
National Food Security Mission (NFSM)	1623.00
Rainfed Area Development (RAD)	227.93
Per Drop More Crop (PDMC) Scheme	2655.45
Mission for Integrated Development of Horticulture (MIDH)	1965.98
National Bamboo Mission (NBM)	50.00
National Innovations in Climate Resilient Agriculture (NICRA)	48.15

The desired objectives/targets have also been successfully met by utilizing the allocated budget. However, there is need for concerted efforts to converge the schemes for upscaling climate resilient agriculture in vulnerable areas."

1.29 The Department added that the Rashtriya Krishi Vikas Yojana (RKVY) being a Centrally Sponsored (State Plan) Scheme provides flexibility and autonomy for selection, planning approval and execution of projects/programs under the scheme as per their need, priorities and agro-climate requirements.

1.30 On being specifically asked by the Committee as to how the Department of Agriculture and Farmers Welfare has enhanced Climate Resilience by implementing short and long-term Climate mitigation and adaptation strategies and to also state as to whether the process was transparent and inclusive participation of multiple actors and stakeholders in decision-making and management processes was ensured, the Department submitted:-

"The Government of India is implementing the National Action Plan on Climate Change (NAPCC) which provides an overarching policy framework for climate action in the country. National Mission for Sustainable Agriculture (NMSA) is one of the Missions within the National Action Plan on Climate Change (NAPCC). The mission aims to evolve and implement strategies to make Indian Agriculture more resilient to the changing climate. NMSA was approved for three major components *i.e.* Rainfed Area Development (RAD); On Farm Water Management (OFWM); and Soil Health Management (SHM). Subsequently, four new programmes were introduced namely Soil Health Card (SHC), Paramparagat Krishi Vikas Yojana (PKVY), Mission Organic Value Chain Development in North Eastern Region (MOVCDNER) and Per Drop More Crop. In addition to aforementioned programmes under NMSA, restructured National Bamboo Mission (NBM) was launched in April 2018.

To meet the challenges of sustaining domestic food production in the face of changing climate, the Indian Council of Agricultural Research (ICAR), Ministry of Agriculture and Farmers Welfare, Government of India launched a flagship network project 'National Innovations in Climate Resilient Agriculture' (NICRA) in 2011. The project aims to develop and promote climate resilient technologies in Agriculture which will address vulnerable areas of the country and the outputs of the project will help the districts and regions prone to extreme weather conditions like droughts, floods, frost, heat waves, etc. to cope with such extremes. The project is implemented through components *viz*. strategic research, technology demonstration & dissemination and capacity building in 151 clusters of villages in each one of the identified climatically vulnerable districts. The program is being implemented in 446 villages involving an area about 2,03,649 hectares with 1,83,753 households distributed in 28 States and one Union Territory. Demonstrations of proven technologies (location specific) were given to farmers to enhance adaptive capacity and to cope with current climatic variability. The interventions are divided into natural resource management, crop production, livestock and fisheries and creation of institutional structures. ICAR-CRIDA in association with other ICAR Institutes, SAUs and KVKs has prepared district agricultural contingency plans for about 650 districts. These plans for implementing the contingency plans for delayed Monsoons and other extreme weather events. These contingency plans are hosted on the Websites of ICAR-CRIDA and Ministry of Agriculture & Farmers Welfare.

The process was transparent and inclusive participation of multiple actors and stakeholders. Promotion of Climate Resilient Farming was carried out through Extension Activities:

- Climate resilient technologies are disseminated among farmers through different Extension activities under ATMA Scheme and through State Government/KVKs.

- Extension activities under the scheme include farmers' training, demonstrations, exposure visits, Kisan Melas, Mobilization of Farmer's Interest Groups, Setting up of Farm Schools in the fields of awardee farmers etc.
- Climate Resilient Technology is covered under ATMA Guidelines. It is also one of the National Priority Areas for carrying out various extension activities under ATMA for enhancing outreach among farmers."

1.31 On being asked that given the three level tier of governance in India *viz* at Centre, State and local level and differences in priorities between National Action Plan on Climate Change (NAPCC) and State Action Plan on Climate Change(SAPCC) due to financial constraints, institutional heterogeneity *et al.,* how does the Department plan to ensure 'Climate justice' *(a term Indian delegations had been invoking strongly on International Fora over the past years)*, to Small and Marginalized Farmers especially from SC/ST across diverse geographical locations ranging from Thar Desert to North Eastern Himalayan region and from Indo Gangetic Plains to Central Highlands & Deccan Plateau till Coastal regions, the Department have stated as under-

> "To support the objectives of NAPCC, as on date 34 States and Union Territories have already prepared their State Action Plan on Climate Change (SAPCC) to address State specific actions. States/UTs were asked to revise the SAPCC based on the SAPCC guidelines issued in the year 2019 from the Ministry of Environment Forest and Climate Change. So far seven States had revised the SAPCC."

F. National Mission for Sustainable Agriculture (NMSA)

1.32 The Committee were informed that the Department of Agriculture & Farmers Welfare is implementing the National Mission for Sustainable Agriculture (NMSA) as part of the National Action Plan on Climate Change (NAPCC) to promote sustainable agricultural practices with environmental considerations. The NMSA aims to transform Indian Agriculture into an ecologically sustainable and climate resilient production system while ensuring food security, employment, and livelihood opportunities in rural areas. Climate Resilient Agriculture technologies are promoted through various mission schemes under the NMSA. Initially, the NMSA was approved for three major components: Rainfed Area Development (RAD), On Farm Water Management (OFWM), and Soil Health Management (SHM). Subsequently, four new programs were introduced, namely Soil Health Card (SHC), Paramparagat Krishi Vikas Yojana (PKVY), Mission Organic Value Chain Development in the North Eastern Region (MOVCDNER), and Sub Mission on Agroforestry (SMAF). In the year 2015-16, the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) was launched, which incorporated the OFWM component of the NMSA under the Per Drop More Crop (PDMC) component of PMKSY. In addition to the aforementioned programs under the NMSA, the Restructured National Bamboo Mission (NBM) was launched in April 2018.

1.33 On being asked to elaborate the vision and strategy of National Mission for Sustainable Agriculture (NMSA), the Department of Agriculture and Farmers Welfare stated:-

> "National Mission for Sustainable Agriculture (NMSA): Vision and Objectives

The National Mission for Sustainable Agriculture (NMSA) aims at transforming Indian Agriculture into an ecologically sustainable climate resilient production system, while ensuring food security, employment and livelihood opportunities in rural areas. Adequate food grain production despite variable climate contributes to economic stability at national level. The Mission builds on the on-going schemes of the Ministry of Agriculture and Farmers Welfare and also leverages related interventions from other Missions.

The Vision

- Bring resilience in agricultural production against climate variability and change.
- Conserve natural resources like soil, water, pollinators & biodiversity to achieve sustainable crop and livestock production.
- Increase green cover & carbon stocks.
- Ensure food security and economic stability.

i.The Mission will address key priorities like rainfed Agriculture, soil health, water use efficiency and climate ready crops/ cropping patterns and farming systems through major functional areas like research & development, technology adoption and upscaling, infrastructure, and capacity building.

ii. NMSA focuses on following key elements for sustaining Agriculture growth.

Key Focus Areas

- Science based strategic interventions for climate change adaptation and mitigation.
- Focusing on vulnerable regions like rainfed, hilly and coastal and agriculturally important heritage sites.
- Upscaling successful practices assessed under the National Innovations on Climate Resilient Agriculture (NICRA).
- Comprehensive coverage of Agriculture and allied sectors including animal husbandry, dairy, fishery, poultry and agroforestry/ bamboo.
- Addressing issues beyond production like value chain and risk management.

iv. Since climate change will have major impact on crop growth and water availability, NMSA will support R & D on climate ready crop varieties tolerant to drought, heat stress and submergence, cropping patterns and integrated farming systems suitable for different agro climatic conditions, pest forewarning, soil health improvement, rain water harvesting and ground water recharge. Adaptation and mitigation technologies already available will be upscaled through the schemes of the Department of Agriculture, Co-operation & Farmers Welfare (DAC&FW) and new initiatives will be launched wherever required.

v. Agriculture waste management, post-harvest processing & value addition, agro forestry including bamboo and organic farming are the new areas that will receive focused approach to bring more sustainability and additional income to farmers.

vi. Conserve globally, nationally, or regionally important agricultural heritage sites, wetlands, inland fresh water lakes, seasonally flooded swamp forests, eco systems and riverine lands to protect the livelihoods and cultures of the local communities.

vii. Encourage efficient energy use in Agriculture through need based mechanization and use of solar energy in Agriculture, zero tillage, residue management to avoid crop residue burning and crop diversification matching with water availability.

viii. Strong linkage to be established with Indian Meteorological Department (IMD) for utilization of short range and medium range weather forecasting at taluka level along with micro-level information of agromet field units (AMFU) for timely dissemination of weather based agro advisories to farmers.

ix. A major shift in the approaches of capacity building of farmers will be undertaken by collaborating with State Government and Non-Government organizations. For this the ongoing extension mechanism will be revitalized with reinforcement of effective institutional system and modules.

x. The Mission will have convergence with other Missions like Water, Green India, Energy Efficiency, Solar Energy, Himalayan Eco system and Strategic Knowledge for formulating strategic interventions and knowledge exchange.

xi. A strong review, monitoring and evaluation mechanism will be part of the Mission with provision for mid-course correction.

(a) Mission Strategy

To achieve these objectives, NMSA will have following multi-pronged strategy:

i. Promoting integrated farming system covering crops, livestock & fishery, plantation and pasture based composite farming for enhancing livelihood opportunities, ensuring food security and minimizing risks from crop failure through supplementary/ residual production systems;
ii. Popularizing resource conservation technologies (both on-farm and off-farm) and introducing practices that will support mitigation efforts in times of extreme climatic events or disasters like prolonged dry spells, floods etc. Promoting effective management of available water resources and enhancing water use efficiency through application of technologies coupled with demand and supply side management solutions;
iii. Encouraging improved agronomic practices for higher farm productivity, improved soil treatment, increased water holding capacity, judicious use of chemicals/ energy and enhanced soil carbon storage;
iv. Creating database on soil resources through land use survey, soil profile study and soil analysis on GIS platform to facilitate adoption of location and soil specific crop management practices & optimize fertilizer use;

v. Promoting location and crop specific integrated nutrient management practices for improving soil health, enhancing crop productivity and maintaining quality of land and water resources;
vi. Involving knowledge institutions and professionals in developing climate change adaptation and mitigation strategies for specific agro climatic situations and promoting them through appropriate farming systems;
vii. Programmatic interventions as per land capability and conducive to climatic parameters in select blocks as pilots for ensuring integrated development through dissemination and adoption of rainfed technologies with greater reach in disadvantaged areas & location specific planning by way of coordination, convergence and leveraging investments from other Schemes/Missions like MGNREGS, IWMP, RKVY, National Food Security Mission (NFSM), Mission for Integrated Development of Horticulture (MIDH), National Mission for Agricultural Extension & Technology (NMAE&T) *etc.* A consortium approach may be evolved with various stake holders including knowledge partners like State Agricultural Universities (SAUs), Krishi Vigyan Kendras (KVKs), Indian Council of Agricultural Research (ICAR) Centres, professional organizations *etc*. by the State Government to provide single window service/knowledge provider system for the benefit of farming community;
viii. State Government may engage reputed NGOs for implementation of cluster/ village development plan in case of limited govt. infrastructure is available in that area through a transparent system of selection and defined process of supervision and monitoring through a line department;
ix. Strong technical monitoring and feedback systems on climate change mitigation and adaptation issues to the National Advisory council for regular updates on technical feasibility of various components and their effectiveness in bringing about the climate resilience. The experts of central institutes and state agricultural universities would be part of such technical monitoring/feedback. The capacity building of the implementing agencies would be steered by MANAGE;
x. Establishing platform to liaison, review and coordinate implementation of interventions outlined in Mission Document of NMSA under aegis of National Action Plan on Climate Change."

(b) Measurable Indicators for the NMSA Activities

1.34 Measurable indicators for the mission activities can be observed through various factors. These include the area of land dedicated to organic farming, the production of bio-fertilizers, the implementation of precision irrigation techniques, the adoption of SRI/Direct Seeded Rice from Transplant method, crop diversification, the expansion of plantation areas in arable land, the identification and release of climate resilient varieties, the discovery of genotypes with enhanced CO_2 fixation potential and reduced water and nutrient consumption, and the development of genotypes that are resilient to drought, flood, salinity, and high temperature.

1.35 On being further asked to enumerate schemes and contingency plans put in place to deal with adverse climate situations especially in drought and flood prone areas

and the infrastructure being created to aid farmers in these areas, the Department have submitted here as under -

"Several schemes have been initiated by the Government of India to deal with the adverse climate situations in the Agriculture sector across the country. The Rainfed area development (RAD) program under National Mission on Sustainable Agriculture (NMSA) aims to make rainfed Agriculture more productive, sustainable, remunerative and climate resilient. The sub-mission on Agroforestry aims to increase tree cover in non-forest areas for higher carbon sequestration. The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) aims to improve on-farm water use efficiency, enhance the adoption of precision irrigation and other water saving technologies (more crop per drop) and enhance recharge of aquifers. The Pradhan Mantri Fasal Bima Yojana (PMFBY) initiated to provide the full insured amount on crop losses due to natural calamities. In addition, programs like Paramparagat Krishi Vikas Yojana (PKVY) aims to improvement of soil health. The scheme Bharatiya Prakritik Krishi Paddhati Programme (BPKP) aims to promote traditional indigenous practices and to create awareness and capacity building of farmers. National Horticulture Mission, National Agroforestry & Bamboo Mission (NABM) and National Policy for Management of Crop Residues (NPMCR) also aim to increase climate resilience.

Indian Council of Agricultural Research (ICAR) has launched a flagship network project 'National Innovations in Climate Resilient Agriculture' (NICRA) in 2011 with an aim to develop and promote climate resilient technologies in Agriculture which will address vulnerable areas of the country. The outputs of the project will help the districts and regions to cope with extreme weather conditions like droughts, floods, cyclone, frost, heat waves etc. Contingency planning is one of the major strategies of preparedness for tackling aberrant weather events. In the face of increasing climate variability, adoption and implementation of the District Level Contingency Plans (DACP) is a priority for many state governments. ICAR prepared DACPs for 650 districts of the country recommending location specific climate resilient crops and varieties and management practices for use by the state departments of Agriculture and farmers."

(c) Schemes under National Mission for Sustainable Development (NMSA)

(i) Rainfed Area Development (RAD)

One of the schemes under the National Mission for Sustainable Development (NMSA) is the Rainfed Area Development (RAD). This scheme is implemented as a component of NMSA in a cluster approach, taking into account the type and extent of natural resources, assets, and commodities that have already been developed or supported. RAD focuses on the integration of farming systems with activities such as agroforestry, horticulture, livestock, fishery, and apiculture. This integration aims to enhance productivity and minimize risks associated with climatic variability, such as droughts, floods, and extreme weather events. By integrating various activities, RAD provides income opportunities for farmers even during crop damage.

RAD has been implemented in all states and union territories (except Punjab and Goa) since 2014-15. An amount of Rs. 1511.56 crore has been released for this scheme, covering an area of 6.74 lakh hectares up to the year 2021-22.

(ii) Per Drop More Crop (PDMC)

Another important scheme is the Per Drop More Crop (PDMC) scheme, which has been implemented by the Department of Agriculture and Farmers Welfare (DA&FW) since 2015-16. PDMC focuses on enhancing water use efficiency at the farm level through the adoption of micro irrigation systems, such as drip and sprinkler irrigation. These systems not only save water but also reduce fertilizer usage, labor expenses, and other input costs. They contribute to sustaining soil health and enhancing overall income for farmers. So far, a total amount of Rs. 16815.66 crore has been released for the Micro Irrigation scheme, covering an area of 70.04 lakh hectares. This includes an area of 1,03,696.49 lakh hectares achieved in Namami Gange areas in the states of Uttarakhand, Uttar Pradesh, Bihar, West Bengal, and Jharkhand. Evaluation studies conducted by NITI Aayog on the PMKSY-PDMC scheme have shown that water use efficiency has improved by around 30% to 70% through micro irrigation adoption, water savings range from 30% to 50%, farmers' income has increased by 10% to 69%, and the scheme has created direct and indirect employment opportunities.

1.36 The Committee desired to know from the Department about the plans to counter the challenges of Micro irrigation in Himalayan States and Hilly districts in other states of the country and to mention any schemes, in the offing, of providing tax incentives/subsidies to Farmers in these mountain areas. In response thereto, the Department stated:

> "Department of Agriculture & Farmers Welfare (DA&FW) is implementing Centrally Sponsored Scheme of Per Drop More Crop (PDMC) in the country from 2015-16. During the year 2015-16 to 2021-22, the PDMC was implemented a component of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY). From the year 2022-23, the PDMC is being implemented under the Rashtriya Krishi Vikas Yojana (RKVY). PDMC focuses on enhancing water use efficiency at farm level through Micro Irrigation namely, Drip and Sprinkler Irrigation Systems.
>
> Micro Irrigation helps in water saving as well as reduced fertilizer usage through fertigation, labour expenses, other input costs and overall income enhancement of farmers. Recent evaluation studies of the scheme have reiterated that Micro Irrigation is relevant in achieving national priorities such as improving on-farm water use efficiency, enhancing crop productivity, improving quality of Agri/Horti. products *etc*.
>
> - The Government provides financial assistance @ 55% for small and marginal farmers and @ 45% for other farmers for installation of Drip and Sprinkler systems under the PDMC which will be met by both Central Government and State Government in the ratio of 60:40 for all states except the North Eastern and Himalayan states. In the case of these states, ratio of sharing is 90:10. For the Union Territories, funding pattern is 100% grant by the Central Government.

- The subsidy computation is as per to the unit costs specified in the Operational Guidelines of the scheme. 25% higher amounts are taken into calculation of subsidy for the North Eastern & Himalayan States and UTs of JK & Ladakh and 15% higher for States with low penetration of Micro Irrigation (Where adoption of Micro Irrigation is lesser).
- The Assistance for installation of Micro Irrigation systems is up to 5 hectares per beneficiary.
- The Operational Guideline of Per Drop More Crop has been revised recently. In the revised guidelines, GST applicable on the Micro Irrigation Systems has been included in the unit cost of Micro Irrigation system on which subsidy will be admissible for the beneficiary. This will help to reduce the financial burden on the beneficiary.
- Besides, the PDMC also promotes Other Intervention (OI) activities to be taken up based on actual requirement. Under OI, micro level water harvesting/ storage *viz*. Farm Pond, Secondary storage structure, Construction of Tube wells / Bore wells (Shallow / Medium), Restoration / Renovation of small tank, Recharge of defunct bore well etc. are promoted. The States can plan for these activities to be restricted upto 40% of the total allocation for North East & Himalayan States/UTs & 20% for other States/UTs. The OI activities are to be mandatorily linked with Micro Irrigation to make potential use of the available water for higher water use efficiency.

Achievements made under PDMC:

Year	Central Assistance released (Rs. in crore)	Area covered under Micro Irrigation (in lakh ha)
2015-16	1556.73	5.73
2016-17	1991.24	8.40
2017-18	2819.39	10.49
2018-19	2918.38	11.59
2019-20	2700.02	11.73
2020-21	2562.19	9.37
2021-22	1796.12	10.15
2022-23	1901.37	11.02
Total	**18245.44**	**78.48**

For the year 2023-24, Central Assistance of Rs 2656.43 crore (BE) has been allocated for implementation of PDMC under RKVY."

(iii) Mission Organic Value Chain Development in North East Region (MOVCDNER)

The Mission Organic Value Chain Development in North East Region (MOVCDNER) scheme aims to harness the potential of organic farming in the North Eastern Region of the country. This Scheme, implemented from 2015-16 to 2017-18, focuses on the development of certified organic production in a value chain mode, linking growers with

consumers. The Scheme supports the entire value chain, including inputs, seeds, certification, and the creation of facilities for collection, aggregation, processing, marketing, and brand building. Currently, 379 Farmer Producer Companies have been formed under this scheme, consisting of 1.89 lakh farmers and covering an area of 1.73 lakh hectares.

(iv) Restructured National Bamboo Mission (NBM)

The Restructured National Bamboo Mission (NBM) launched in 2018-19, aims to develop the complete value chain of the bamboo sector. This includes activities such as plantation, the creation of facilities for collection, aggregation, processing, marketing, and brand building. The objectives of the NBM are to increase the area under bamboo plantation in non-forest government and private lands, supplement farm income, meet the raw material requirement of industries, increase the green cover, and enhance carbon sequestration potential.

(v) Paramparagat Krishi Vikas Yojana (PKVY)

The Paramparagat Krishi Vikas Yojana (PKVY) was introduced in 2015-16 as an unprecedented initiative in the nation, with the purpose of promoting chemical-free organic farming through a cluster approach, along with the implementation of the Participatory Guarantee System (PGS) certification. This Scheme aims to uphold soil health, reduce cultivation costs, empower farmers through institutional building, and provide support to farmers in terms of value addition and marketing linkage for their organic products. The objectives of this Scheme include the promotion of integrated and climate-resilient farming systems that are based on natural resources, ensuring the enhancement of soil fertility, conservation of natural resources, on-farm nutrient recycling, and reducing farmers' reliance on external inputs. Additionally, the Scheme aims to decrease cultivation costs, thereby increasing farmers' net income, produce chemical-free and healthy food for human consumption in a sustainable manner, and protect the environment from hazardous inorganic chemicals by adopting eco-friendly and low-cost traditional techniques, as well as farmer-friendly technologies.

Under this Scheme, assistance is provided to farmers for various activities such as cluster formation, capacity building, procuring inputs, processing, packing, labeling, branding, and marketing of organic products. Currently, an area of 11.80 lakh hectares has been covered, benefiting 16.19 lakh farmers.

(vi) System of Rice Intensification/ Direct Seeded Rice (SRI/DSR)

The System of Rice Intensification/Direct Seeded Rice (SRI/DSR) is included in the National Food Security Mission (NFSM) and Bringing Green Revolution to Eastern India (BGREI) programs. The NFSM was launched in 2007-08 with the aim to increase the production of rice, wheat, and pulses through expanding the cultivation area and enhancing productivity, restoring soil fertility and productivity, creating employment opportunities, and improving the farm-level economy. Coarse cereals were included in the NFSM from 2014-15 onwards. The mission has continued during the 12th Five-Year Plan with a new target of additional food grain production of 25 million tonnes, including

10 million tonnes of rice, 8 million tonnes of wheat, 4 million tonnes of pulses, and 3 million tonnes of coarse cereals by the end of the 12th Plan. Beyond the 12th Plan, the mission is being continued with a new additional target of 13 million tonnes of food grains, comprising 5 million tonnes of rice, 3 million tonnes of wheat, 3 million tonnes of pulses, and 2 million tonnes of nutri-cum-coarse cereals from 2017-18 to 2019-20.

(vii) Crop Diversification

Crop diversification is a Programme that has been implemented in the original Green Revolution states, namely Punjab, Haryana, and Western Uttar Pradesh, as a sub-scheme of the Rashtriya Krishi Vikas Yojana (RKVY) since 2013-14. The goal of this Programme is to divert the cultivation area from water-intensive paddy to alternative crops such as pulses, oilseeds, coarse/nutri cereals, cotton, and agroforestry, with the objective of addressing the issues of declining soil fertility and depleting water table in these states.

(viii) Mission for Integrated Development of Horticulture (MIDH)

Mission for Integrated Development of Horticulture (MIDH) is a Centrally Sponsored Scheme that has been implemented since 2014-15 to promote the holistic growth of the Horticulture Sector. This includes fruits, vegetables, root and tuber crops, mushrooms, spices, flowers, aromatic plants, coconut, cashew, and cocoa. The main objectives of this mission are to encourage the comprehensive development of the horticulture sector, including coconut, through regionally differentiated strategies based on the comparative advantage of each state/region and its diverse agri-climatic features. This includes research, technology promotion, extension services, post-harvest management, processing, and marketing. The mission also aims to encourage the formation of farmers' groups such as Farmers Interest Groups (FIGs), Farmer Producer Organizations (FPOs), and Farmers Producer Companies (FPCs) to achieve economies of scale and scope, enhance horticulture production, increase farmers' income, strengthen nutritional security, improve productivity through the use of quality germplasm, planting material, and water-efficient technologies like micro-irrigation, support skill development, and create employment opportunities for rural youth in horticulture and post-harvest management, particularly in the cold chain sector. Furthermore, the mission provides support for capacity building of farmers and technicians in adopting improved technologies through existing institutions such as State Agriculture Universities, Krishi Vigyan Kendras, and institutes with departments of horticulture in states. Currently, Rs. 13300.08 crore has been released, covering an area of 11.26 lakh hectares.

(ix) Soil Health Card (SHC)/ Soil Health Management (SHM)

The Soil Health Card (SHC)/Soil Health Management (SHM) scheme, initially under the National Project on Management of Soil Health & Fertility, is now a component of the Rashtriya Krishi Vikas Yojana (RKVY) from the year 2022-23. The main objective of this Scheme is to assist states in promoting Integrated Nutrient Management (INM) by judiciously using chemical fertilizers, including secondary and micronutrients, in conjunction with organic manures and bio-fertilizers, to improve soil health and

productivity. This Scheme includes sub-components such as the establishment/strengthening of Soil Testing, Fertilizers/Bio-fertilizers & Organic fertilizers Quality Control Labs, promotion of micro-nutrients, and testing soil samples to issue Soil Health Cards. The soil samples should be processed following standardized procedures and analyzed for various parameters such as pH, electrical conductivity (EC), organic carbon, available N, P, K, S, and micronutrients (Zn, Cu, Fe, Mn, B). Soil Health Card facilitates farmers with valuable information regarding the nutrient status of their soil and offers suggestions on the optimal dosage of nutrients that should be administered in order to enhance the soil's well-being and fertility. The government has already allocated a substantial sum of Rs. 1335.68 Crore for the implementation of this Scheme.

Soil Health Management

(a) Establishment of Soil Testing Labs

The management of soil health encompasses several key activities. Firstly, there has been a significant effort in establishing soil testing laboratories. A total of 499 new static soil testing labs (STLs), along with 113 new mobile STLs, have been sanctioned. Additionally, the existing STLs have been strengthened with the establishment of 864 new units. Furthermore, 8811 mini STLs and 2395 village level STLs have also been approved for various states and union territories under this scheme.

(b) Establishment of Quality Control Labs

Another aspect of soil health management is the establishment of quality control laboratories. Specifically, 11 new fertilizer quality control labs (FQCLs) and 123 strengthened FQCLs have been sanctioned. Moreover, 17 new bio-fertilizer/organic fertilizer quality control labs (BOQCLs) and 16 strengthened BOQCLs have also been approved under this scheme.

(c) Establishment of Bio-fertilizer Production Units and Compost Unit

In addition to soil testing and quality control, there has been a focus on establishing bio-fertilizer production units and a compost unit. A total of 25 bio-fertilizer production units and 31 strengthened units have been established. Furthermore, one compost unit has also been established/strengthened as part of this scheme.

(d) Miscellaneous Activities

Lastly, under the promotion and distribution of micro-nutrients in the scheme, an area of 1,029,355 hectares has been covered. This highlights the comprehensive efforts being made to improve soil health through various activities.

Overall, these initiatives demonstrate the commitment to soil health management and the recognition of its importance in agricultural practices.

Soil Health Card (SHC)

(a) Distribution of SHCs to Farmers

Soil Health Cards (SHCs) have been distributed to farmers in large numbers over the years. In the first cycle from 2015 to 2017, a staggering 10.74 crore grid-based soil health cards were distributed. The distribution continued in the second cycle from 2017 to 2019 with 11.97 crore cards reaching the farmers. Additionally, in the Model Village Programme of 2019-20, 19.64 lakh land-holding based soil health cards were distributed nationwide. The distribution efforts persisted in the year 2020-21, as 11.52 lakh land-holding based Soil Health Cards were distributed, including in Varanasi, Uttar Pradesh.

(b) Organizing various types of Trainings

The Scheme focused on organizing various types of trainings to educate and empower individuals. Specifically, 1904 trainings were conducted for soil chemists, 1827 trainings were organized for extension staff, and a staggering 93781 trainings were provided to farmers for the implementation of SHC recommendations. These trainings were held in different states and union territories under the scheme.

(c) **Organizing Demonstrations, Farmer Melas and Workshops**

Demonstrations, farmer melas, and workshops were also organized to further promote the adoption of SHC recommendations. A total of 6.45 lakh demonstrations, 7425 Farmer Melas, and 79 workshops were conducted in various States and Union Territories as the part of this Scheme.

(x) **Sub-Mission on Agroforestry**

The Sub-Mission on Agroforestry, introduced in 2016-17 by the Government of India, aimed to encourage tree plantation on farm land. This scheme, known as "Har Medh Par Ped" promotes the simultaneous cultivation of trees and crops. It is being implemented in 21 States and Union Territories, including Andhra Pradesh, Bihar, Gujarat, Maharashtra, Rajasthan, Tamil Nadu, and Uttar Pradesh, among others. The scheme facilitates the planting of selected tree species in States that have relaxed transit regulations for such trees. The objective is to create an additional source of income for farmers and contribute to carbon sequestration.

Agroforestry encompasses the cultivation of multipurpose tree species that yield short, medium, and long-term returns. This approach enables farmers to generate additional income at regular intervals by cultivating fruits, fodder, medicinal plants, and timber species. It also promotes tree plantation in farmland, thereby enhancing soil organic matter and improving nutrient uptake by crops. Agroforestry not only provides income and savings opportunities for farmers, but also acts as a safeguard against crop

damage. Furthermore, it contributes to carbon sequestration and aligns with national initiatives on climate change adaptation and mitigation.

The impact of agroforestry on soil health is measured through the soil health card, which is periodically issued to farmers. The card reflects the soil health status and provides valuable insights into the organic matter content and nutrient uptake by crops at different stages of the program.

1.37 When asked to furnish the details of the effectiveness of the Scheme in adaptation/ mitigating the side effects of Climate Change especially in Backward/Tribal / Drought Prone/Flood prone regions of the country alongwith relevant examples, the Department stated as under -

> "The effectiveness of the Scheme in adaptation/ mitigating the side effects of Climate Change through various schemes of NMSA can be summarized as:
> To promote efficient use of water and fertilizer through micro-irrigation, Per Drop More Crop (PDMC) scheme is being implemented for which an amount of Rs. 16815.66 crore has been incurred with area coverage of 70.04 lakh ha. Rainfed Area Development (RAD) scheme is being implemented to promote sustainable Integrated Farming System with area coverage of 6.74 lakh ha. for which an expenditure of Rs. 1511.56 crore has been incurred. For promoting organic farming, under Mission Organic Value Chain Development in North East Region (MOVCDNER), 379 Farmer Producer Companies have been formed comprising of 1.89 lakh farmers and covering an area of 1.73 lakh ha. Mission for Integrated Development of Horticulture (MIDH) is being implemented in which so far Rs. 13300.08 crore has been released with area coverage of 11.26 lakh ha. Paramparagat Krishi Vikas Yojana (PKVY) was initiated to promote organic farming in the country and so far 11.80 lakh ha area has been covered with 16.19 lakh farmers being benefitted. Soil health Cards/Soil Health Management Scheme is being implemented for which an expenditure of Rs. 1335.68 crore has been incurred so far for various activities for improving soil health and its fertility. Till now 22.71 crore grid based soil health cards have been distributed to farmers under the scheme. Although climate change is understood to have its negative impact on food crops, through the help of technology, the negative impacts have been dealt with effectively."

1.38 On being asked to furnish details of schemes being implemented by the Department to safeguard interests of the Farmers and those employed in Allied Sector from the adverse effects of Climate Change and to also provide details of the Schemes to supplement income of Farmers apart from credit enhancement to protect their livelihood with deleterious effects of Climate Change, the Department stated:

> "National Mission for Sustainable Agriculture (NMSA) is one of the Missions within the National Action Plan on Climate Change (NAPCC) under Hon'ble Prime Minister's Council for Climate Change. The mission aims to evolve and implement strategies to make Indian Agriculture more resilient to the changing climate. NMSA was approved for three major components *i.e.* Rainfed Area Development (RAD); On Farm Water Management (OFWM); and Soil Health Management (SHM).Subsequently, four new programmes were introduced namely Soil Health

Card (SHC), Paramparagat Krishi Vikas Yojana (PKVY), Mission Organic Value Chain Development in North Eastern Region (MOVCDNER) and Sub Mission on Agroforestry (SMAF). During 2015-16, Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) was operationalised wherein the OFWM component of NMSA was subsumed under Per Drop More Crop (PDMC) component of PMKSY. In addition to aforementioned programmes under NMSA, Restructured National Bamboo Mission (NBM) was launched in April 2018.

Government introduced flagship yield based Pradhan Mantri Fasal Bima Yojana (PMFBY) along with weather index based Restructured Weather Based Crop Insurance Scheme (RWBCIS) from Kharif 2016. The scheme aims at supporting sustainable production in Agriculture sector by way of providing financial support to farmers suffering crop loss/damage arising out of unforeseen natural calamities, adverse weather incidence and to help in stabilize the income of farmers to ensure their continuance in farming. Comprehensive risk insurance to farmers is provided against non-preventable natural calamities such as drought, dry-spells, flood, hailstorm and inundation *etc.* under the scheme for entire crop cycle including pre-sowing to post-harvest losses.

The Scheme is being implemented on actuarial/bidded premium rate basis. However, farmers have to pay a minimum uniform fixed premium rate maximum 2% for Kharif, 1.5% for Rabi food and oilseed crops and 5% for annual commercial/horticultural crops, with balance of actuarial/bidded premium being shared by the Central and State Government on 50:50 basis except in North Eastern States (from Kharif 2020) and Himalayan States (from Kharif 2023), where it is 90:10. The scheme is voluntary for the States since inception and for all farmers *w.e.f.* Kharif 2020.

The Scheme envisages coverage of all food crops, oilseeds and commercial/ horticultural crops subject to availability of specified past yield/weather data. The crops for which requisite past yield data is not available can be covered under RWBCIS. Actual crop under the scheme is notified by the concerned State Government.

The Scheme envisages use of improved technology in implementation of the scheme. Accordingly, various measures have been taken by the Government to infuse technology for better results in the implantation of the Scheme, viz., capturing of yield data/Crop Cutting Experiments (CCEs) data through CCE-Agri App &uploading them on the National Crop Insurance Portal (NCIP), allowing insurance companies to witness the conduct of CCEs, Yield Estimation through Technology (YESTECH), Weather Information Network Data System (WINDS), Collection of Real-time Photos and Observation of Crops (CROPIC), integration of State land records with NCIP etc. to improve timely settlement of the claims to farmers, launch of DIGIClaim Payment Module for Direct claim disbursement to farmers account through NCIP via DIGICLAIM under the scheme along with penalty provisions for delay in settlement of claims. These technological advancements have taken PMFBY one step further towards modernization of the scheme. PMFBY is one of the area based scheme globally to use technology so extensively in its implementation

Since inception of the scheme in 2016-17 to 2022-23, 4,814 lakh famer applications have been enrolled over an area of 3,479 lakh ha. for a sum insured of Rs. 14,37,645 crore. Claims of Rs. 1,35,248 crore have already been paid to 1,346 lakh farmer applications which includes partial claims for Kharif-22 also (As on 30-04-2023)."

G. National Innovations in Climate Resilient Agriculture (NICRA)

1.39 National Innovations on Climate Resilient Agriculture (NICRA) is a network project of the Indian Council of Agricultural Research (ICAR) launched in February, 2011. The Project aims to enhance resilience of Indian Agriculture to climate change and climate vulnerability through strategic research and technology demonstration. The research on adaptation and mitigation covers crops, livestock, fisheries and natural resource management. The project consists of four components *viz*. Strategic Research, Technology Demonstration, Capacity Building and Sponsored/Competitive Grants.

Project Components

1.40 Both short term and long term outputs are expected from the Project in terms of new and improved varieties of Crops, Livestock breeds, management practices that help in adaptation and mitigation and inputs for policy making to mainstream climate resilient Agriculture in the developmental planning. The overall expected outcome is enhanced resilience of agricultural production to climate variability in vulnerable regions. The project is comprised of four components.

1) Strategic research on adaptation and mitigation
2) Technology demonstration on farmers' fields to cope with current climate variability
3) Sponsored and competitive research grants to fill critical research gaps
4) Capacity building of different stake holders

1.41 On being asked to provide the objectives of National Innovations in Climate Resilient Agriculture(NICRA) programme and the difficulties faced in its implementation along with subsequent actions taken thereon to overcome the same, the Department stated:-

"The objectives of NICRA project are:

- To enhance the resilience of Indian Agriculture to climatic variability and climate change through strategic research on adaptation and mitigation,
- To validate and demonstrate climate resilient technologies on farmer's fields,
- To strengthen the capacity of scientists and other stakeholders in climate resilient Agriculture and
- To draw policy guidelines for wider scale adoption of resilience-enhancing technologies and options.

Budget allocation for NICRA is insufficient. However, through convergence with ongoing schemes of different ministries some of the expenditure for technology demonstration component is met."

1.42 The Committee inquired as to how Climate risk screening was done for finalization of villages to be adopted/ covered under NICRA (National Innovations in Climate Resilient Agriculture) and the complete procedure followed and the parameters taken into account in this regard may please be stated. In response thereto, the Department submitted:

> "Following the framework given in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report, risk and vulnerability of Agriculture to climate change were assessed at district level. Climate change risk was assessed in terms of an index that combines indices of exposure, vulnerability and hazard which were constructed by aggregating relevant indicators. Climate change projections derived from CMIP-5 climate models based on the scenario Representative Concentration Pathway 4.5 (RCP 4.5) for the period 2020-49 were used to represent hazard. Climate change risk was found to be 'very' high' in 109 districts and 'high' in 201 districts. Districts with 'very high' climate change risk are located in the states of Rajasthan, Uttar Pradesh, Bihar, Kerala, Uttarakhand, Odisha, *etc*. while those with 'high' risk are in Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Rajasthan, Karnataka, Maharashtra, etc. After identifying the risk prone districts in the country, representative villages in each of the identified districts were selected for implementing the NICRA programme."

1.43 On being asked to state the comparative differences in performance of villages adopted/ covered under NICRA and others who were not in the past five years and additionally, state as to how NICRA has brought changes in social and economic criterion in villages wherein it has been implemented, the Department submitted:-

> "As part of the Technology Demonstration Component (TDC) of National Innovations in Climate Resilient Agriculture (NICRA), demonstration of location specific climate resilient technologies is being taken up to minimize crop losses and enable farmers to cope with the adverse weather conditions. The demonstrations are taken up in farmers' fields in 151 risk prone districts of the country. Climate resilient technologies which can minimize the impact of dry spells, drought, flood and heat wave are being taken up in a cluster of villages in each of the district to make the farmers aware about the new technologies by way of demonstrations and by training them so that they can adopt these technologies to minimize crop losses and to enable them to become resilient even under variable climatic conditions.
>
> Adoption of the technologies led to minimization of the impact of climatic stresses and reduced the yield loss during the stress years. Short-duration and drought-tolerant varieties of pigeon pea (BDN-708), green gram (BM 2002-1), and chick pea (Digvijay and Vijay) were introduced on selected farmers' fields in Aurangabad district of Maharashtra (rainfall of 645 mm), which gave 20–25% higher yield than the local varieties under deficient rainfall situations. Drought-tolerant, short-duration varieties of sorghum (CSH-14) and pigeon pea (AKT-8811) introduced in several NICRA villages gave about 60 and 37% higher yields, respectively compared to local varieties of farmers who were not covered under NICRA. In regions where depth of water was more than 1 m and duration of flooding was more than 10 days submergence-tolerant rice varieties, such as

Jalashree and Jalkuwari produced about 53% higher grain yield compared to traditional rice varieties in Dhubri district, Assam. Adoption of in-situ conservation practices such as conservation furrows helped to improve the soil moisture availability at the root zone and eventually increased the productivity of crops by 15–20% in dry regions compared to the traditional practices of farmers. Crops performed better under ridge and furrow method of sowing and the seed yields increased by 22% in pigeon pea, 28% in black gram, 39% in green gram, and 27% in soybean when compared to farmers' practice of flatbed method of sowing in several locations. Formation of broad bed and furrow in soybean in Vertisols of Central India served as conservation as well as for draining excess water and increased yields to the extent of 23% and also enhanced net benefit by Rs. 6223 per hectare than that of flat method of sowing.

Harvesting water contributed to improvement in the area under irrigation in several NICRA villages and contributed to increase in cropping intensity to 139%. Efficient methods of irrigation such as sprinkler and drip methods resulted in reducing the application losses and enhanced the income of farmers through high value crops with optimum use of harvested water. In some of the locations, critical irrigations saved the crop from drought and contributed to yield improvement up to 100%. Introduction of fish and duck in the dugout pond resulting in an additional revenue of Rs. 60,200 per hectare per year which was significantly higher than that of sole arable cropping. Balanced ration coupled with feeding of urea molasses bricks and mineral mixture supplementation resulted in average improvement in milk yield by 15–20% in livestock. Improved shelter resulted in decreased mortality in animals from 4 to 10% and expenditure for treatment of affected animals was also avoided."

1.44 On being asked to provide the details of major impact created by National Innovations in Climate Resilient Agriculture since 2011 till date in the country and its contribution in the uplifting the agricultural yield and to also list some specific technologies in this field which have proved to be a game changer, the Department stated:

"The NICRA project aims at strategic research on adaptation and mitigation, demonstration of technologies on farmers' fields and creating awareness among farmers and other stakeholders to minimize the impacts of climate change on Agriculture. The major impact created by the project so far is given below:

- Studied the impact of elevated CO_2 and temp on crops, livestock, fisheries, soil, water, pests and diseases using simulation models. This helps to develop new and innovative climate resilient technologies to minimize the adverse impact of climate change.
- GHG inventorization and C sequestration potential of predominant production systems in the country is being carried out, contributing to India's Biannual Update Reports (BUR) being submitted to UNFCCC.
- Developed climate resilient varieties for different abiotic and biotic stresses in major crops. So far 15new varieties/hybrids were released in rice, wheat, green

gram, maize, lentil and tomato under NICRA. Apart from this, 177 climate resilient varieties have been evaluated for different climatic stresses in 151 vulnerable districts across the country. These climate resilient varieties can be upscaled by State Governments.

- District level risk and vulnerability assessment of Indian Agriculture to climate change is documented. The document contains information on relative position of districts of the country in relation to climate change risk and study showed that out of 573 districts, 109 were falling under very high risk prone and 201 are highly prone. This document is being extensively used by different Ministries, Developmental Departments and financial institutions viz., NABARD and World Bank for prioritizing resources for climate change adaptation and mitigation.
- Prepared district agricultural contingency plans (650 districts), updated (386 districts), validated (23 village clusters in 15 states) and sensitized State officials for preparedness through 60 State-level interface meetings.
- Dynamic crop-weather calendar for farm level decisions, agro-climatic atlas for Maharashtra and Bihar, and contributed to 'Meghdoot App' for accessing real-time weather information (> 2 crore users).
- Climate-induced pest and disease outbreaks in the country were studied in 9 crops *viz.,* rice, wheat, sorghum, chickpea, mustard, safflower, potato, tomato and onion (10 insects and 29 diseases) to build pest and disease forewarning models. Web enabled and mobile App for Forewarning Blue Tongue Disease in cattle have been developed and made available to farmers.
- To generate awareness and build capacity of farmers and other stakeholders and to evolve innovative institutional mechanisms at village level innovative institutional interventions *viz*., Village Climate Risk Management Committee (VCRMC), Custom Hiring Center(CHC), seed and fodder production systems *etc*., were established in the NICRA villages enabled to sustain the activities envisaged and scaling up of interventions.
- Participatory Technology Development is a unique feature of the NICRA Project. It involved farmers in risk assessment and adaptation techniques in 151 vulnerable district clusters covering 454 villages. Large-scale on-going demonstrations of location specific resilient technologies were undertaken to address major climatic vulnerabilities. Capacity building programs have been taken up involving 5.16 lakhs comprising researchers, farmers, entrepreneurs, line department officials, policy makers and NGOs in the field of climate resilient Agriculture.
- The outcome of NICRA is shared in several international fora *viz*., G-20, SAARC, BIMSTEC, ASEAN, QUAD, UNFCCC, FAO etc. and the climate change initiative of India is highly appreciated."

1.45 On being asked that in India, States such as Maharashtra and Odisha are implementing programmes similar to NICRA and adaptation and mitigation processes are being upscaled in several State Governments across the country and to name

States other than Maharashtra and Odisha, which are upscaling the adaptation and mitigation practices, the Department have stated as under:

> "Upscaling the adaptation and mitigation practices are being taken up in the following states
>
> - Scaling-up Climate Resilient Agriculture Practices towards Climate Smart Villages (Haryana)
> - Scaling Climate Smart Agriculture through mainstreaming Climate Smart Villages (Bihar)
> - Resilient Agricultural Households through Adaptation to Climate Change in Mahbubnagar District (Telangana)."

H. Sustainable Development Goal - 13

1.46 The Department was asked to furnished to detailed roadmap in regard to Sustainable Development Goal 13 (SDG 13) of United Nations and the key issues/challenges being faced by the Department at various levels and as to how does it plan to address successful implementation of SDG 13 to minimize the challenges being posed by Climate Change and to enlist the steps/measures already taken in this regard. In response thereto, the Department submitted:

> "India is a party to UNFCCC and its Paris Agreement. Despite having no binding mitigation obligation under the Convention, the Government of India had announced, in 2010, a voluntary goal of reducing the emission intensity of its GDP by 20-25% from 2005 levels by 2020. India has achieved a reduction of 24% in emission intensity of its GDP between 2005 and 2016, thereby achieving this voluntary goal. For the post 2020 period, India submitted its Nationally Determined Contribution (NDC) in 2015 outlining eight targets. India submitted its updated NDC in August 2022 translating Panchamrit targets announced by Hon'ble PM at COP-26 in Glasgow. India's NDC is ambitious and makes a significant contribution towards achieving the targets of the Paris Agreement. Achievement of India's NDC will be captured as its progress in achievement of SDG 13 on climate action.
>
> National Mission for Sustainable Agriculture (NMSA) is one of the Missions under the National Action Plan on Climate Change (NAPCC) in the Hon'ble Prime Minister's Council for Climate Change. The mission aims to evolve and implement strategies to make Indian Agriculture more resilient to the changing climate. NMSA was approved for three major components *viz.* Rainfed Area Development (RAD); On Farm Water Management (OFWM); and Soil Health Management (SHM) in the beginning. Subsequently, four new programmes were introduced namely Soil Health Card (SHC), Paramparagat Krishi Vikas Yojana (PKVY), Mission Organic Value Chain Development in North Eastern Region (MOVCDNER) and Sub Mission on Agroforestry (SMAF). During 2015-16, Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) was operationalised wherein the OFWM component of NMSA was subsumed under Per Drop More Crop (PDMC) component of PMKSY. In addition to aforementioned programmes under NMSA, Restructured National Bamboo Mission (NBM) was also launched in April 2018 to address successful implementation of SDG-13.

Further, National Innovations in Climate Resilient Agriculture (NICRA), a flagship network project of ICAR was initiated in the year 2011. NICRA project is a multi-sectoral, multi-location carrying the major mandate of addressing climate change and variability, and addressing range of stake holders needs across the country. Research, demonstration and capacity building are the three major components besides providing policy briefs on several aspects related to Agriculture and climate change. Given the persistent challenges of poverty and malnutrition, role of sustainable agricultural development in addressing these challenges assume importance. Climate change accentuates all other problems that threaten sustainability of Indian Agriculture."

I. Impact of Climate Change on India

(a) Impact on Crops

1.47 The effects of climate change on the cultivation of major crops, including rice, wheat, maize, and onion were examined. It utilized an integrated simulation modeling framework to analyze the impact of rising temperatures and carbon dioxide on soil organic carbon. Without the implementation of adaptation measures, it is projected that rainfed rice yields in India will decline by 20% in 2050 and 47% in 2080 scenarios. Similarly, irrigated rice yields are expected to decrease by 3.5% in 2050 and 5% in 2080 scenarios. The study also reveals that climate change will reduce wheat yield by 19.3% in 2050 and 40% in 2080 scenarios, with significant spatial and temporal variations. Furthermore, the research indicates that the kharif maize yields may decrease by 18 to 23% in 2050 and 2080 scenarios. However, kharif groundnut yields are projected to increase by 7% in 2050 scenario, but decline by 5% in 2080 scenario. It is anticipated that future climates will benefit chickpea cultivation, resulting in increased productivity (NICRA, 2019).

1.48 On being inquired as to whether the Government have conducted any study on the would-be-impact on Indian Agriculture and if so, the details of such study and remedial measures/steps taken in this regard, may please be shared, the Department submitted:

"Impact of climate change on crops was studied using integrated simulation modelling framework. The results indicate that in the absence of adoption of adaptation measures, climate change projections are likely to reduce rainfed rice yields by 20% in 2050 and 47% in 2080 scenarios while, irrigated rice yields by 3.5% in 2050 and 5% in 2080 scenarios, wheat yield by 19.3% in 2050 and 40% in 2080 scenarios and kharif maize yields by 18 to 23% in 2050 and 2080 scenarios. *Kharif* groundnut yields are projected to be increased by 7% in 2050 scenario where as in 2080 scenario the yield is likely to decline by 5%. Climate fluctuations such as drought, flooding, hailstorm etc. associated with global warming can prove disastrous to farmers engaged horticulture cropping. Flooding for 24 hours severely affects tomato during flowering stage. Onion during blub stage is highly sensitive to flooding, whereas warmer temperatures shorten the duration of onion bulb development leading to lower yields. Similarly, soil warming adversely affects several cucurbits. Reduction in chilling temperature in

the recent years in Himachal Pradesh drastically affected apple production, and the farmers are shifting from apple to kiwi, pomegranate and other vegetables. Also, climate change is likely to alter the biology and forging behaviour of pollinators that play key role in several horticulture crops.

- To meet the challenges of sustaining domestic food production in the face of changing climate, the Indian Council of Agricultural Research (ICAR), Ministry of Agriculture and Farmers Welfare, Government of India launched a flagship network project NICRA in 2011. Location specific climate resilient technologies were demonstrated for coping with climate variability in vulnerable districts, to generate awareness and build capacity of farmers and other stakeholders and to evolve innovative institutional mechanisms at village level so as to enable the communities to respond to climate change. The interventions are broadly divided into four modules viz., natural resource management, crop production, livestock and fisheries and creation of institutional structures for sustaining the activities envisaged and scaling up of interventions. Climatic vulnerabilities *viz.,* droughts, floods, cyclone, heat wave, high temperature stress, cold wave and frost are being addressed. Prioritization of interventions is done based on the climate vulnerability of the district, predominant farming situations and the resource endowments of the village. Location-specific climate resilient technologies have been tested and validated at on-farm sites of 151 climatically vulnerable districts for adoption by the farmers. One village cluster from each of the 151 districts were selected by the respective Krishi Vigyan Kendra (KVK) in the district and the program is implemented through farmer participatory approach. During the past decade, 19,564 capacity building programs were conducted throughout the country under NICRA project to educate stakeholders on various aspects of climate change and resilient technologies, covering 5,60,016 different stakeholders including farmers so as to enable wider adoption of climate resilient technologies."

1.49 The Committee desired the Department to elaborate the adverse impact of Climate Change on crops & crop patterns and the adaptation/mitigation measures in form of Schemes being implemented/ proposed along their efficacy. In response thereto, the Department stated:

"The climatic stresses have been affecting the productivity of crops. For instance, recent heat wave during March, 2022 second fortnight affected the wheat production by about 3.5 Mt. Similarly, in 2014, 2015 unseasonal rainfall coinciding pod maturation phase of soybean affected production significantly.

- **Rice***:* the negative effects of climate change on rice yield have been projected, with 4% loss in irrigated rice yield and 6% loss in rain-fed rice yield projected for the 2020 (2010–2039) scenario in India. With adaptation, however, the irrigated rice yield increases by 17%, while the increase in yield of rain-fed rice is 20%.
- **Wheat***:* climate change is projected to affect wheat yield in India ranging from 6% to 23% up to 2060s, without any specific adaptation. The yield would reduce in areas with current seasonal maximum mean temperatures in excess of 27°C and 13°C for minimum, respectively. Sowing a suitable variety, adjusting sowing time and fertiliser and irrigation management may be a low-cost and practical

adaptation strategy that can significantly increase wheat yield in changing climates. Earlier studies have indicated that a 1°C increase in growing season temperature can result in a loss of 4–5 Mt of wheat yield.

- **Maize***:* climate change is projected to affect the yield of maize in the Kharif season by 18% up to 2039. However, adaptation measures can significantly increase yields.
- **Sorghum***:* the projected effects of climate change on rain-fed sorghum show a reduction in yield of about 2.5% in the 2020 scenario (2010–2039). Simple adaptation options, however, can improve productivity by 8%.
- **Mustard***:* In India, climate change is projected to affect mustard seed yield by about 2% in the 2020 (2010–2039) scenario. Areas with current mean seasonal temperatures (max/max) in excess of 25/10°C will lose mustard yield due to the temperature rise. A reduced climatically suitable window for the cultivation of mustard is also projected. Therefore, short-duration cultivars (<130 days) with a 63% period for pod filling can adapt better.
- Other crops such as chick pea, cotton and pigeon pea are projected to have either beneficial effects due to reduced frost events or no significant adverse effects in large areas. Potato yield are projected to be negatively impacted in eastern India while in north-west India it may benefit due to reduced frost events and slight increase in rainfall during rabi season.
- The coconut yields are projected to increase in western coast, parts of Tamil Nadu and Karnataka and in NE region, while yields are projected to reduce in eastern coast, Odisha and West Bengal and adaptation can significantly improve the productivity.
- It is also predicted that due to warming, there will be a shift in crop zones of Apple and other temperate crops.
- Climate analogues also showed that the spice area may be expanded in both the Western and Eastern Ghat regions.
- Under NMSA different programs such as Micro Irrigation, Rainfed Area Development, Agroforestry, Organic Farming, Systems of Rice Intensification (SRI) / Direct Seeded Rice (DSR), Crop Diversification, Additional area under plantation in arable land (MIDH/ SMAF/NBM) *etc*. are operational and an area coverage of these schemes is 71.84 lakh ha during last five years. Soil Health Cards/Soil Health Management Scheme is being implemented for improving soil health and its fertility. Till now 22.71 crore grid based soil health cards have been distributed to farmers under the scheme. ICAR has developed 2279 varieties, out of which 1888 are climate resilient varieties. 407 abiotic stress tolerant varieties and 1481 are biotic stress tolerant. These varieties are being promoted through various schemes of DA&FW, KVKs and state extension functionaries."

1.50 On being asked to furnish details of different Agro Climactic Zones drawn by the Department to chalk out relevant planning and requisite implementation strategy accordingly, the Department stated:

"National Agricultural Research Project (NARP) was launched by ICAR for initiating agricultural research in the agro-climatic zones of the country. The objective was to set up or upgrade a zonal research station in each agro-climatic zone for generating location specific, need based research targeted for specific agro-ecological situations. The focus was on analyzing agro-ecological conditions and cropping patterns and come out with a programme directly targeted to solve the major bottle necks of agricultural growth in a zone based on natural resources, major crops, farming systems, production constraints and socio-economic conditions prevalent in that zone. Stress was on technology generation. In NARP, the country was divided into 127 agro climatic zones.

Subsequently the Planning Commission of India, as a result of the mid-term appraisal of the planning targets of the Seventh Plan, has divided the country into fifteen broad agro-climatic zones based on physiography, soils, geological formation, Climate, cropping patterns, and development of irrigation and mineral resources for broad agricultural planning and developing future strategies. These are further divided into more homogeneous 72 sub-zones. Fourteen regions were in the main land and the remaining one in the islands of Bay of Bengal and the Arabian Sea. The main objective was to integrate plans of the agro-climatic regions with the state and national plans to enable policy development based on techno-agro-climatic considerations. In the agro-climatic regional planning, further sub-regionalization was possible based on agro-ecological parameters.

The National Bureau of Soil Survey & Land Use Planning (NBSS&LUP) came up with twenty agro-ecological regions based on the growing period as integrated criteria of effective rainfall, soil groups, delineated boundaries adjusted to district boundaries with a minimal number of regions. Subsequently, these twenty agro-ecological regions were sub- divided into 60 sub-regions. The agro ecological regions developed by ICAR are scientific and also take in to consideration the length of growing period which is very important to chalk out the relevant planning and requisite implementation strategy accordingly."

(b) Impact on Horticulture

1.51 The Horticulture Sector is susceptible to severe impacts caused by unseasonal rains and fluctuations in temperature. Global warming-induced phenomena such as droughts, floods, and hailstorms can prove disastrous for farmers engaged in horticulture cropping. Hailstorms occurring during the flowering and fruit set stage (March-June) result in reduced fruit yields in mango. Additionally, flooding for 24 hours significantly affects tomato crops during the flowering stage. Flooding during the bulb stage of onion cultivation leads to diminished yields. Moreover, the reduction in chilling temperatures in Himachal Pradesh may necessitate the shifting of apple cultivation to higher elevations. In recent years, the drastic decrease in chilling temperature has had a substantial impact on apple production in Himachal Pradesh, prompting diversification towards kiwi, pomegranate, and vegetables. It is noteworthy that temperature and carbon dioxide levels are likely to influence the biology and foraging behaviour of pollinators, which play a crucial role in the cultivation of various horticulture crops.

(c) Impact on Livestock

1.52 The Livestock Sector is expected to be affected by the rise in temperature caused by climate change. This increase in temperature is likely to have an impact on the physiological responses and energy expenditure of livestock, resulting in a decrease in productivity in terms of milk, meat, wool, and draught power. If no adaptation measures are taken, it is estimated that global warming could lead to a loss of 15 Mt of milk production by 2050. In India alone, the annual loss of milk yield due to heat stress in cattle and buffalo is approximately 1.8-2 million tonnes, resulting in an economic loss of Rs. 5953.65 crore per year. The States most affected by these losses are Uttar Pradesh, Tamil Nadu, Rajasthan, and West Bengal. Furthermore, climate change may also impact animal health by causing the emergence and re-emergence of infectious diseases, particularly those transmitted by vectors, parasites, and protozoa. In the poultry sector, heat stress not only increases mortality rates but also reduces feed intake, egg production, egg weight, shell quality, and overall productivity. High ambient temperatures (>350oC) combined with high humidity (>65%) significantly reduce feed consumption (up to 25%) and ultimately lead to lower body weight gain (150-250g/bird) in broilers, as well as decreased egg production (about 10 eggs/bird) during the summer season.

1.53 The Committee specifically desired to know as to how Climate Change would adversely impact Livestock production & animal health in terms of productivity and GDP (in economic terms) of the country along with the likely changes to be faced by the Livestock during to Global warming & the steps being taken/proposed to be taken in this regard. The Department submitted:

> "Increasing temperature due to climate change is likely to impact livestock production and health. Although, the impacts of climate change are global, countries like India are more vulnerable in view of the high livestock population. Climate change is likely to impact the physiological reactions and energy expenditure of livestock resulting into a decline in productivity in terms of milk, meat, wool and draught power. In India, significant negative impacts have been implied with medium-term (2010-2039) climate change. The estimated annual milk loss due to heat stress in cattle and buffalo in India is about 1.8–2 million tonnes. The losses in productivity on account of climate changes are higher in crossbreds than indigenous cattle and buffaloes. Global warming is likely to lead to a loss of 1.6 Mt of milk production by 2020 and 15 Mt by 2050 if no adaptation is followed. The losses may be highest in UP followed by Tamil Nadu, Rajasthan and West Bengal. Increased number of heat stress days and probable decline in availability of water may further impact animal productivity.
>
> Animal health may also be impacted by climate change by emergence and re-emergence of many infectious diseases especially vector-borne diseases critically dependent on environmental and climatic conditions. Climate change affects the diseases and parasitic challenges and increases incidence of parasitic and protozoan diseases. It has been reported that the transmission of wind-borne diseases such as foot and mouth disease and infections transmitted by ticks, mosquitoes, midges and other arthropods may be of great concern with respect to climate change. Inadequate resources and infrastructure is likely to put stress on

livestock and livestock production system with further and substantial increase (160%) in stressful days due to climate change. The temperature rise due to global warming is likely to cause a change in the composition of species, breeds and their mix at farm level. India is also likely to face a major water crisis that will severely impact livestock and livestock production system.

Several location specific climate resilient technologies *viz.,* feed supplements with mineral mixtures, making available improved fodder seedlings, breed improvement in cattle using indigenous breeds, shelter management techniques in large and small ruminants etc. have been developed and demonstrated on large scale through NICRA KVKs in 151 climatically vulnerable districts across the country."

(d) Impact on Fisheries sector

1.54 In the Fisheries Sector, even a slight increase in temperature of 1°C can have a profound impact on the survival and distribution of various freshwater and marine fish species. This temperature rise is likely to affect fish migrations and habitats, leading to an increase in fish stocks in some areas and a decrease in others. It may even result in the permanent displacement of fish stocks to new habitats. Shrimp culture is also vulnerable to the impact of severe cyclonic storms. Post-cyclonic heavy rains can reduce salinity levels, mineral composition, and ionic ratio, while increasing pond water turbidity, all of which cause stress to shrimp in the culture pond. A zone-wise vulnerability assessment of 68 commercially important species shows that some species are highly vulnerable, while others have medium or low vulnerability. Changes in the metabolic activities of fish species have been observed due to the increase in temperature. For example, the Indian mackerel, Rastrelliger Kanagurta, has been found to descend to deeper waters in the last two decades due to variations in surface-water temperature. Furthermore, there is a negative correlation between marine plankton concentration and sea surface temperature (SST), indicating that as SST increases, plankton concentration decreases. With future scenarios predicting an increase in SST according to the IPCC, there will likely be a reduction in plankton concentrations in coastal waters, which could have a significant negative impact on the survival, growth, and overall population of fish larvae and adult fish.

1.55 On being asked to share details as to how rise in temperatures would impact the survival and migration/habitat of different fresh water and marine fish species, what are the adverse effects of rise of Sea Surface Temperature (SST), how does the Department plan to handle the scenario and the list of programmes being run/proposed & measures being taken/proposed to be taken, the Department stated:

"Relationship of temperature and spawning in marine and freshwater fisheries is elucidated so that fish catch in different regions can be predicted by temperature monitoring. Relationship was established between increase in Sea Surface Temperature (SST) and catch and spawning in major marine fish species. Simulation modelling was used to understand the climate change and impacts at regional/national level. A shift in the spawning season of oil sardine was observed off the Chennai coast from January-March season to June-July. Optimum temperature for highest hatching percentage was determined in Cobia. A closed poly house technology was standardized for enhancing the hatching rate of common

carp during winter season. An e-Atlas of freshwater inland capture fisheries was prepared which helps in contingency planning during aberrant weather. For the first time a greenhouse gas emission measurement system was standardized for brackish water aquaculture ponds. Cost effective adaptation strategies like aeration and addition of immuno-stimulant in the high energy floating feed helped freshwater fish to cope with salinity stress as a result of seawater inundation in Sundarban islands.

As per the India's Second National Communication to the UNFCCC, the hydrological changes in the flow pattern of river Ganga related to changes in the climatic patterns have been a major factor resulting in erratic breeding and decline in fish spawn availability. There is also a perceptible shift in geographic distribution of fish in Ganga. The warm water fish species earlier available only in the middle stretch of the River Ganga, are now available in the colder stretch of the river around Haridwar due to increase in river water temperature. The phenomenon of maturing and spawning of Indian major carps has been observed as early as March in West Bengal. Its breeding season has also extended from 110 days to 120 days (pre-1980–85) to 160 days to 170 days (2000–05). As a result, it has been possible to breed these fishes biannually at an interval ranging from 30–60 days. A prime factor influencing this trend is elevated temperature, which stimulates the endocrine glands of fish and helps in the maturation of the gonads.

Sea surface temperature in the Indian seas may increase by about 3^{o}C by 2100. This is likely to affect fish breeding, migration, and harvests. If the sea surface temperature in the southern latitudes increases beyond the physiological optimum of the fish, it is possible that the population may be driven away from the southern latitudes, which will reduce the catches along the southwest and south-east coasts in the future."

J. Research Infrastructure on Climate Change

1.56 ICAR has established state-of-the-art infrastructure facilities in the National Agricultural Research and Education and Extension System (NAREES) throughout the country. These facilities have been put in place to support research on climate change. Noteworthy infrastructure facilities include High Throughput Plant Phonemics, the Free Air Temperature Enrichment facility (FATE), the Free Air CO_2 Enrichment facility (FACE), CO_2 Temperature Gradient Chambers (CTGC), eddy flux towers, gas chromatography, atomic absorption spectrophotometers, thermal imaging system, psychometric chambers, automatic weather stations, growth chambers, rainout shelters, animal calorimeter, shipping vessel, flux towers, and a satellite data receiving station. These facilities have been established across various ICAR institutes to investigate the impact of climate change on crops, livestock, fisheries, soil organic carbon, and irrigation water (CCRI, 2019). Multiple ICAR institutes are currently engaged in research that covers areas such as the development of stress-tolerant crop genotypes, natural resource management, quantification of greenhouse gas emissions in Agriculture, development of technologies for their reduction, climate resilient horticulture, marine, brackish and inland fisheries, heat-tolerant livestock, as well as mitigation and adaptation to changing climate in small ruminants and poultry.

1.57 On being asked by the Committee to state steps being taken by the Department to develop and upgrade infrastructure facilities aligned to global standards pan India to facilitate Climate Change research, to list outstanding achievements in terms of research breakthroughs in regard to Climate Resilient Technologies, Developments made in poultry, fisheries, etc. being achieved by institutes of ICAR along with plans of monetizing the innovations made by these Research Institutes by way of seeking patents and so on, the Department stated:

"State of the art infrastructure required or climate change research such as high through-put phenotyping platforms, free air temperature enrichment (FATE), carbon dioxide and temperature gradient tunnels (CTGC), high performance computers, automatic weather stations, growth chambers, rainout shelters, animal calorimeter, shipping vessel, flux towers and satellite receiving station were established in the research institutes across the country under National Innovations in Climate Resilient Agriculture (NICRA) project of ICAR. These facilities enabled to Scientists to understand the impact of climate change on crops, livestock and fisheries and develop innovative technologies to minimize the adverse impact. The salient achievements under NICRA are as below:

- Studied impact of elevated temperature and CO_2 on crops (rice, wheat, maize and onion), livestock, fisheries, soil carbon, pests and diseases using integrated simulation modelling framework.
- In rice, wheat, maize, pigeon pea and tomato crops, core sets of genetic resources were assembled and field phenotyped to identify sources of tolerance to climatic stresses.
- District level risk and vulnerability assessment of Indian Agriculture to climate change has been revised as per IPCC AR-5 guidelines and is widely used by policy makers and research managers for prioritization of resources related to climate change action plans. Agricultural contingency plans are ready for 650 districts and updated for 386 districts.
- Developed Agriculture Contingency Plans for 650 districts, and 350 plans are updated.
- Established location specific GHG inventory for different cropping systems and production systems and quantified carbon sequestration potential through agro-forestry systems and major cropping systems.
- Forecasted area expansion of black pepper (97 to 133 districts) and cardamom (24 to 104 districts) using climate analogues for habitat suitability in the future changing climate.
- Developed an environmentally safe spray formulation for synchronization of flowering in mango. Efforts are made to characterize heat stock proteins and heat stress induced genes in native breeds that can be used as biomarkers to induce resilience.
- Developed rainbow trout farming in Re-Circulating Aquaculture System (RAS) to improve fish production in high altitude areas.

- Several resources use efficient technologies and low carbon technologies are identified for rice (DSR, SRI, Alternate wetting and drying of rice, neem oil coated urea, *etc*) and demonstrated in the farmers' fields."

K. Green House Gas (GHG) Emissions from Agriculture Sector

1.58 Another aspect of concern within the Agricultural Sector pertains to the emission of Green House Gases (GHGs), specifically methane (CH_4) and nitrous oxide (N_2O), which constitute a significant portion. CH_4 emissions primarily arise from livestock rearing (via enteric fermentation and manure management) as well as rice cultivation. On the other hand, N2O emissions are mainly a result of the application of fertilizers to agricultural soils. In the year 2016, the Agricultural Sector in India emitted 407,821 Gg of CO_2, accounting for 14% of the country's total emissions. This figure represents a decrease of 2.25% compared to the levels observed in 2014 (Ministry of Environment, Forest and Climate Change [MoEFCC], 2021). Within the Agricultural Sector, enteric fermentation accounted for the largest share of GHG emissions (54.6%), followed by rice cultivation (17.5%), fertilizer application to agricultural soils (19.1%), manure management (6.7%), and field burning of agricultural residues (2.2%). The burning of crop residues leads to the release of gases such as CH_4, CO, N_2O, and NO_x, as well as particulate matter. This practice not only results in the loss of plant nutrients but also has adverse effects on the atmospheric environment and soil health. Approximately 80-90% of carbon (C), 25% of nitrogen (N), 20% of phosphorus (P), 20% of potassium (K), and 50% of sulfur (S) present in crop residues are lost in the form of various gaseous and particulate matters, contributing to atmospheric pollution. Additionally, it is estimated that approximately 70% of CO_2, 7% of CO, 0.66% of CH_4, and 2.1% of N are emitted as N_2O through the burning of crop residues, thereby exerting an impact on the environment. Burning one tonne of rice residue releases 13 kg of particulate matter, 60kg of CO, 1460kg of CO_2, 3.5kg of NO_x, and 0.2kg of SO_2. In North-West India, the burning of 23 million tonnes of rice residues annually results in a loss of approximately 9.2 million tonnes of carbon equivalent (equivalent to about 34 million tonnes of CO_2) and a loss of around 1.4×105 tonnes of nitrogen (equivalent to Rs 200 crore) per year. In addition to these losses, straw burning also leads to the deterioration of soil physical health, health hazards and accidents, air pollution, emissions of greenhouse gases, and a loss of micro-biodiversity. The rice-wheat system is a significant contributor to greenhouse gas emissions in North-west India. Implementing conservation Agriculture (CA)-based production technologies within the rice-wheat cropping system can greatly enhance system productivity while minimizing global warming potential (GWP). By diversifying crops, adopting demand-driven nitrogen application, and implementing zero-till (ZT) permanent broad bed with residue practices, GHG emissions can be reduced by a substantial margin (16-19%). Moreover, the CA-based cotton-wheat, maize-wheat-green gram systems hold promise as viable alternatives to the rice-wheat system, serving as important strategies for both adaptation and mitigation of Climate Change. These alternatives could be adopted particularly in the northern and north-western regions of the country where the rice-wheat cropping system is currently prevalent.

1.59 On being asked by the Committee to state the Programmes being undertaken by the Department to reduce the emission of Green House Gases (GHG) in Agricultural Sector in the last 5 years and the achievements in this regard, if any, the Department submitted:

"From Agriculture sector GHG emissions like methane (CH_4) and nitrous oxide (N_2O) form the major share. CH_4 emissions occur mainly due to livestock rearing (enteric fermentation and manure management) and rice cultivation. N_2O emissions are mainly due to the application of fertilizers to agricultural soils. Agriculture sector emitted 407,821 Gg of CO_2e (14% of the emissions of India) in 2016, which is 2.25% low compared to 2014. Within Agriculture sector, the major share of GHG emissions was due to enteric fermentation (54.6%), followed by rice cultivation (17.5%), fertilizer applied to agricultural soils (19.1%), manure management (6.7%) and field burning of agricultural residues (2.2%).

ICAR has developed several climate resilient technologies that helps in reducing emissions from Agriculture sector. The mitigation of GHG emissions can be achieved by implementation of technologies like System of Rice Intensification (SRI) cultivation as alternative to transplanted paddy, Direct Seeded Rice (DSR) cultivation, use of slow release nitrogen fertilizers, integrated nutrient management practices, soil health card based fertilizer application, leaf color charts based N fertilizer application, integration of trees especially fruit trees in the arable systems, integrated farming systems in reducing emissions, replacing fossil fuels with biogas and vermi composting, micro-irrigation (drip and sprinkler), balanced ration for livestock, Neem-coated urea, solar pumps, avoidance of crop residue burning by promoting zero tillage cultivation in rice-wheat. Demonstration of zero-till cultivation in NICRA villages has resulted in 26 villages as residue burning-free villages in the two states of Haryana and Punjab.

The Government has made all the Urea Neem oil coated which is reported to reduce the nitrous oxide emissions by up to 9%. In addition, the use of solar energy is being promoted. The other low GHG emitting technologies/ approaches such as direct seeded rice, SRI, etc. and improved nutrient and water use efficient technologies are being promoted. In livestock sector, efforts are on to promote the technologies to reduce the enteric fermentation related methane emission.

In order to modernize traditional animal husbandry practices and adopt new technologies in Animal Husbandry to reduce greenhouse gas emissions from livestock, following steps has been taken by the Department and are implemented by the States:

(i) Breed Improvement: Department of Animal Husbandry and Dairying is promoting breed improvement under Rashtriya Gokul Mission to enhance milk production and productivity, genetic upgradation of indigenous bovine population thereby making dairying more green and sustainable.

(ii) Balanced Feeding: Department of Animal Husbandry and Dairying is promoting green fodder production, silage making, chaff cutting, and total mixed ration under National Livestock Mission. Ration Balancing Programme is promoted under National Dairy Plan-I. Department of Animal Husbandry and Dairying has

launched e Gopala App on 10.9.2020 for farmers, this app is guiding farmers for balanced feeding of animals.

(iii) Improving Feed Quality: To reduce the ill-effects of poor quality feed, the Department of Animal Husbandry and Dairying has issued advisory to the States for urea-molasses treatment of straw, silage making, and chopping of fodder before feeding livestock.

(iv) Improvement in Health Status: In order to control and eradicate animal diseases the Department is implementing disease control programme for control of FMD, Brucellosis, *Pesti-des Petits Ruminants* (PPR) and Classical Swine Fever (CSF) through carpet vaccination for all eligible livestock in the country. Funds are made available to States for establishment of Mobile Veterinary Units in order to deliver quality livestock health services at the farmer's doorstep.

(v) Better management of cow dung is promoted by the Department of Animal Husbandry and Dairying. With the efforts made by the Department, National Dairy Development Board has taken up a establishment of 4000 cubic meter biogas plant at Varanasi Milk union, which will use 100 MT per day of dung purchased from farmers. The biogas is used to produce thermal and electrical energy required for milk processing of the dairy plant. Bio slurry obtained from the plant will be converted in bio fertilizer and made available to member farmers at reasonable rates.

Banaskantha Milk Union has installed 2000 cubic meter of biogas plant. Around 40 Tonnes of dung is purchased by the union from its farmers to produce the biogas. The biogas produced is purified and compressed to produce CBG which is used as fuel in vehicles. An exclusive CBG fuel station is setup by the Banaskantha Milk Union. Bio slurry produced from the biogas plant is utilized to produce value added organic fertilizer and sold at reasonable rates to dairy farmers.

The programs under NMSA promote sustainable Agriculture practices and farming methods which has the potential for carbon sequestration and reducing emission. The Ministry has come out with framework for the voluntary carbon markets in the Agriculture sector to promote development of a market-based mechanism to incentivize sustainable agricultural practices. Farmers can embrace regenerative farming and increase carbon sequestration/reduce emission in their farm."

1.60 On being asked by the Committee to state projections in regard to reduction of GHG emissions from the Agriculture Sector in the next two decades, for a period for 5 year cycle *viz*. from 2023-2028, 2029-2034 and so on, the Department submitted:

"One of the targets under India's NDC is "To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly Agriculture, water resources, Himalayan region, coastal regions, health and disaster management". Hence, Agriculture sector is one the sectors identified for climate adaptation actions. Further, it has been clarified that India's NDC do not bind it to any sector specific mitigation obligation or action, including in Agriculture sector. India's goal is to reduce overall emission intensity and improve

energy efficiency of its economy over time and at the same time protecting the vulnerable sectors of economy and segments of our society.

About 86% of farmers in India are small and marginal (less than 2.0 ha). Additional investments towards mitigating greenhouse gases like methane will be an additional burden for the resource poor farmers. Any commitment towards methane reduction from Agriculture sector for the next 10 years period would require huge investment and support from the Government for up-scaling the proven resilient practices. As per the commitment of Government of India in the NDC, Agriculture is not part of economy-wide emission intensity reduction goal.

The Indian Council of Agricultural Research (ICAR) under National Innovations in Climate Resilient Agriculture (NICRA) project has developed several technologies with mitigation potential for methane from rice *viz*., Direct Seeded Rice (DSR) (30-50%), System of Rice Intensification (SRI) (25-30%), intermittent drying (25-30%) and promotion of short duration varieties (15-20%).

The National Mission on Sustainable Agriculture (NMSA) implemented by the Ministry of Agriculture & Farmers Welfare is up-scaling the several climate resilient practices including the methane reduction practices in rice. These practices contribute to substantial reduction of methane emissions. Over the past eleven years (2012-2023), 11.84 lakh ha area has been brought under SRI/DSR cultivation from traditional transplanted rice.

The Sub Mission on Agricultural Mechanization being implemented from the year 2016 has resulted in substantial reduction of residue burning in States like Punjab, Haryana and Uttar Pradesh. So far, a total of 2,00,570 crop residue management machinery have been provided to the farmers across the country. A study by ICAR on real-time monitoring of residue burning in Punjab, Haryana and Uttar Pradesh using satellite data has shown reduction of burning events by 13.2% in 2021 compared to 2016.

The conventionally cultivated rice-wheat in the trans Indo Gangetic plains, wherein transplanted puddled rice followed by conventional tilled wheat is converted to zero tilled direct seeded rice (ZTDSR) followed by zero tilled wheat (ZTW), this will result in a 60% reduction in global warming potential. By 2023-2028, if 1 Mha rice-wheat area under conventional cultivation in trans- Indo-Gangetic plains is converted to ZTDSR-ZTW, the reduction in GHG emissions will be approx. 3 Mt CO_2 eq. By 2023-2028, if 1 Mha rice-wheat area under conventional cultivation in trans Indo Gangetic plains is diversified to maize-wheat or cotton wheat, the reduction in GHG emissions will be approx. 1.5 Mt CO_2 eq. Several technologies have been developed to reduce the GHG emissions from rice cultivation and agricultural soils. Crop establishment technologies of Direct seeding in rice has the potential to mitigate GHG by 1.6 t CO_2 eq. ha^{-1} whereas, and Zero tillage wheat (ZTW) and permanent bed planting has the potential to mitigate GHG by 1.3 t CO_2 eq. ha^{-1} and 0.9 t CO_2 eq. ha^{-1}, respectively. If rice residue is retained in soil in ZTW instead of burning it, the GHG mitigation potential can be increased by 0.5 t CO_2 eq. ha^{-1}. Sub surface drip irrigation has the potential to reduce GHG by 1.0 t CO_2 eq. ha^{-1}, and diversifying from rice to maize in

rice-wheat system can mitigate GHG by 0.5 t CO_2 eq. ha^{-1}. All these GHG mitigation techniques have the additional benefit of water saving and productivity gain."

L. Carbon market in Agriculture

1.61 The Agriculture sector contributes approximately 14% to the country's greenhouse gas (GHG) emissions. The Government is actively promoting various measures to mitigate GHG emissions in Agriculture. Implementation of technologies such as System of Rice Intensification (SRI) cultivation, Direct Seeded Rice (DSR) cultivation, use of slow-release nitrogen fertilizers (particularly neem-coated urea), integrated nutrient management practices, Soil health card-based fertilizer application, leaf color charts-based N fertilizer application, integration of fruit trees in arable systems, and integrated farming systems can help achieve the reduction of GHG emissions. Other effective methods include replacing fossil fuels with biogas and vermi composting, adopting micro-irrigation techniques (such as drip and sprinkler), providing balanced ration for livestock, utilizing green energy through solar pumps, and promoting zero-tillage cultivation to avoid crop residue burning in rice-wheat farming in the Indo-Gangetic plains. The demonstration of zero-till cultivation in NICRA villages has successfully resulted in 26 residue burning-free villages in Haryana and Punjab. By embracing regenerative farming practices, farmers can transform their land from being a net emitter of GHG to becoming a carbon sink, effectively sequestering carbon and earning carbon credits. To facilitate this, the Ministry is initiating a carbon market in the Agriculture sector, allowing farmers who adopt regenerative Agriculture practices to earn additional income by mitigating emissions and sequestering carbon. In order to develop a framework and mechanism for the carbon market in the Agriculture sector, a separate Cell has been established in the Natural Resource Management (NRM) Division of the Department of Agriculture and Farmers' Welfare.

1.62 On being asked to furnish details of steps being taken for initiation of Carbon Market in Agriculture by the Department, list the foreseeable challenges likely to be faced by the Department in this regard, state as to how does the Department plan sequestration of Carbon Dioxide(CO_2) to enable farmers develop an alternative source of income and to also state plans, if any, to appointment any third party auditor to check the veracity of claims made in regard to carbon credit, the Department submitted:

"India's NDC do not bind it to any sector specific mitigation obligation or action, including in Agriculture sector. India's goal is to reduce overall emission intensity and improve energy efficiency of its economy over time and at the same time protecting the vulnerable sectors of economy and segments of our society. There is a growing demand for sustainably produced food, which can create new markets and value added opportunities for farmers. By adopting these practices, farmers can tap into these markets and capture higher prices for their produce. Besides this, Soil organic carbon (SOC) is a crucial component of healthy soils and sustainable Agriculture. It refers to the amount of carbon stored in soil in the form of organic matter, such as decomposed plant and animal materials. SOC plays a vital role in soil fertility, water

retention, and erosion prevention, as well as in mitigating climate change. Carbon sequestration through SOC restoration can have significant environmental and economic benefits. Therefore, a voluntary carbon market in India can incentivize Soil Organic Carbon (SOC) restoration by providing a financial mechanism for farmers to adopt sustainable practices such as conservation tillage, agroforestry, cover cropping, and nutrient management, which promote SOC accumulation. By creating a demand for carbon credits generated from SOC sequestration, the voluntary carbon market can provide financial incentives for farmers to adopt climate-smart agricultural practices that improve soil health and mitigate climate change. In the Department of Agriculture and Farmers Welfare, a committee has been constituted to look in to the prospects of carbon markets in Agriculture."

M. Natural Resource Management

1.63 The frequency of high-intensity rainfall, reaching about 20-30 cm in a day, has been increasing in recent times, leading to significant yield losses, soil erosion, and flooding in low-lying areas. To address this issue, it is crucial to maximize rainwater harvesting at the location where it falls. As a response, ex situ and in situ water harvesting technologies have been developed and demonstrated to suit various agro-ecologies. Location-specific technologies, such as farm ponds, percolation tanks, and check dams, have been put in place to meet contingencies in rainwater harvesting. Additionally, technologies for groundwater recharge, including open well and tube well recharge models, have been developed and scaled up. The construction of *in-situ* and *ex-situ* water harvesting structures, along with efficient utilization of harvested water, has resulted in higher yields and net returns, particularly under deficit rainfall conditions in various crops and locations. In some low rainfall regions with higher variability, critical irrigation has led to yield improvements of up to 85%. The utilization of harvested water has also increased cropping intensity, particularly in rabi crops such as wheat, mustard, chickpea, and vegetable crops, resulting in enhanced yields and returns.

1.64 Apart from water management, soil health management plays a vital role in promoting sustainable Agriculture. It involves the implementation of practices tailored to specific crops and locations, including residue management, organic farming techniques, nutrient management, balanced fertilizer application, and minimizing soil erosion and degradation. Conservation treatments have shown improvement in soil aggregates and water stability. Recent studies on maize-based cropping systems in the North-Eastern Hill region have demonstrated that the application of biochar at a rate of 5.0 t ha-1, along with 75% recommended dose of fertilizer (RDF) and 4 t ha-1 of farmyard manure (FYM), enhances productivity, nutrient use efficiency, and carbon sequestration potential. Furthermore, the application of biochar has led to significant improvements in Soil Microbial Biomass Carbon (SMBC), Dehydrogenase Enzyme Activity (DEA), and Soil Organic Carbon (SOC), while reducing exchangeable aluminum and exchangeable acidity. Achieving balanced fertilization and implementing integrated nutrient management systems are crucial for sustainable crop production, as they contribute to the buildup of carbon, structural stability, crop yield, and climate mitigation options.

N. Climate Resilient Varieties

(a) Food grains/Crops

The process of evaluating a wide range of germ plasms, including local genetic resources, in multiple crops such as rice, wheat, maize, black gram, green gram, pigeon pea, chickpea, and lentil, for various abiotic stresses like drought, heat, salinity, nitrogen use efficiency, and submergence tolerance, plays a crucial role in the identification of stress-tolerant donors. Moreover, the use of molecular techniques has facilitated the identification and characterization of genes responsible for conferring resistance to climatic stresses in field crops. Extensive screening of numerous wild germplasm lines collected from various locations across the country has allowed the identification of new sources that can be utilized in future breeding programs to develop novel, stress-tolerant varieties that can withstand drought, flood, and heat stress. The continuous efforts of research have led to the development of improved varieties of rice (CR Dhan 201, NICRA Aerobic Dhan 1, CR Dhan 412), mungbean (Virat, Varsha, Heera, Kanika), and lentil (IPL 534) that exhibit resistance to diseases and extreme weather conditions. These climate-resilient varieties have been widely adopted by farmers in drought, flood, and heat wave affected districts, resulting in increased crop yields and economic returns in different regions. Simulation studies have indicated that the adoption of improved varieties, coupled with enhanced agronomic management practices, can significantly enhance rice yields by 17% in irrigated conditions and by 35% in rainfed conditions, as well as wheat yields by 40% and maize yields by 10%. On-farm evaluations of multiple climate-resilient varieties in various crops, including rice (74 varieties), soybean (9 varieties), finger millet (11 varieties), maize (17 varieties), black gram (20 varieties), mung bean (20 varieties), groundnut (14 varieties), pigeon pea (31 varieties), sesame (9 varieties), wheat (3 varieties), pearl millet (4 varieties), and 51 varieties in other crops, have been successfully demonstrated and integrated into developmental programs in climatically vulnerable districts. In order to address the challenges posed by climate change, concerted efforts are being made to breed climate-resilient varieties across ICAR institutes, encompassing crops that play a vital role in ensuring the food security of the country. Substantial achievements have been made in this direction, with the development of 400 climate-resilient varieties tolerant to drought/moisture stress, water submergence/flood/water logging, salinity /alkalinity /sodicity, frost/low temperature/chilling, and high temperature/heat stress over the past eight years. The utilization of modern molecular tools has now become an integral part of crop improvement programs, enabling the precise introgression of genes responsible for various biotic and abiotic stresses, thereby ensuring foolproof tolerance/resistance to specific stressors. To date, a total of 71 varieties of different crops have been bred using genomic tools, including 12 varieties of rice for submergence tolerance, 4 varieties for drought tolerance, 1 variety for salinity, and 3 varieties of chickpea for drought tolerance. These varieties are being promoted among farmers to address the challenges posed by climate change. Additionally, ICAR has established the unique Phenomics Facility at IARI Pusa Campus, New Delhi, which was dedicated to the nation by the Honorable Prime Minister in 2017 in the name of Shri Nanaji Deshmukh Plant Phenomics Facility. This facility serves as a platform for conducting research on the identification of donors with high temperature tolerance, drought tolerance, and salinity

tolerance. Currently, the major focus of research programs at this facility is on wheat and rice, but it can also be extended to other crops. The identification of resistant/tolerant donors for various abiotic stresses is a critical activity that serves as the foundation for breeding climate-resilient varieties. Genome editing has emerged as a novel tool for improving varieties with enhanced tolerance to both biotic and abiotic stresses. ICAR has initiated work on breeding salt and drought tolerant varieties through genome editing since 2018, and one of the popular rice varieties, MTU 1010, has already been edited to enhance its drought and salt tolerance, resulting in a yield increase of over 20% compared to the original MTU 1010. This edited variety is now ready for field evaluation and is expected to be released within the next 3-4 years.

1.65 On being asked about the challenges being faced by the Department in implementing climate resilient varieties of crops across the country including inhibitions of farmers faced, and how the modern molecular tools have contributed to the crop improvement programs, the Department submitted:

> "Efforts were made in exploring the available genetic resources for evaluation and characterization having tolerance to climatic stresses (drought, heat and flood) in different crops. The identified genetic resources were further used for genetic enhancement using various breeding tools including molecular marker assisted selection approaches. In the process number of tightly linked molecular markers/ QTLs were identified for the trait of interest for the respective crops. The introgression of these traits was carried out using various molecular tools into suitable agronomic background leading to development of climate resilient crop varieties. So far, this has resulted into the development of 1622 resilient crop varieties by ICAR.
>
> Adoption of heat tolerant varieties developed by ICAR-IIWBR, Karnal and ICAR-IARI, New Delhi (*e.g.*HDCSW-18, HD-3410, HD-3385, DBW-187, DBW-222) by the farmers in Punjab, Haryana and UP has minimized the heat wave experienced during the previous season (March 2022) and also likely to benefit in the current season (February 2023).
>
> Large scale demonstrations of climate resilient varieties in the farmers' fields through KVKs in 151 vulnerable districts in the country enable wide scale adoption of these varieties by farmers. Attempts are also being made to produce sufficient quantity of quality seeds for easy access to the farming community. However, production is not sufficient to meet the demand. Concerted efforts are initiated to address this issue through various mechanisms including the initiative taken under seed hubs."

(b) Horticulture

A Study on Climate analogues for habitat suitability in the future changing climate has indicated that there is a potential expansion of black pepper cultivation from 97 to 133 districts, as well as an increase in cardamom cultivation from 24 to 104 districts. The changing climate has also led to the issue of staggered flowering in mango, which is a major concern. To address this, a spray formulation that is environmentally safe has been developed under the NICRA program. This formulation, when sprayed once in September/October at a concentration of 60 to 75 ml/l, has successfully induced

synchronized flowering in various mango varieties such as Alphonso, Dashehari, Kesar, Langra, Amrapali, and Banganapalli. Additionally, a technique for inter-specific grafting of tomato onto brinjal has been standardized to withstand drought and flooding. Furthermore, the use of osmotolerant bacterial strains for microbial inoculation has been found to improve yield under limited moisture stress in tomato.

1.66 On being asked to list the challenges likely to be faced by the Horticulture Sector due to Climate Change and also stating measures taken/Programmes implemented/proposed to be undertaken to mitigate the adverse impact on this Sector as well as list out adaptive measures being implemented/proposed to be implemented, the Department submitted as under :

> "As per the Third BUR report, there is a consistent increase in production of both food grains and horticulture in India which indicate resilience to climate change made possible by development of climate resilient varieties, appropriate farming system and other interventions. Mission for Integrated Development of Horticulture (MIDH) promotes holistic growth of horticulture sector, duly ensuring backward and forward linkages. The Mission includes various activities of Coconut Development Board, Horticulture Development Board and Development of Commercial Horticulture through production and post-harvest management, capital investment subsidy for construction, expansion, modernization of cold storages for horticulture produce, technology development and transfer for horticulture produce."

1.67 The major challenges likely to be faced by the Horticulture Sector due to Climate change are:

- Influencing the performance of horticultural crops including annual and perennial horticulture crops.
- Reduction in production of fruits and vegetables is likely to be caused by short growing period, which will have negative impact on growth and development particularly due to terminal heat stress and decreased water availability.
- In the normal condition, cashew and cocoa are not much affected due to climatic vagaries but during the critical periods i.e. flowering and fruit setting, any major changes in the climatic factors adversely affect the flowering and fruit setting. Unseasonal rainfall, low morning temperature followed by dew and temperature more than 42^0C are detrimental factors especially for cashew production and productivity. These climatic factors are beyond the control of human interference and too little extent any adverse affects of high temperature can be subdued by following some cultural practices.
- Spices are very sensitive to climate changes Different abiotic factors, especially temperature, rainfall, photoperiod, sunshine hours, wind, *etc.* directly or indirectly influence different physiological growth stages like flowering, fruit setting, fruit development, seed setting and final reproductive or vegetative yield of spice crops. The intrinsic quality and storage life is also affected by climatic factors. Climate change affect the major spice crops like Black pepper, Cardamom, Chilli, Nutmeg, Clove, Cinnamon, Ginger, Turmeric, seed spices *etc.*
    i. High temperature causes spike shedding in black pepper and heavy rainfall results in development of quick wilt disease.

ii. Prolonged dry season may cause reduced pollination and abortion of cardamom flowers.
iii. Excessive rainfall during NE monsoon had favoured the establishment of thrips which in turn resulted 40 per cent of crop loss to chilli in Andhra Pradesh during last year.
iv. All the seed spices are very sensitive to temperature in terms of their production and quality. Germination of seeds also affected by high temperatures. High rainfall and humidity invite pests like aphid and diseases like powdery mildew in most of the seed spices *viz*., coriander, fenugreek, cumin, etc. Crop damage due to frost is also reported in seed spices.
v. The stress effect of environment also influences the seed production and storage life of the spice crops.
vi. High rain fall leads to the occurrence of disease like rhizome rot and wilt in ginger. In case of turmeric, high temperature leads to early maturing of rhizomes and poor development of curcumin.
vii. Leaf spot disease of Areca nut, which was a minor disease earlier has become an epidemic in Karnataka region due to the changes in rainfall pattern, high humidity, prolonged leaf wetness, windy weather etc. Average yield loss due to the incidence of leaf spot was more than 50%.

Adaptive Measures

- To achieve the targeted production, it needs climate smart horticulture interventions which are highly location specific and knowledge-intensive for improving production in the challenged environment.
- Use of recommended production systems for improved water-use efficiency and to adapt to the hot and dry conditions. Strategies like changing sowing or planting dates in order to combat the likely increase in temperature and water stress periods during the crop-growing season should be adopted.
- Develop new varieties suitable to different agro-ecological regions under changing climatic conditions.
- In order to mitigate climatic vagaries farmers have been trained to adopt cultural practices to avoid loss to the minimum extent especially during summer season.
- Under the development programmes implemented by the Directorate of Arecanut and Spices Development (DASD) Calicut, production and distribution of quality planting materials of climate resilient varieties of spices developed by SAUs / ICAR institutes are promoted.
  The spices varieties tolerant to abiotic / biotic stress promoted under MIDH are listed below.

S.No	Crop	Variety	Tolerance/Resistant
1	Black Pepper	IISR Thevam	Tolerant to Phytophthora foot rot
		IISR Shakthi	Tolerant to Phytophthora foot rot
		Pournami	Tolerant to root-knot nematode
		Panniyur 8	Tolerant to Phytophthora foot rot and drought
		Panniyur 9	Tolerant to quick wilt and drought.
2	Turmeric	IISR Pragati	Resistant to nematode

		NDH 98	Tolerance to salinity
		BSR 2	Resistant to scale insects
		Suguna	Resistant to rhoizome rot
		Co 1	Resistant to rhoizome rot
3	Ginger	IISR Mahima	Resistant to M. incognita (Nematode)
		Athira,Karthika	Tolerant to soft rot and bacterial wilt disease
4	Chilly	LCA 334	Tolerant to viruses and abiotic stresses
5	Cumin	GC 1	Resistance to wilt
		GC4	Resistance to wilt
6	Coriander	ACr 1	Resistant to stem gall and tolerance to powdery mildew
		Co 2	Suitable for saline and alkaline prone area
		Azad Dhania 1	Tolerant to moisture stress

i. Demonstrations on judicious water utilization following drip / sprinkler irrigation are established in locations with water shortage.

ii. Adoption of plant tissue culture / micro rhizome techniques in ginger/ turmeric crops helps to assure availability of disease free seed material.

iii. To save the seed material from sudden change in the climatic conditions after harvesting, safe storage& processing facilities are established at main production centres.

iv. Climate smart Techniques for off season production (polyhouse / rain shelters) are promoted in spices

v. Cropping system approach promoted under demonstration programmes like Arecanut based multi species cropping system, intercropping cinnamon in Coconut gardens *etc* ensures better utilization of GHGs.

vi. Cinnamon is a hardy crop and tolerant to drought. It is promoted under the programme by DASD.

vii. Nutmeg was found to recuperate fast from flooded condition. It is also promoted by DASD.

1.68 Climate Change impacts several horticultural crops in the country. Flooding for 24 hours severely affects tomato during flowering stage. Onion during blub stage is highly sensitive to flooding, whereas warmer temperatures shorten the duration of onion bulb development leading to lower yields. Similarly, soil warming adversely affects several cucurbits. Reduction in chilling temperature in the recent years in Himachal Pradesh drastically affected apple production, and the farmers are shifting from apple to kiwi, pomegranate and other vegetables. More importantly, temperature and carbon dioxide are likely to alter the biology and forging behavior of pollinators that play key role in several horticulture crops.

1.69 High throughput screening of germplasm and rainout shelter facility enabled to characterize large number of germplasm lines and identifies suitable donors for breeding against drought, heat stress and flooding in tomato, brinjal and onion.

1.70 Forecasted area expansion of black pepper (97 to 133 districts) and cardamom (24 to 104 districts) using climate analogues for habitat suitability in the future changing climate. Staggered flowering in mango is one of the major issues induced by changing climate. An environmentally safe spray formulation has been for synchronization of flowering in mango. Spray of this formulation (60 to 75 ml/l) once in September/October helped induction of synchronized flowering in several mango varieties (Alphonso, Dashehari, Kesar, Langra, Amrapali and Banganapalli).

1.71 The technique for inter-specific grafting of tomato over brinjal has been standardized and large-scale demonstrations have been taken up to withstand drought and flooding in tomato. A microbial inoculation with osmotolerant bacterial strains has been developed to improve yield under limited moisture stress in tomato. Several resilient horticulture technologies *viz.,* resilient varieties, mulching and inter-cultivation of cauliflower/cabbage in apple orchards, anti-hail nets in apple orchards, spur type of apple cultivation, ridge and furrow cultivation of green pea in North east, paddy straw and crop residue mulching in ginger, plastic mulching and micro irrigation in marigold, protected cultivation of vegetables in poly house, micro irrigation system in vegetables for efficient use of harvested water to increasing the water productivity, frost management by smoke pockets in onion, crop diversification of brinjal and tomato, zero tillage in field pea, community vegetable seedling nursery for timely availability of improved varieties, broad bed ridge and furrow in brinjal and chilli crops have been demonstrated in farmers' fields in climatically vulnerable districts across the country through Krishi Vigyan Kendras (KVKs). Large-scale adoption of these climate resilient technologies enable to adopt to the changes associated with global warming and also keep pace with increasing demand for horticulture products in the country in the years to come.'

(c) Livestock

1.72 Cross-breed cattle are more susceptible to the effects of climate change compared to indigenous breeds. Efforts have been made to characterize heat shock proteins in order to understand their role in heat stress resilience. Biomarkers for heat stress have been identified in the genes of native breeds and can be utilized to induce resilience. Among the 833 heat shock proteins identified so far, 566 were found to be differentially down-regulated and 86 were up-regulated in Tharparkar (an indigenous breed) compared to Karan fries (a cross breed). Various feed supplements have been identified and successfully tested to mitigate heat stress in cattle. Supplementation of animal diets with Vitamin E and selenium has shown beneficial effects on thermal stress in both breeds of cattle. Additionally, supplementation of betaine at a rate of 25 g/day/animal has been found to be effective in mitigating heat stress as it improves reproductive and growth performance in dairy cows. Custom-designed shelter systems and feed supplementation with chromium propionate and mineral supplements (Cu, Mg, Ca, and Zn) in both feed and fodder have significantly improved the ability of cattle to withstand heat stress. Local birds have shown higher tolerance to common poultry

diseases. Nutritional and management approaches have been implemented to sustain and enhance the performance of both rural and commercial chicken during thermal/heat stress conditions. Supplementation of betaine at a rate of 0.1% and the inclusion of prebiotics such as MOS/FOS at a rate of 0.1% have been found to reduce the negative effects of heat stress in broiler and rural chicken. Furthermore, the inclusion of herbal extracts such as Aswagandha, Tulsi, Amla, and Turmeric at a rate of 0.2 to 1% in the diet has shown improvements in growth in broilers under heat stress. Moringa leaf meal and pomegranate peel meal have been found to enhance immune responses in broilers. A herbal crude powder-based tablet called Stressol-G has been developed to reduce climatic stress in goats. Malpura ewes have shown signs of recovery from heat stress (42-46^{o}C) within a period of one week.

1.73 On being inquired by the Committee as to whether the Department propose to promote integration of Livestock with crop production system and if so, furnish the details thereof, and if not, furnish specific reasons therefore, the Department submitted:

"To promote Natural Farming, a traditional farming system based on the integration of livestock and local resources, National Mission of Natural Farming is being proposed as centrally sponsored scheme with an out lay of Rs. 2841 crores (Rs. 1584 crores GoI share) for the period from 2023-24 to 2025-26 with the following objectives.

- To promote alternative system of farming for freedom from external purchased inputs, cost reduction and thereby increasing income of farmers.
- To popularize integrated Agriculture- animal husbandry models based on livestock and local resources.
- To collect, validate and document natural farming being practiced across the country and encourage participatory research with farmers on upscaling of the mission.
- To undertake activities for awareness creation, capacity building, promotion and demonstration of natural farming.
- To create standards, certification procedure and branding for natural farming products.

ICAR-Indian Institute of Farming Systems Research through AICRP on Integrated Farming Systems and All India Network Programme on Organic Farming developed 71 Integrated farming system models including 8 integrated organic farming system models suitable to 26 States/UTs. In all the IFS models, location specific livestock components such as dairy (cow & buffalo), poultry, goat, sheep and pig are integrated along with cropping systems of the region to enhance the sustainability and profitability. Out of 64 models evaluated for carbon neutrality, 52 were found carbon neutral and positive. Out of 38 models evaluated for credit financing, 32 were found bankable as per NABARD assessment. IFS models developed for Jammu and Kashmir, Kerala, Tamil Nadu and Odisha are implemented through State schemes covering about 80,000 farm households."

1.74 On being asked to state as to whether Bio gas digesters and like technologies are being promoted by the Department or not and if so, the details thereof, the Department have submitted as under:

> "Ministry of New and Renewable Energy (MNRE) is promoting biogas digesters and similar technologies to process scientifically the organic wastes/ Biomass waste as feed stocks for the purpose of setting up Biogas Plants as a source of Renewable Energy. Under the schemes material such as cattle dung/ animal wastes, food & kitchen waste, poultry dropping waste in single mode or with mix of poultry waste and cattle dung/ goat & sheep dropping, paddy straw, green grass including elephant grass/ Napier grass grown especially for biogas production are used as a feed stock. Also wastes from rural Industries such as residue /effluents from Agro Processing Industries and Food Processing Industries/ Food Processing Parks, Agricultural Farms/ Dairy Farms, Gaushalas and Milk processing effluent from all dairies are also converted in to biogas. Creation of biogas plant facilities for Farmers/ Dairy Farmers / Individual organizations in Rural Areas is being promoted."

(d) Fisheries

1.75 The vulnerability assessment of Indian marine fishes to climate change, using impact and adaptation attributes and mitigation options to combat vulnerability, was investigated. The vulnerability of 68 key marine species (24 Pelagic, 24 Demersal, 15 Crustacean, and 5 Mollusc) was assessed and ranked based on their vulnerability in different zones. Measures such as establishing basic community infrastructure, strengthening seawalls, and implementing bio shields have been taken to enhance the preparedness of fishing communities. Additionally, an e-commerce system has been developed to improve the income of fisher communities through the use of information and communication techniques. The implementation of a climate resilient technology, known as Rainbow trout farming in Re-Circulating Aquaculture System (RAS), has been developed to improve fish production in high altitude areas. The adoption of climate resilient adaptation techniques can contribute to the improvement of livelihood security and restoration of indigenous fishes in wetlands. As part of this effort, a Climate Resilient Pen System (CRPS) was developed and demonstrated in five wetlands across three states. Furthermore, culture-based fisheries, which involve the stocking of fish fingerlings of Indian Major Carps in wetlands to enhance fish production, have been practiced in India. This approach not only boosts fish production but also contributes to the conservation of indigenous fishes, thereby increasing the adaptive capacity of fishers in the face of changing climate conditions. The carbon sequestration potential of six wetlands in Assam and West Bengal was found to be significantly higher (1.6 to 4.2 times) than that of the reference upland sites, highlighting the effectiveness of wetlands as carbon sinks for mitigating global warming. Studies on the biomass and carbon stock of mangroves in different estuarine wetlands of North Kerala revealed their profound role in sequestering atmospheric carbon and storing carbon in their biomass and sediments. The estimated carbon assimilation potential of the above-ground mangrove biomass in the Punnakayal, Palayakayal, and Tuticorin region of Tamil Nadu was found to be 635.6 Gigagram carbon per year based on Landsat satellite imagery.

O. Pest Modelling and Forecasting

1.76 The Study examined the occurrence of pest and disease outbreaks caused by climate change in the country, focusing on nine crops, namely rice, wheat, sorghum, chickpea, mustard, safflower, potato, tomato, and onion. The study aimed to develop models for predicting and warning against such pest and disease outbreaks. To facilitate this, a nationwide system for pest surveillance and monitoring, combined with the monitoring of weather parameters, was established. Furthermore, several mobile applications were developed to predict and identify pests, as well as to provide appropriate control measures. These applications are freely available for download and use by farmers through the Krishi Portal.

1.77 On being asked to furnish details on Pest Modelling and Forecasting and enlist latest technologies including Artificial Intelligence, IoT, Robotics being used, if any as disruptive practices, the Department have submitted as under:

> "Climate-induced pest and disease outbreaks in the country were studied across 6(six) agro climatic zones covering major pests and diseases in 4 crops (rice, pigeon pea, groundnut and tomato). Digital tools in the form of mobile apps for using pesticides (insecticide and fungicide calculator) and Integrated Pest Management (IPM) for rice, pigeon pea, groundnut and tomato have been developed and is available in the Google Play store for free download by the users. Studies are under progress on use of Artificial Intelligence, IoT, Robotics for detection of pest damage and develop application in pest management."

P. Agroforestry and sequestration

1.78 The quantification of the potential for carbon sequestration in agroforestry systems has been completed in 17 states, covering 60 districts. The carbon sequestration potential of agroforestry systems on farmers' fields is estimated to be 0.35 tons of carbon per hectare per year. The total carbon sequestration potential of these systems across the 17 states is projected to be 8.13 million tonnes. These findings were reported by the National Innovations on Climate Resilient Agriculture (NICRA) in 2019. Additionally, the total soil organic carbon in agroforestry systems on farmers' fields varied between 46.59 to 100.13 tons of carbon per hectare in the 0-90 cm soil depth across different states.

1.79 On being asked to furnish the list of steps taken by the Ministry of Environment, Forests and Climate Change to preserve natural carbon-rich ecosystems such as forests and wetlands in the last 5 years which in turn can boost agricultural productivity and sequester carbon dioxide, the Ministry of Environment, Forests and Climate Change (MoEFCC) submitted as under:

> "National Mission for a Green India (GIM) is one of the eight Missions outlined under the National Action Plan on Climate Change. It aims at protecting, restoring, and enhancing India's forest cover and responding to Climate Change by undertaking the GIM activities in the forest and non-forest areas in the selected landscapes in different category including plantation on moderately dense forest showing degradation, eco restoration of degraded open forests, restoration of

grasslands, rehabilitation of shifting cultivation areas, restoring scrub lands, ravine reclamation, restoration of abandoned mining areas, farmers land including current fallows, shelterbelt plantation, Highways/rural roads/canals/ tank bunds. During the last 5 years Rs. 591.86 Crore have been released to the Sixteen States and one union territory for taking up the GIM activities in the selected landscapes.

Wetlands are essential components of global carbon and nitrogen cycles. Wetlands act as long-term carbon sinks, preserving atmospheric CO_2 in their sediments at high-rate intensities for centuries. Altogether, the wetlands store almost one third of the world's total carbon.

● MoEF&CC is implementing a centrally sponsored scheme namely, National Plan for Conservation of Aquatic Ecosystems (NPCA) for conservation and management of wetlands, including Ramsar Sites, in the country on cost sharing basis between Central Government and respective State/UT Governments. The scheme aims at holistic conservation and restoration of wetlands, besides improvement in biodiversity and ecosystems. It promotes mainstreaming of wetlands in developmental programming with States by supporting formulation and implementation of integrated management plans, capacity building and research. During the last 5 years, an amount of about Rs. 152 crore (central share) was provided for the conservation and management of 28 wetlands in the country.
● As a significant milestone during 75th year of independence, India designated 75 wetlands as Ramsar sites *i.e*. Wetlands of International Importance, from only 26 in year 2014, making it home to the second largest network of Ramsar sites in Asia.
● MoEF&CC's recently announced Amrit Dharohar Initiative aims to build on the role of a healthy network of Ramsar Sites in climate change mitigation by supporting the several activities such as establishing a baseline GHG account of Ramsar Sites with specific focus on carbon stock and sequestration rates, interventions to conserve wetlands carbon by restoring degraded wetlands, linking conservation of Ramsar Sites with the Green Credit programme etc.

In this regard, an expert consultation workshop was held for developing a climate co-benefit assessment methodology for wetlands on 26th April, 2023. Based on the outcome of the workshop, the methodology is being developed in collaboration with national and international experts and knowledge partners."

Q. Crop Residue Management through Farm Mechanization

1.80 In order to address the issue of burning crop residues and reduce winter smog pollution, the government launched a Central Sector Scheme in 2018. This scheme, titled "Promotion of Agricultural Mechanization for *In-situ* Management of Crop Residue in States of Punjab, Haryana, Uttar Pradesh, and NCT of Delhi," is operated by the M&T division of the Department of Agriculture and Farmers Welfare in New Delhi. The scheme was initially allocated a budget of Rs 1151.80 crore for two years (Rs 591.65 crore in 2018-19 and Rs 560.15 crore in 2019-20), and it has been extended for an additional year (2020-21) with a budget allocation of Rs 600 crore. Furthermore, it has been further extended for one more year (2021-22) with a fund allocation of Rs 700 crore. Under this scheme, financial assistance is provided for the purchase of various straw management implements. These include the Super Straw Management System

(Super SMS), Happy Seeder, Paddy Straw Chopper/Shredder/Mulcher, Shrub Master/Cutter cum Spreader, Hydraulic Reversible M.B. Plough, Rotary Slasher, Zero Till Seed cum Fertilizer Drill, Super seeder, and Rotavator. Individual farmers receive 50% of the cost of the implement as financial assistance; while Custom Hiring Centres (CHCs) operated by co-operative societies of farmers, groups or self-help groups (SHGs), Farmer Producer Organizations (FPOs), and private entrepreneurs receive 80% of the cost of the implements. The progress made under this Scheme is detailed here as under:

- During past four years, totally 2.13 lakhs equipments/machines were supplied in these states (Punjab- 85386, Haryana- 72237, and UP-55711)
- 39,391 Custom hiring centres were established in Punjab (25403) , Haryana (6775) and Uttar Pradesh (7213) for making easy availability of equipments/machines to the small and marginal farmers on hire basis.
- Mobile app-based aggregator platform to facilitate hiring of machines from Custom Hiring Centres was created.
- The ICAR-KVKs have put tremendous effort for creating awareness among farmers to use machines to use the machines for *in-situ* crop residue management through Information Education and Communication (IEC) activities in Punjab (22 KVKs), Haryana (15 KVKs) and Uttar Pradesh (23 KVKs).
- Survey conducted by the ICAR-KVKs in Punjab and Haryana revealed that the Happy seeder sown (in-situ crop residue managed) resulted in 2.7% higher wheat yield with saving of 25% water for irrigation (usually one irrigation) and 20 kg urea/ha.
- Burning events were monitored by multiple satellites with thermal sensors during the harvest period from 01-Oct to 30-Nov every year in the states of Punjab, Haryana and Uttar Pradesh. The burning events recorded during 2019 were 18.8% less as compared during 2018, 31% less as compared to 2017, and 52% less as compared to 2016.

R. Agricultural Contingency Crop Planning and Agro Advisory Services

1.81 ICAR-CRIDA, in collaboration with other ICAR institutes and State Agricultural Universities, has developed District Agriculture Contingency Plans (DACP) for 650 districts. These plans recommend location-specific climate-resilient crops, varieties, and management practices for use by state departments of Agriculture and farmers. The contingency plans cover various weather aberrations, such as drought in rainfed and irrigated areas, floods, unseasonal rains, and extreme weather events like heat waves, cold waves, frost, hailstorms, and cyclones. The plans are designed to enhance preparedness and facilitate real-time implementation to ensure the sustainability of agricultural production systems in the face of weather aberrations and extreme climatic events. The plans have been updated in 386 districts and validated in 23 village clusters across 15 states. Sensitization workshops for preparedness are conducted annually through state-level interface meetings. Over the past 8 years, a total of 54 meetings have been held based on the prevailing contingency needs. Additionally, dynamic crop-weather calendars for farm-level decision-making and agro-climatic atlases for Maharashtra and Bihar have been prepared. The Indian Meteorological Department

(IMD), in collaboration with ICAR, has also developed the 'Meghdoot App' for accessing real-time weather information, which is currently used by more than 2 crore users. Furthermore, algorithm-based software has been developed to enhance the accuracy of climate predictions. National Council of Applied Economic Research (NCAER) recently conducted an assessment on the impact of Gramin Krishi Mausam Seva (GKMS) provided by the Indian Meteorological Department (IMD). The assessment revealed that farming households that implemented 1 to 4 crop management practices experienced an average annual income of Rs. 2.43 lakh per hectare. Similarly, those farmers who modified 5 to 8 practices had an average income of Rs. 2.45 lakhs, while those who adopted all nine practices had an income of Rs. 3.02 lakhs. In contrast, farmers who did not adopt the Agricultural Advisory Services (AAS) had an income of Rs. 1.98 lakh.

1.82 On being asked as to how the District Agriculture Contingency Plans (DACPs) fared & whether they have been effective in districts prone to extreme weather events/conditions and to furnish a few examples to display the effectiveness of DACPs in combating adverse effects of Climate Change, the Department have submitted as under:

"The District Agricultural Contingency Plans (DACPs) are technical documents detailing the interventions to be taken up for different weather aberrations. Both preparedness measures and real time interventions are listed in these documents. Utilizing these plans, the State Governments are preparing their state action plans for input supply (improved varieties, alternate crops, in case of delay in monsoon/early season drought *etc.*). The impact of these interventions could be seen at district level where the shift in cropping pattern observed due to delay or deficiency of monsoon. Preparedness mechanisms such as promotion of *in-situ* water conservation mechanisms through adoption of appropriate farm machinery, identification of sources for supplemental irrigation etc. are taken up by State governments. Response to DACPs is increasing by various State governments over a period of time as evidenced by more number of interface meetings organized based on forecast of information.

For example, in case of Natural resource management, technologies such as *in-situ* moisture conservation, water harvesting and efficient use, biomass mulching, residue incorporation instead of burning, supplemental irrigation, improved drainage in flood prone areas, conservation tillage where appropriate, artificial ground water recharge and water saving irrigation methods, etc. have resulted in yield improvement of 8 to 48 per cent in different locations and crops.

Similarly in case of crops, drought/heat stress tolerant varieties, advancement of planting dates of rabi crops in areas with terminal heat stress, water saving paddy cultivation methods (SRI, aerobic, direct seeding), frost management in horticulture through fumigation, staggered community nurseries for delayed monsoon, custom hiring centers for timely completion of farm operations, location specific intercropping systems with high sustainable yield index, *etc*. have shown efficacy of increasing yield in the range of 7 to 104 per cent in different crops under various adverse weather conditions."

1.83 On being inquired as to how the Department of Agriculture & Farmers Welfare plan for timely dissemination of weather based agro advisories to farmers residing in remote areas having low bandwidth and inadequate technological infrastructure, the Department have submitted as under:

"India Meteorological Department (IMD) runs an operational Agrometeorological Advisory Services (AAS) *viz.*, Gramin Krishi Mausam Sewa (GKMS) scheme specifically for the benefit of farming community in the country. Under the scheme, medium range weather forecast for next 5 days at district and block level and also subsequent week Met Sub-division wise rainfall and temperature forecast are generated by IMD. Based on the forecast, 130 Agromet Field Units (AMFUs), located at State Agricultural Universities (SAUs), institutes of Indian Council of Agricultural Research (ICAR) and Indian Institute of Technology (IIT) *etc.,* prepare Agromet Advisories on every Tuesday and Friday for the districts under their jurisdiction and for the blocks of the district of their location and communicate to the farmers to take decision on day-to-day agricultural operations. AAS rendered by IMD is a step towards weather-based crop and livestock management strategies and operations dedicated to enhancing crop production and food security besides reducing crop damage and loss due to unusual weather.

After successful implementation of district level AAS, District Agromet Units (DAMUs) have been established at Krishi Vigyan Kendras (KVKs) in collaboration with ICAR to implement block level AAS. Till date, 199 District Agromet Units (DAMUs) have been established at KVKs across the country under ICAR network and these DAMUs prepare district and block level Agromet Advisories based on district and block level weather forecasts for their respective districts and communicate to the farmers on every Tuesday and Friday. Block level weather forecast and Agromet Advisories aid the farmers in taking decision on day-to-day agricultural operations at micro-level. Along with the biweekly bulletins, daily weather forecast and now cast information are also disseminated to the farmers by Regional Meteorological Centres (RMCs) and Meteorological Centres (MCs) of IMD. Impact based forecast (IBFs) for Agriculture are also being prepared by AMFUs and DAMUs based on the severe weather warnings for different districts of various States and UTs across the country issued by National Weather Forecasting Centre (NWFC), New Delhi and RMCs and MCs of IMD. The Agromet Services mentioned above takes care of the impact on different crops due to extreme weather scenario including extreme temperatures along with the necessary guidelines for farming operations during such occasions.

Agromet Advisories are disseminated to the farmers through multichannel dissemination system like print and electronic media, Doordarshan, radio, internet etc. including SMS using mobile phones through Kisan Portal and also through private companies under Public Private Partnership (PPP) mode. SMS-based alerts and warnings along with suitable remedial measures are being sent during extreme weather events like cyclone, deep depression *etc*. through Kisan Portal. With the advancement of ICT, Farmers access the weather information including alerts and related agromet advisories specific to their districts through the mobile App *viz.*, 'Meghdoot' launched by Ministry of Earth Sciences, Government of India. These weather details are also accessible by farmers through another App 'Kisan Suvidha',

launched by Ministry of Agriculture & Farmers Welfare. Also, a few AMFUs have developed mobile Apps to facilitate quick dissemination of agromet advisories to the farmers of their region. Social media like 'WhatsApp' is also used for quicker dissemination of forecast and advisories to the farmers. At present farmers of 1,25,695 villages in 3,998 blocks have been covered through 17,591 WhatsApp groups. State Agriculture Department officials of District and Block level are also included in these WhatsApp groups. Continuous efforts are being made to increase the number of farmers and villages covered to disseminate Agromet advisories using WhatsApp.

In addition to above, advisories are also being circulated through a number of Facebook pages created by AMFUs and DAMUs. Initiative on collaboration with State Government has been taken up for integration of weather forecast and Agromet advisories with state government mobile apps and websites. The integration has been completed for Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Kerala, Madhya Pradesh, Meghalaya, Nagaland, Odisha, Rajasthan, Tamil Nadu and Uttarakhand states and about 15.6 million farmers of above-mentioned states are getting benefitted from weather forecast and agromet advisories. IMD is also taking continuous efforts to popularize the services among the farming community by organizing Farmers' Awareness Programmes (FAPs) in collaboration with AMFUs and DAMUs in various parts of the country. IMD along with the experts from AMFUs and DAMUs also participate in Kisan Melas, Farmers' Day, Field visits etc. to create awareness about the services, so that more farmers get benefitted."

S. Upscaling of Resilient Practices

1.84 The scaling up of proven resilient technologies in the district requires close collaboration with development departments. Over the past decade, numerous resilient technologies have been demonstrated in farmers' fields across the country, benefiting many farmers in vulnerable districts. Some of these resilient technologies have been adopted by developmental departments in their respective states. Expanding the demonstration of such resilient technologies in farmers' fields nationwide will bring benefits to a large number of farmers in vulnerable districts. To further scale up climate resilient Agriculture practices, it is crucial to involve civil society and tap into funding opportunities provided by social corporate responsibility initiatives. The Climate Resilient Villages (CRVs) models established under the NICRA project have already been adopted by some state governments (Maharashtra and Bihar) as well as various national and international funding agencies (NABARD, ADB, World Bank, *etc*.) through platforms like the Green Climate Fund (GCF), Global Environmental Facility (GEF), and Adaptation Fund (AF).

1.85 In response to list steps taken to popularize resource conservation technologies (both on-farm and off-farm) that would support mitigation efforts in times of extreme climatic events and to also specify measures taken to promote location and crop specific integrated nutrient management practices, the Department submitted:

"The Department is implementing, Sub Mission on Agricultural Mechanization (SMAM) in all the States and UTs and Crop Residue Management Scheme in the States of Punjab, Haryana, Uttar Pradesh, NCT of Delhi and Madhya Pradesh.

Under both the schemes, the funds are released for various activities such as training of farmers, testing of machinery for quality check, demonstration of technologies on farmer's field for its speedy adoption. Subsidy is also provided for purchase of agricultural machines by the farmers on individual ownership basis, establishment of Custom Hiring Centres, Hi-tech hubs of high cost machinery and village level Farm Machinery Banks to ensure easy availability of agricultural machines and equipment to the farmers on rental basis.

The machines and equipment for resources conservation are also promoted under these schemes which include the following:

1) Zero or minimum tillage sowing technologies such as Happy Seeder, Super Seeder, Zero Till Seed cum Fertilizer Drill, Spatial Zero Till Drill, Strip Till Drill (Smart Seeder), Surface Seeder
2) Crop residue management machines such as Super Straw Management Systems (SMS), Straw Chopper, Rotary Mulcher, Shrub Master/Rotary Slasher, Straw Balers, Tractor operated harvester cum straw collector, Straw Reaper/Straw Combine, Hydraulic Reversible Plough.
3) Resources Conservation Technologies such as Laser Guided Land Leveller, Rotavator, Direct Seeded Rice
4) Precision Farming Technologies such as agricultural Drones

As part of the Technology Demonstration Component (TDC) of National Innovations in Climate Resilient Agriculture (NICRA), demonstration of location specific climate resilient technologies is being taken up to minimize crop losses and enable farmers to cope with the extreme weather conditions. The demonstrations are taken up in farmers' fields in 151 risk prone districts of the country. Climate resilient technologies which can minimize the impact of dry spells, drought, flood and heat wave are being taken up in a cluster of villages in each of the district. The objective is to make the farmers aware about the new technologies by way of demonstrations and by training them so that they can adopt these technologies to minimize crop losses and to enable them to become resilient even under variable climatic conditions. The program is being taken up in 28 states and 5 union territories. The details of the technologies demonstrated are as follows:

As part of NICRA-TDC several resource conservation technologies which can minimize the impact of climatic stresses were demonstrated such as *in-situ* moisture conservation, biomass mulching, residue incorporation instead of burning, water harvesting and recycling for supplemental irrigation, improved drainage in flood prone areas, conservation tillage where appropriate, artificial ground water recharge and water saving irrigation methods, *etc.* depending on the crops grown and the resource endowments of the farmers. Location specific and crop specific integrated nutrient management practices such as green manuring, residue management, site specific nutrient management practices such as soil test-based fertilizer application, correction of micro nutrient deficiencies, vermi composting, techniques for compost preparation *etc*."

T. Human Resources in Climate Resilient Agriculture

1.86 Capacity building of various stakeholders is a crucial aspect to consider. Currently, the Climate Change research network project involves 1,200 scientists and 872 young research fellows from 41 research institutes and 121 KVKs. The establishment of skilled scientific manpower and state-of-the-art infrastructure through NICRA has motivated numerous students to engage in research activities, resulting in the award of 105 Ph.D. and 51 M.Sc. degrees. Furthermore, a total of 16,958 capacity building programs have been conducted, benefiting 514,816 stakeholders. In terms of publications, 280 research papers in high-impact international journals, 113 book chapters, 174 technical bulletins, and 9 policy briefs have been published, all of which are related to climate change research. The presence of these young talents, as well as trained and experienced researchers, will undoubtedly play a significant role in the future of climate resilient Agriculture. Additionally, a meta-analysis of research publications from NICRA was conducted, which included 424 research publications contributed by 1,336 authors from 53 ICAR institutes. The collaboration index of 3.1 indicated that each publication involved three or more institutes and more than six authors. It is worth noting that the number of publications is increasing at an annual rate of 20.87%.

1.87 On being asked by the Committee to furnish details about steps being taken to introduce the syllabus on Climate Change/Climate Resilient Farming In Indian Agricultural Universities and Research Institutions & whether the Department plan to introduce the topics of Climate Change, Climate Resilient Farming at school level syllabus to create awareness among the youth and also whether any consultations have so far been held or has been proposed to be held with Ministry of Human Resources Development in regard to introduction of syllabus at School Level in this regard, the Department have submitted as under:

> "The details of the steps initiated to introduce the syllabus on climate change / climate resilient farming in Indian agricultural universities is as given below.
>
> i. To make the students aware on the different environment-related issues and its conservation and to know about the basic disaster management practices a common course "Environmental Science and Disaster Management" for Undergraduate students has been introduced by VI Deans committee.
>
> ii. The M.Sc / Ph.D degrees are offered in the discipline of the Environmental sciences.
>
> iii. A Postgraduate course in Organic Farming has been initiated after its approval from Broad Subject Matter Committee (BSMA) 2022.
>
> iv. Introduction of syllabus pertaining to the above-mentioned issue in school education does not come under the purview of ICAR. However, ICAR deals with Higher Agriculture Education only.
>
> v. The Indian Agricultural Research Institute (IARI), New Delhi is having a course on Climate Change and Climate Smart Agriculture being taught for M. Sc

and Ph. D students. Also, the classes and training courses are offered to various levels of scientists, students and other stakeholders."

1.88 On being asked to enlist steps taken by the Department to harness the potential of Knowledge platforms and research partnerships of Central and State/Private Universities/ Professional Institutions like IITs etc to leapfrog innovations in Agriculture, the Department have submitted as under:

"There are two collaborative projects with IIT, Delhi as given below:

i. Feasibility study for developing renewable energy system for tea plantation in Assam. Under research collaboration between ICAR and IITD (Extramural Fund).IASRI-ProjectCode:AGEDIASRICOP202000100160 Centre for rural Development and Technology, IIT, Delhi

ii. Artificial intelligence based mobile app for identification and advisory of maize diseases and insect pests. Funded by NASF ICAR. IASRI-Project-Code:AGEDIASRISOL201901000156 (ICAR-IASRI as Lead Centre and IIT, Delhi and IIMR, Ludhiana as Cooperative Centers)."

1.89 On being asked to furnish the outcome of the National Agricultural Research and Education and Extension System (NAREES) and how much has the system been effective in providing assistance to the farmers and tribal communities across the country in dealing with adverse impact of climate change, the Department submitted:

"The climate change research infrastructure established in many institutes across the country in NAREES enabled to understand the impact of climate change on crops, livestock, fisheries and natural resources. It also helped to develop new and innovative technologies and build capacities of different stakeholders including farmers on climate resilient Agriculture. A large number of climate resilient varieties such as drought escaping, short duration and flood tolerant varieties are being developed using advanced molecular breeding techniques. These varieties are evaluated under farmers' fields in the climatically vulnerable districts and found to have improved yield and resilience. Some of these varieties are being cultivated in large scale in farmer's fields across the country. The climate resilient crop varieties developed help in minimizing impact of climate change and their by risk to farmers and tribal communities across the country."

1.90 On being asked by the Committee to furnish the number of Farmers trained by KVKs annually in Climate Resilient Farming related programmes in the last three years and also provide the number of Farmers who were trained for the first time by KVKs, the Department submitted:

"The number of farmers trained during the last three years on various aspects of climate resilient farming is as follows:

Year	No. of programmes	Farmers involved
2020-21	1293	34270
2021-22	1381	39395
2022-23	1519	44452
Number of farmers who were trained for the first time	-	16594

U. Creating Mass Awareness about Climate Change

1.91 On being asked as to how does the Department plan to involve Private Sector and Civil Society Groups to achieve the targets of Climate Change and raise awareness among the common masses and list out the Programmes being run, campaigns done if any along with notable achievements and the challenges faced in raising awareness among masses especially in under developed/backward regions with low literacy rates of the country, the Department submitted as under:

> "To enhance the outreach of activities, events and achievements under various schemes/missions and sub-missions of Department of Agriculture & Farmers Welfare (DA&FW), Extension Division is implementing various communication strategies using electronic, print & social media.

a) Electronic Media

Doordarshan, DD Kisan and All India Radio telecast & broadcast the sponsored Agriculture and allied sector programmes. Krishi Darshan programme being telecast through 18Regional Kendras of Doordarshan, 03 programmes namely Krishi Darshan, Hello Kisan and Choupal Churcha *(05 days a week)* on DD Kisan & 30 minutes of programmes namely Kisan Vani *(06 days a week)* through 97 Rural FM Radio Stations of All India Radio are being utilized to broadcast. Success stories compiled by ICAR are telecasted through DD Kisan. Coordination with 310 Community Radio Centre (CRS) and Resident Commissioners of States and UTs for wider outreach of activities/events under various schemes, Production of Audio spot/ Jingles, Video spots, Films, Documentaries for publicity of schemes of DA&FW.

b) Print Media

Publicity & awareness is also carried out by Outdoor publicity through Banners/Hoardings/Digital panels as well as through print advertisements in leading newspapers across the country.

c) Social Media

In view of growth in spread of mobiles and internet usage even in the rural areas, social media platforms *viz.* Facebook, Twitter, Instagram, YouTube, Koo, Public app *etc.* are also utilized for the publicity of various schemes/missions. Tweets/ Retweets/ Posts from line Ministries/Departments, creative info graphics and short audio-video clips on new schemes, successful startups, success stories of farmers, collage viral video of the Event (Summing up and Conclusions of the event) *etc.* are prepared and utilized for amplification of outreach activities for wider publicity among masses.

d) Krishi Melas

To highlight the achievements of Agriculture, dissemination of information and latest technologies among farmers and stake-holders various Krishi Melas are organized at regular intervals which bring all the stakeholders on one platform and create market for agro-products at International/National level."

V. Digital Agriculture

1.92 On being asked to furnish as to how the Department plans to harness the disruptive power of Digital Agriculture and whether any Schemes/Programmes have

being envisaged for the same, expected contribution of Digital Agriculture to the GDP of the country by 2030 and how can Digital Agriculture can enhance adaptation Plans/Programmes across the country, the Department submitted as under:

"The Department have been promoting the use of implementation of emerging technologies, *i.e.*, Artificial Intelligence, Data Analytics, Drones, Robotics etc. in Agriculture through its NeGP-A scheme. The guidelines of the NeGP-A scheme were revised in June 2020, in line with recommendations of Doubling Farmers Income Committee to promote the usage of emerging technologies.

Further, the Department as a roadmap for digital interventions is also working towards enabling Digital Public Infrastructure (DPI) for Agriculture. The DPIs will enable delivery of digital services at a national scale. As part of the initiative the Department is working towards enabling:

1. Agri Stack with,
   - Registries (*i.e.*, Federated Farmers Registry, Geo-referenced Village Maps, and Crop Sown Registry)
   - Digital Crop Survey to enable the Crop Sown Registry
   - Unified Farmer Service Interface (UFSI)
   - Agri Data Exchange
2. Krishi Decision Support System (KDSS)

Details about the above initiatives:

i. Agri Stack is a Digital Public Infrastructure for Agriculture that will open up the data in the Agriculture sector for the development of innovative solutions and services. Further, Agri Stack seeks to bring interoperability in the Digital Agriculture ecosystem by establishing Data Standardization in the form of a common vocabulary for the entire ecosystem. Agri Stack will enable use-cases in key focus areas of Access to Finance, Access to Inputs, Access to Markets and Access to Advisory.
ii. As part of the Agri Stack initiative, the Department is also enabling the Digital Crop Survey. The Digital Crop Survey would help to establish a clear picture of crops being sown across all farmlands in the country with proofs in the form of geo-tagged photos. The project aims to create one verified source of truth about the farmers' crop sown data.
iii. Krishi DSS is being developed using geo-spatial technologies and related databases to enhance the evidence based decision making capability of all stakeholders in the Agriculture sector. Krishi DSS will also enable development of solutions based on geo-spatial technologies and enable cross domain solution development using thematic layers, *i.e.*, Disaster Management, Crop Forecasting etc.

Using the Digital Public Infrastructures, the ecosystem participants, *i.e.*, Central Government, State Government, will get access to data, technologies, solutions and services that will enable them to better monitor, plan and implement schemes and services and reach a higher level of inclusion in line with the GoI vision of 100% inclusion."

1.93 On being asked to state the Institutional, Technological and Financial barriers identified in implementation of Digital Agriculture and the steps planned/being taken to overcome them and the challenges being faced in providing equitable access to Digital Agriculture to Small and Marginalized Farmers specially from Scheduled Castes and Tribal Communities, the Department submitted:

- "Institutional Barriers identified: Since Agriculture is a State Subject, Agri Stack is being built in a federated manner with the State Governments. This requires active participation from the States *w.r.t.* the implementation of Agri Stack.
- Technological Barriers identified: Enabling DPIs in Agriculture is a complex task, requiring a highly specialized knowledge of DPIs and Solution Architecture.
- Financial Barriers identified: Data Storage: Heaps of year wise data generated would require a lot of Cloud hosting space and associated management costs.

The Department have engaged Managed Cloud Service Provider for managing data usage and its storage. In future, it may require more funds to implement solutions around this data. An Agri Stack Technical Committee has been established with key members from the industry with experience in designing and implementing Aadhaar, UPI, NDEAR, NDHM *etc.* that advises the Agri Stack Team as and when required. Steering Committee and Implementation Committees have been established in every State chaired by Chief Secretary to ensure the Agri Stack project is implemented in a fast and efficient manner.

Challenges faced for providing equitable access:

- Linking of geo-referenced and geo-fenced Agriculture plots in State
- Mapping of community and temple land in the country for the purpose of Agriculture
- Crop Assessment & Loss Assessment
- Farmer Based specific Crop Advisories."

1.94 On being asked to state as to whether the Department intends to tap mobile networks available in the country to measure rainfall using Commercial Microwave Links (CML), which may provide real time rainfall observations in remote areas/flood prone areas and may be of high use to farmers especially those with small holdings and the strategies being developed jointly with Indian Meteorological Department (IMD), if any, in this regard may be furnished, the Department submitted:

"The wireless Commercial Microwave Links (CMLs) are widely deployed, because rainfall causes attenuation to the radio signals between transmitter and receiver stations in the network, CMLs can be used to draw reliable rainfall estimates based on changes observed in the quality of the signal. However, at present there is no on-going or proposed activity in IMD for measurement of rainfall using Commercial Microwave Links."

1.95 On being asked to furnish a roadmap regarding Agri Digital Financial services in the country and the projections for the next five years, the Department submitted as under:

"The Department as a roadmap for digital interventions is working towards enabling Digital Public Infrastructure (DPI) for Agriculture. The DPIs will enable delivery of digital services at a national scale. As part of the initiative the Department is working towards enabling:

1. Agri Stack with,
   - Registries (*i.e.,* Federated Farmers Registry, Geo-referenced Village Maps, and Crop Sown Registry)
   - Digital Crop Survey to enable the Crop Sown Registry
   - Unified Farmer Service Interface (UFSI)
   - Agri Data Exchange
2. Krishi Decision Support System (KDSS)

These DPIs will enable the delivery of innovative services and solutions by Government and Private sector in key focus areas, i.e., Access to Finance, Access to Inputs, Access to Markets and Access to Advisory for the Indian Farmers. Under the key area of Access to Finance, the Ministry is working with Department of Financial Services to enable delivery of KCC using the JanSamarth and Agri Stack infrastructure. The enablement of KCC using these infrastructures will enable the farmers to get quick and easy access to KCC, without the need to submit manual documents and with reduced time to get the KCC Cards. Further, the same infrastructure can be used by other Authorized Service Providers to enable better Financial Inclusion and access to financial products for the Indian Farmers. Further, the Agri Stack project also enables the various Departments/Ministries of State and Central Government to get access to verified information on the Farmers with consent. This will enable the Government to increase inclusion and reduce leakages in their beneficiary oriented Schemes."

1.96 On being asked to enlist steps being taken by the Department to incentivize Private Sector engagement in Digital Agriculture alongwith steps taken to synergize the energies of Public Private Partnership(PPP) expertise in Digital Agriculture and coordination at various levels of governance *viz*. State, District, region among various Government Agencies, the Department submitted :

"This Department is working on building registries *viz*. farmers' registry and crop registry would likely to be in place for about 75% of the states by December, 2023. Further, this Department has signed MoUs with 10 Agritech Players on Pro-bono basis. Also, based upon the completion of MoUs outcome of the collaboration with Agribazzar and ESRI India Limited has been integrated with Farmers' Database."

1.97 On being asked to enlist the steps taken to train and raise awareness among farmers across the country regarding use of Artificial Intelligence Techniques and other innovations and how does the Department plan to ensure that Startups in Agriculture

Sector dealing with latest technologies pertaining to Climate Change, which have been provided Financial Assistance and other aid through various Government Schemes provide latest innovations available from the Agricultural Sector at optimal rates to Small and Marginalized farmers, the Department submitted as under :

> "The Department have been promoting the use of implementation of emerging technologies, *i.e.* Artificial Intelligence, Data Analytics, Drones, Robotics etc. in Agriculture through its NeGP-A scheme. The guidelines of the NeGP-A Scheme were revised in June 2020, in line with recommendations of Doubling Farmers Income Committee to promote the usage of emerging technologies. Further, the Department have been working towards enabling a Digital Public Infrastructure for Agriculture, *i.e.,* Agri Stack. The Digital Public Infrastructure (DPI) for Agriculture will open up the data in Agriculture sector for the development of innovative services and solutions by Government and Private sector. A key focus of the DPI is to enable innovative use-cases such as Crop Advisory using Artificial Intelligence, Ease of Access to Credit etc."

W. Promotion of Millets/Coarse grains

1.98 On being asked to state as to how the Department plans to incentivize Farmers to grow Millets and subsequently boost mass consumption of these coarse grains including millets which are priced higher to rice, wheat and so on, the Department submitted as under:

> "Under NFSM-Nutri Cereals, the assistance is being provided to farmers through state governments on following interventions;
>
> - Demonstrations on latest crop production & protection technologies.
> - Seed distribution of certified seeds of hybrids & High Yielding Varieties (HYVs).
> - Seed production of Certified seeds of High Yielding Varieties (HVYs).
> - Integrated Nutrient & Pest Management Technologies.
> - Improved Farm Implements/tools, Water application tools (Sprinkler).
> - Cropping system based trainings to farmers.
> - Organizing Events / workshops etc.
>
> Other initiatives taken for promotion of Nutri Cereals/millets:
>
> - Farmer Producer Organizations (FPOs) in cluster areas (50 Nos.)
> - Creation of processing units for FPOs.
> - Centers of Excellence (CoE) on Nutri Cereals (For Bajra at Hisar, for Jowar at Hyderabad, for small millets at Bengaluru).
> - Creation of Seed Hubs (for production of quality seeds: 19 Nos).
> - Publicity through print and electronic media etc.
> - Distribution of seed mini kits of millets free of cost to the farmers. '

1.99 On being categorically asked to elucidate measures taken to popularize Millets among the masses, provide the details of expenditure incurred in publicity/ advertisement budget in this regard to create awareness and what innovative measures are being planned to push for consumption of millets and millet based products, the Department submitted:

“The Government of India is implementing a multi stakeholder approach towards celebration of International Year of Millets (IYM) - 2023. The action plan of IYM-2023 focuses on strategies to enhance production and productivity, consumption, export, strengthening value chain, branding, creating awareness for health benefits *etc*. To promote Shree Anna a yearlong action plan for monthly activity has been prepared by Central Ministries, State Governments and Indian Embassies. In order to increase production and productivity of Shree Anna, the Department of Agriculture and Farmers Welfare (DA&FW) is implementing a Sub-Mission on Nutri-Cereals under National Food Security Mission (NFSM) in all districts of 28 States & 2 Union Territories *viz*. Jammu & Kashmir and Ladakh. Under NFSM–Nutri Cereals, the incentives are provided to the farmers, through the States/UTs, on crop production and protection technologies, cropping system based demonstrations, production & distribution of certified seeds of newly released varieties/hybrids, Integrated Nutrient and Pest Management techniques, improved farm implements/tools/resource conservation machineries, water saving devices, capacity building of farmers through trainings during cropping season, organizing events/workshops, distribution of seed minikits, publicity through print and electronic media *etc*. The interventions such as formation of Farmer Producer Organizations (FPOs) for Shree Anna, setting up Centers of Excellence (CoE) and seed hubs for Shree Anna have also been supported under NFSM. In addition, states such as Assam, Bihar, Chhattisgarh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttarakhand and Uttar Pradesh have initiated Millet Missions in the States to promote Shree Anna. To make India a global hub for 'Shree Anna', the Indian Institute of Millets Research (IIMR), Hyderabad has been declared as the Centre of Excellence for sharing best practices, research and technologies at the national and international level.

Shree Anna are also included under the Poshan Abhiyan of the Ministry of Women and Child Development. Further, the Ministry of Food and Public Distribution has revised its guidelines to increase the procurement of Shree Anna under the Targeted Public Distribution System (TPDS), Integrated Child Development Services (ICDS) and Mid-Day Meal. The Ministry has also advised the State Governments and Union Territories to increase the procurement of Shree Anna. An Export Promotion Forum dedicated to promotion of Shree Anna in the international market has been set up to facilitate promotion, marketing and development of Shree Anna exports from India. Under the Eat Right campaign, the Food Safety and Standards Authority of India (FSSAI) is creating awareness to promote the use of Shree Anna as part of a healthy and varied diet.

Ministry of Food Processing Industries (MoFPI) has implemented the Production Linked Incentive Scheme for Food Processing Industry for Millet-based products (PLISMBP) during 2022- 23 to 2026-27 with an outlay of Rs. 800 crore. The Pradhan Mantri Formalization of Micro Food Processing Enterprises (PMFME) Scheme, launched under the Atmanirbhar Bharat Abhiyan is currently being implemented in 35 States and Union Territories (UTs). The Government is also popularizing Agri-Infrastructure Fund Scheme to invite farmers/FPOs/Entrepreneurs to avail the benefit of interest subvention on loans up to 2 crore for setting up

primary processing units in Shree Anna. Government is also promoting Shree Anna based startups to increase the demand of Shree Anna.

As a part of promotional activities of IYM 2023, the Ministry of Agriculture and Farmers welfare is promoting Shree Anna during India's G20 presidency. Shree Anna are also showcased in various events such as International Trade Fair, Suraj Kund Mela *etc*. A key event organized towards International Year of Millets was the Global Millets (Shree Anna) Conference, held from 18th – 19th March 2023 at IARI Pusa campus, New Delhi which was inaugurated by the Hon'ble Prime Minister. In continuation to the efforts towards mainstreaming Shree Anna, a 'Millets Experience Centre (MEC)' has been opened at Dilli Haat, INA, New Delhi with an aim to raise awareness on Shree Anna and encourage its adoption among general public. In order to encourage consumption of Shree Anna among government employees, all Government offices have been advised to include Shree Anna snacks in departmental trainings/meetings and Shree Anna based food items in departmental canteens. DA&FW has also installed vending machines for Shree Anna products through National Agricultural Cooperative Marketing Federation of India (NAFED) to various Ministries/Departments. Shree Anna and its products have been identified as One District One Product (ODOP) in 19 districts of 10 States.

Further, there is no separate budget provision under NFSM-Nutri Cereals for publicity/advertisement."

1.100 Further, DA&FW was asked to list steps taken to develop and promote plant based protein value chains in farming and allied areas to create low carbon footprints. In response, the Department submitted:

"However, Under NFSM programme, the NFSM-Pulses is being implemented all 28 states and 2 UTs *viz.* Jammu & Kashmir and Ladakh. Under NFSM assistance is given to farmers for demonstration on latest crop production and protection technology, distribution and production of seeds of HYVs / Hybrids, INM and IPM technologies, improved farm implements/tools, water saving devices, capacity building of farmers etc. In addition, distribution of seed mini kits of pulses free of cost to the farmers."

X. Food and Nutrition Security

1.101 Department of Agriculture and Farmers Welfare was asked to furnish as to how does it plan to ensure Food security for the country in times of adverse impact on Agricultural productivity due to increasing events of extreme weather conditions as India has become the most populous Nation and to share a roadmap in this regard alongwith all relevant details. In response, the Department submitted as under:

"The Department of Agriculture and Farmers Welfare is implementing National Food Security Mission (NFSM) in 28 states and 2 UTs *viz*. Jammu & Kashmir and Ladakh with the objective to increase food grain production through area expansion and productivity enhancement. Under NFSM, the assistance is given to farmers for demonstration on latest crop production and protection technology, distribution and production of seeds of HYVs / Hybrids, INM and IPM technologies, improved farm

implements/tools, water saving devices, capacity building of farmers etc. In addition, the programme implementing states are advised to use climate resilient/stress tolerant varieties of seeds under demonstrations and seed distribution interventions.

In order to ensure food security in case of adverse condition, the programme adopts various strategies for sustaining the production of food grains such as focus on low productivity and high potential districts, implementation of cropping system centric interventions in a mission mode approach, agro-climatic zone wise planning and cluster approach, focus on pulse production through utilization of rice fallows, rice bunds and inter-cropping of pulses with coarse cereals, oilseeds and commercial crops *etc*. In addition, under NFSM cluster front line demonstrations of new technologies are organized through ICAR- Krishi Vigyan Kendras, seeds of new varieties of pulses and nutri-cereals are distributed in the form of seed mini kits free of cost to the farmers.

Further flexibility is also given to the NFSM programme implementing states to take up local initiatives as per their needs for enhancing production and productivity of food grains."

1.102 International Food Policy Research Institute through their Report 'Global Food Policy 2022' have stated that due to Climate Change, global population about 65 million including 17 million from India would face hunger by 2030. It is further stated in the Report that there would be 60% growth in Global Food production by 2050 but 50 Crore Indians would be facing hunger risk. On being asked the response of the Government in regard to the aforesaid, the Department submitted as under:

"As per the Global Food Policy Report 2022 of the IFPRI, Washington DC climate change is likely to slow down the progress towards hunger reduction in India, with around 16.0 million people remaining at risk of hunger in 2030. Indian Council of Agricultural Research under the network of project on National Innovations in Climate Resilient Agriculture (NICRA) has planned to develop and promote climate resilient Agriculture to address vulnerable areas of the country and help the districts and regions to cope up with extreme weather conditions like droughts, floods, frost, heat waves, *etc.* It has three components *viz.* strategic research, technology demonstration and capacity building. The main thrust areas include (i) identification of the most vulnerable districts/regions, (ii) development of crop varieties and management practices for adaptation and mitigation and (iii) assessment of climate change impacts on livestock, fisheries and poultry *vis-a-vis* identification of adaptation strategies.

Despite the climate change is impacting Indian Agriculture, the food grain production has been increasing since decades due to interventions made through several schemes under NMSA. Further, National Food Security Mission launched in the country aided the country to maintain the food production levels."

1.103 On being asked to list steps taken to ensure food and nutrition security especially in tribal dominated areas/backward regions/underdeveloped regions, the Department have submitted as under:

"Under NICRA, location-specific Climate Resilient Technologies (CRTs) were demonstrated in tribal dominated/backward regions/underdeveloped regions of 11 vulnerable districts in Punjab, Himachal Pradesh, Uttar Pradesh, West Bengal, Telangana and Tamil Nadu to cope with climate variability. Apart from demonstration, capacity building programs were also taken up to farmers and other stakeholders and to evolve innovative institutional mechanisms at village level so as to enable the communities to respond to climate stresses and to ensure food and nutrition security. Climatic vulnerabilities *viz*., droughts, floods, cyclone, heat wave, high temperature stress, cold wave and frost are being addressed in NICRA villages."

Y. Role of Nuclear Technology in boosting Agricultural Productivity

1.104 Department of Agriculture & Farmers Welfare was asked to share the role of nuclear technology in improving Agricultural productivity and its applications in ensuring Food security for the country. In response thereto, the Department submitted as under:

"The nuclear technology such as gamma radiation is being used in mutation breeding. Several varieties have been developed and released by using gamma radiation induced mutagenesis in crops. Gamma irradiation is being used to developing mutant populations in crops, particularly in crops having limited natural genetic diversity. Besides crop improvement, radioisotope induced mutation is also used to improve microbes. Bhabha Atomic Research Centre (BARC) has developed a mutant of the bio control agent *Trichodermavirens* using gamma radiation. Radio isotopes are used as tracer molecules in studying nutrient uptake and utilization efficiency, understand the metabolic processes, Stable isotope technology is being used to identify the germplasm with high water use efficiency and water pollution studies."

1.105 On being asked as to how does the Department plan to tap nuclear technology to address present and future challenges in Agriculture, the Department have submitted as under:

"The Department will continue to use nuclear technology in crop improvement through mutation breeding, and use for basic research on water and nutrient use efficiency and plant metabolism as tracer molecule."

1.106 On being asked to list the challenges being faced by the Department in implementation of Centrally Sponsored Schemes (CSS) in various States and to elucidate the measures taken by the Department to overcome these challenges and the change in results achieved, if any, the Department submitted as under:

"The Ministry faces certain challenges while planning and implementing the schemes/programs with the State/UT Governments. There are challenges in planning stage in ensuring the State plan meets the scheme objectives and other priorities. In some cases, State/UT Governments do not prepare/submit Annual Action Plan in time which results in delay in implementation of the scheme.

During the implementation the major problem faced is in timely release of funds to State Governments as per approved allocation in view of high unspent balance of earlier released fund on the part of the State/UT Governments. Some time, State Governments have high unspent balance more than the permissible limit prescribed by Ministry of Finance, Government of India for releasing funds.

Further due to non- submission of utilization certificate or other related documents by the State/UT Governments, funds could not be released in time, resulting in delay of implementation of schemes.

Such problems calls for a more comprehensive and coordinated approach on the part of Central and State governments, in terms of planning and implementation of various government programs and schemes. State governments have been asked to draw up a comprehensive strategic plan for the Agriculture sector of the State, keeping in view their priorities. Further States/UTs while formulating their plans under different schemes should have an articulation of the overall strategy and the schemes/programs should be linked with the program objectives. States are already preparing State and District level Agriculture Plans. Regular meetings/interaction has been held with the States/UTs while formulating the State plans, to ensure convergence with schemes of other Departments, as well as those implemented by the State government.

To overcome problems of progress in the implementation on the part of the States/UTs, Ministry conducts meeting regularly with the State/UT Governments' representatives to review implementation of this schemes and sensitizing them to fast track the process / mechanism of utilization of unspent fund."

Z. Lifestyle for the Environment (LiFE)

1.107 On being asked to furnish key highlights of the Department's global initiative to combat Climate Change—'Lifestyle for the Environment (LiFE) Movement', its objectives and the manner in which the Department plans to proceed ahead to fulfill the objectives of the Movement, the Department submitted as under:

"Mission LiFE was introduced by Hon'ble PM Shri Narendra Modiji at COP-26 in Glasgow on 1st November 2021.It is a mass movement for mindful utilization instead of mindless consumption. Mission LiFE aims to create Pro-Planet People by nudging them to take simple climate-friendly actions in their daily lives. The Mission focuses on 7 themes, viz. Energy Saved, Water Saved, Single Use Plastic Reduced, E-waste Reduced, Sustainable Food Systems Adopted, Waste Reduced (Swachhata Actions), Healthy Lifestyles Adopted, and encompasses a comprehensive but non-exhaustive list of 75 LiFE Actions which individuals can

take to live a more sustainable lifestyle. It is a behavioural change framework on transitioning to a circular economy by influencing individual and community behaviour.

The relevant themes of the Mission LiFE are integrated in ongoing schemes for achieving energy efficiency and water productivity while adopting sustainable food production system. In addition to this, waste reduction through recycling of wastes in Agriculture is also being adopted. Wherever plastics are used in Agriculture, efforts are made to reduce the single use plastics. As part of advocacy and awareness, the Department have organized series of campaign programmes covering the themes of Soil Health Management, Drone application in Agriculture, Promotion of Climate Resilient crops/ varieties /seeds, rainwater harvesting and its efficient use, Waste to Wealth/ Composting and Sensitizing FPOs for Integration Mission LiFE.

Ministry of Agriculture and Farmers Welfare organized Mega Event on Mission LiFE on the occasion of "World Environment Day", 5th June 2023. The program included tree plantation activity and an exhibition on Natural and Organic Farming showcasing and creating awareness on the sustainable agricultural practices symbolizing Mission LiFE.

The Ministry of Agriculture prepared Plan of Action (POA)/ strategy for mass mobilization through various activities. The various campaign programmes organized as per the plan of action were uploaded on Meri LiFE portal. Presently the dashboard of Meri LiFE portal shows a total of 789 awareness events and 875 action events have been organized with 62426 no. of participants and total 58703 people took pledge under Mission LiFE so far. For publicity of the events, the Ministries/Departments were utilized their own social media handles *viz*. Facebook, Twitter, Instagram, *etc*. and posted creatives and activities on social media for maximum outreach. Additionally, a number of competitions for school and college students such as drawing, poster, declamation, quiz etc were also conducted by various participating Organizations."

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Observations/Recommendations of the Committee

1. Creation of Single Nodal Agency at National Level to deal with issues of Climate Change.

Several studies have now unequivocally established that the phenomenon of climate change has a detrimental effect on crop yields and agricultural productivity. The impact can be negated by implementing both modern and traditional adaptation measures, with the necessary Institutional and Policy support. Every Ministry/Department is mandated to prepare a Disaster Management Plan under Sections 36/37 of Disaster Management (DM) Act, 2005. Accordingly, Department of Agriculture and Farmers Welfare also prepare a National Agriculture Disaster Management Plan (NADMP) to include key aspects of Disaster Risk Reduction (DRR) that addresses Climate Change adaptation and sustainable development goals related to the Agriculture Sector. However, a unified command at the National Level is required for having seamless coordination among various Ministries, acting dynamically as and when the situation so requires, take swift decisions on urgent issues effecting Agriculture coming under the ambit of several ministries *viz.* Ministry of Science & Technology, Ministry of Earth Sciences, Ministry of Water Resources, Ministry of Environment, Forests & Climate Change.

Making any single Ministry as the Nodal Agency to deal with Climate Change in Agriculture would not be able to create the desired impact as it cannot use its powers effectively over other Ministries/Departments or do seamless liaisoning with different State Governments or take swift decisions nor it can be held responsible for the Subjects lying under the jurisdiction of other Ministries/Departments which a National Level Authority with unified command can do or achieve.

The Committee, therefore, are of the firm view that the issues pertaining to ground water, Meteorological events and advisories, Agro advisories and other overlapping areas related to Agriculture or covertly connected with it, require the need for a National Authority, especially in times of calamitous events & extreme phenological events to work in close cooperation with various stakeholders including State Governments and their Agencies and take swift decisions and to deal with all Climate Change issues holistically.

The Committee are further of the considered view in this regard that issues related to Climate Change and its effects impacting Agriculture needs to be handled by a single Authority at the National level on the pattern of National Disaster Management Authority(NDMA)which can be named as National Agriculture Disaster Management Authority(NADMA). The Committee further desire that the proposed NADMA may consist of experts having rich experience in the relevant fields for the purpose. This will not only enhance dynamism in decision making but also fix accountability which is presently missing in the

system. The Committee again express their suggestion that formation of NADMA will act as a catalyst and game changer and enhance the responsive mechanism of the government.

2. Nationwide implementation of Comprehensive and Integrated Approach to mitigate adverse impact of Climate Change on Agriculture- Implementation of NICRA Scheme in all Risk Prone Villages due to Climate Change

Climate change impacts are not evenly distributed among different populations and countries. Developing countries, which heavily rely on the Agriculture and lack the necessary technologies and finances for risk management, face greater vulnerability to climate risks. Research has found that elevated temperatures have a more detrimental effect on the Agricultural growth in developing countries as compared to developed ones. Recent studies have demonstrated that Climate Change has resulted in a substantial decrease in the productivity growth of global Agriculture in the last five- six decades. With a more pronounced impact on developing countries, similar evidence has been reported for India, where climatic hazards have led to a substantive reduction in productivity growth, especially in low-income and agrarian States. The socio-economic consequences of Climate Change's negative impact on agriculture are also more significant for developing countries. Studies have indicated that climatic shocks have disproportionately increased undernutrition and poverty rates in the South Asia and Sub-Saharan Africa compared to other regions of the world. Numerous other studies have also documented a significant decline in household income and consumption expenditure due to adverse rainfall shocks.

The long-term consequences of repeated exposure to multiple risks can be devastating. They can deplete household savings, force the sale of assets, increase indebtedness, discourage the adoption of new technologies and innovations, and degrade natural resources and ecosystem services. There are concerns that, without mitigation and adaptation measures, poor farmers may find it difficult to fully recover from the impacts of climatic shocks and remain trapped in a cycle of low-income, debt, and poverty. The adverse impacts of Climate Change on Agriculture and Agriculture-based livelihoods can be reduced by implementing comprehensive and integrated approaches. These approaches include technological advancements in agriculture, meteorology, information and communication, data sciences, and the incorporation of traditional farming practices. Depending on risk aversion, resource availability, and access to information and finances, farm households adopt various measures to manage climate risks. Extensive analysis of adaptation literature has shown that integrating scientific innovations with traditional practices is a strong strategy for enhancing productivity, sustainability, and resilience in smallholder-dominated agrarian economies.

Against this backdrop, the Committee desire that NICRA (National Innovations in Climate Resilient Agriculture) Scheme should be implemented in

all identified risk prone/vulnerable villages to empower the farmers and shield them from the vagaries of natural events & meteorological incidents and thus enabling them to usher in a new era of financial security.

3. Giving prominence to Village Panchayats to raise awareness about impact of Climate Change and its effects on Agriculture

The most challenging political issue in the Climate Change policy arises from the inadequate acknowledgement and recognition of the changing climate by Village Panchayats or Local Self-governing Bodies. An enlightened or aware Sarpanch will act as a force multiplier and in turn educate the farmers who are the front line warriors about the effects of Climate Change on Agriculture and the need for adoption of Climate Resilient practices. The farmers need to be enlightened clearly that the impact of climate risks could transmit along the Supply or Value chains from genetics to end-consumption, affecting the efficiency and sustainability of the entire chain and the livelihoods of chain actors.

Until a village Sarpanch is made aware of the need to align the development strategies of a Gram Panchayat with the goal of adapting agriculture to climate variability, any efforts made at higher levels of governance may not yield the desired outcomes. The institution of a Panchayat possesses the ability to leverage funds from a multitude of Govt. schemes. Funds provided under Govt. Schemes can be utilized in adaptation and mitigation strategies for enhancing Climate Resilience by working on agro forestry and plantation, soil & water management, creation of water ponds/reservoirs and so on. Workshops containing information for Beginners, Medium and Advance Level Training and Refresher courses for Village Sarpanchs and Panchayats on Climate Change issues need to be conducted on a regular basis at District, Regional and National Level to keep them attuned to the developments happening worldwide. National/regional Level ranking of villages adopting best Climate Resilient practices may be started and those topping the charts may be felicitated to motivate others to follow the suit.

The Committee are of the considered opinion that to enhance awareness regarding impact of Climate Change on Agriculture, in villages especially among the farming community and Village Sarpanchs, messages may be broadcast on social media platforms extensively in Hindi, English as well as in vernacular languages across the country. Focus on dissemination of these informative messages regarding impact of Climate Change on Agriculture in remote areas with sub optimal connectivity and border areas may be given prominence so that farmers residing there do not remain oblivious about the adverse impact of Climate Change and adopt essential adaptative and mitigative practices.

4. Role of Krishi Vigyan Kendras(KVKs) and the need for transformation

The Committee note that significant contribution has been made by the KVKs (Krishi Vigyan Kendras) towards the overall enhancement of farmers' quality of life. These contributions include in the areas of income generation, agricultural productivity, the introduction of state-of-the-art technologies, approaches to resource conservation, the promotion of organic farming, diversification of agricultural activities, Training Programmes for rural youth and farm women to foster entrepreneurial endeavors, the development of integrated farming systems, models for climate-resilient agriculture, and the utilization of information and communication technology (ICT) for effective dissemination of information. It is an established fact, as revealed by field-based stakeholder analysis, that the presence of a KVK in each district has led to tangible progress in the Agrarian sector. This progress is attributed to the provision of a Single-Window Platform that offers technology and services - within easy reach of all stakeholders.

The Committee think that time has arrived wherein infrastructural and technological facilities in KVKs need a boost to enable them to cater training to farmers in the latest technological Agrarian practices. The record keeping of KVKs especially in regard to records of training being imparted to the Farmers, also needs to be spruced up. KVKs should resort to data analytics to ensure that all farmers are imparted training in the relevant fields. The KVKs need to utilize Artificial Intelligence and other latest innovations to act as Knowledge Centres where information/Knowledge can be imparted in Vernacular languages too, through online mode 24 x7 as and when queries are raised by the farmers. These changes will revamp the existing system and KVKs will usher in a new version KVK 2.0 fully equipped and geared to meet not only the challenges of Climate Change but other exigencies too, as and when the need arises. These changes will also enable KVKs to provide courses in Capacity Building Programmes for Farmers and Farmer Producer Organisations (FPOs).

5. Ensuring Food and Nutritional Security for all

At the core of the Sustainable Development Goals (SDGs) lie objectives to terminate the state of hunger, accomplish food security, and enhance nutrition. The issue of food security remains of utmost importance for India, within its roster of developmental concerns as a result of the nation's comparably elevated levels of economic advancement. Achieving and sustaining Food and Nutritional security remains a challenge for India, the world's most populous Nation. In the last three decades or so, India has transitioned itself from a food deficit nation to a self sufficient food producing nation. In this context, merely achieving satisfactory levels of food production is not sufficient to guarantee a nation's food security. The National Food Security Act(NFSA) 2013 aims to provide for food and nutritional security by ensuring access to adequate quantities of quality

food at affordable prices to the most vulnerable segments of the Society through various Schemes and Programmes.

The primary issue encountered in Indian agriculture pertains to the insufficiency of productivity. The Nation necessitates an escalated level of public investment in the advancement and dissemination of crop varieties that exhibit heightened tolerance towards fluctuations in temperature and precipitation, while also being more proficient in water and nutrient utilization. The Committee are of the considerate view that Agricultural Policy ought to prioritize the enhancement of crop productivity, while concurrently formulating safety nets to effectively cope with the associated risks posed by Climate Change.

The introduction of the POSHAN Abhiyan (Nutrition Mission) in March 2018 by the Government of India has reoriented the national focus on nutrition. This initiative aims to enhance productivity and ensure food security for individuals as well as their families and communities. Poor nutrition is a major risk factor in non communicable diseases (NCD). The Committee strongly recommend that latest technologies such as Artificial Intelligence, Big Data Analytics etc. may be utilized to ensure food and nutritional security for the masses especially vulnerable sections of the society, rural population in fulfillment of Sustainable Development Goals and for overall growth of the Agriculture sector.

6. Need for giving priority to Crop Diversification and Water conservation

Diversification and modification of crop species and variety portfolios are commonly employed strategies by farmers to address environmental and socio-economic variability and to effectively respond to transformative shifts, such as climate change. Despite the undeniable importance of crop diversity in enabling agro ecosystems for successful adaptation to climate change as current public policies and development interventions offer inadequate assistance in promoting crop diversification. The Committee feel that understanding the dynamics of alterations in the crop portfolios of farmers, the intricate interaction between climate and other factors that drive these changes, and the consequences for the food security, nutrition, and income of farmers assumes paramount importance in providing valuable insights for agricultural decision-making, which is primarily crucial in designing feasible approaches for enduring adaptation in a swiftly evolving global context. The Committee recommend that as Crop Diversification is an efficient tool in ensuring food security, enhancing soil fertility, controlling pests & diseases , brings about yield stability and more importantly, mitigate effects of Climate Change and hence it should be actively promoted by the Ministry and all possible assistance rendered to farmers in pursuance of the same across the country.

Better management of water resources must be a key feature of sustainable Agriculture. Water Supply Management Options such as new storages and water harvesting are important, especially in the water-stressed regions of North-western India. Water use efficiency in Agriculture needs to be

enhanced. India's irrigation infrastructure needs to be upgraded; particular attention needs to be given to north-western India, the country's food basket that is prone to climate-induced droughts. Despite the benefits of drip irrigation, it is still largely adopted for high-value horticultural crops. To enhance the area under micro and drip irrigation, the government needs to take a nuanced stance on the subsidy on electricity for drawing water for irrigation purposes, which has been a major contributor to declining groundwater levels, towards the adoption of Drip Irrigation techniques.

In view of the foregoing, the Committee strongly recommend the use of latest technologies such as Artificial algorithms, which will optimize irrigation schedules, conserve water and minimize environmental impact, particularly in the light of growing water scarcity issues.

7. Impetus to Research in Climate Smart Practices and Big Data Analytics

Climate Change is anticipated to modify pest behavior, specifically in terms of infestation levels, resistance and resurgence, and the emergence of novel pests in response to altered climatic conditions. Numerous research studies have examined the influence of climate change on Indian Agriculture using diverse datasets and estimation methods. In the realm of biological science, controlled experiments are often employed to quantitatively assess the effects of weather parameter fluctuations, particularly temperature, on crop yields. With all other factors held constant, these controlled conditions expose crops to varying temperature levels, enabling the determination of the extent of yield reduction.

The Committee having noticed the importance of modern technologies in agriculture, do recommend that Ministry of Agriculture and Farmers Welfare should give top priority to the advancement of research in emerging areas of Climate Science in order to develop technologies that encompass pest surveillance and forecasting systems, simulation modeling, and big data analytics, among others. The implementation of digital agriculture, utilizing ICT (Information and Communication Technology) and emerging technologies, has the potential to play a crucial role in facilitating the adoption of various climate-smart interventions. Emphasizing agricultural research and innovation is necessary to ensure the efficient utilization of resources such as water and nutrients, carbon sequestration, and the assessment of Greenhouse Gas emissions from the Agricultural sector. This requires an augmented allocation of budgetary support and the establishment of collaborations and partnerships. Therefore, the Committee further recommend that the Ministry/Department should ensure sufficient allocation for this purpose from the resources available with them.

8. Availability of Farm inputs and finance

Climate Change is the most defining challenge for Agriculture, human development and ecological well being in the 21st century. Climate Change has forced farmers to use adaptative and mitigation methods to lessen the impact. The Committee do recommend that seeds of Climate Resilient Varieties may be provided to the farmers and accordingly, Seed Hubs need to be promoted on a large scale and indigenous breeds in Animal Husbandry may be made available alongwith necessary food supplements at affordable prices. Climate Resilient varieties may be popularized be it Horticulture or Fisheries. These Climate Resilient varieties would ultimately help in reduction of GHG emissions and pave for enhanced agricultural yields too in uncertain times.

9. Promotion of Organic/Natural Farming:

Organic Farming have the potential to contribute to the mitigation of climate change through two main mechanisms. Firstly, by minimizing the release of Green House Gases (GHGs), and secondly, by sequestering Carbon dioxide (CO_2) from the atmosphere within the soil. The impact of Traditional Agricultural Practices on Global Warming is significantly impacted by the application of synthetic Nitrogen Fertilizers and the presence of high levels of Nitrogen in soil. In contrast, Organic Agriculture is capable of sustaining itself with Nitrogen. Mixed organic farms engage in highly efficient recycling of manures from livestock and crop residues through the process of composting. Additionally, Leguminous Crops contribute an ample amount of nitrogen, particularly on stockless organic farms where it serves as the primary source.

The emission levels of Nitrous Oxide are directly correlated to the concentration of easily accessible mineral Nitrogen in soil. Following the application of fertilizers, high rates of emission are observed, displaying significant variability. However, in Organic Agriculture, the prohibition of mineral Nitrogen and the decreased number of livestock units per hectare substantially decrease the concentration of easily available mineral nitrogen in soil, consequently resulting in reduced N2O emissions. The implementation of diversified crop rotations with the use of green manure enhances soil structure and diminishes the release of Nitrous Oxide and organically managed soils possess improved aeration and significantly lower levels of mobile Nitrogen concentrations, both of which lead to decreased emissions of Nitrous Oxides.

The Committee strongly feel that as Organic Farming/ Natural Farming has the potential to reduce GHG emissions, enhance soil fertility and strengthen Climate resilience, hence Ministry should help farmers adapt to Climate Change by promoting Organic Farming through research and extension services. Government Schemes such as Rashtriya Krishi Vikas Yojana(RKVY), National Mission on Natural Farming, MOVCD-NER(Mission Organic Value Chain Development for North East Region),One District One Product(ODOP) are steps

taken in the right direction. The Committee recommend that inputs at affordable prices may be made available to the farmers, latest technologies such as Al and IoT (Internet) of Things used extensively in the certification process and awareness may be created among various stakeholders, be it farmers or consumers, by using social media platforms too, regarding the benefits of Organic/natural Farming which would go a long way in not only increasing the prosperity of farmers, but also, improve health of common man and more importantly, mitigate effect of Climate Change.

10. Upgradation/Digitization of Agriculture Markets

Since independence, India has traversed a long journey in agriculture marketing but still numerous problem such as fragmented and non-compressed value chains that involve numerous intermediaries, the lack of transparency in price discovery mechanisms and the absence of scientifically advanced storage and logistics systems etc remain a big challenge to overcome. Agricultural market reforms were introduced through Agricultural Produce Market Committee (APMC) Act, 2003, which were enacted by State Governments. The reforms encompasses several key aspects, including the facilitation of direct trading between farmers and buyers, promotion of contract farming, the encouragement of private sector involvement in constructing market infrastructure, such as warehousing, cold chains, and other logistical systems, and the move towards establishing a unified national market. The virtual market platform, e-NAM(National Agriculture Market), since its inception in April 2016, has been consistently enhanced in terms of new technology, innovation, the enhancement of transparency in transactions, digital payments, and user-friendly attributes. In July 2022, the e-NAM platform, through the introduction of the Platform of Platforms (PoPs) as a comprehensive unified structure, has served as a Single platform for all stakeholders in the value chain, including farmers, Farmer Producer Organizations (FPOs), e-platform service providers, transport service providers, quality assaying service providers, value addition, processors, exporters, Fintech, storage, etc. Various service platforms have been enlisted under the following 10 service categories on the Platform of Platforms(PoP) module, namely Quality Assaying, Transportation, Warehousing, Fin-tech, Trading platforms, Agri advisory, Market information, Institutional buyers, Sorting and grading, and Agri input aggregators.

Having analyzed the spectrum of this phenomenon in holistic spectrum, the Committee are of the considerate view that disruptive technological solutions in the agricultural marketing sphere is the need of the hour. Measures need to be taken to ensure that participants in these markets can assess each other's credibility by way of providing ratings to each other which in turn is visible to other users which will significantly enhance transparency and enhance the reputation of the system. Similarly, digitization of entire FPOs may be done which would enable the traceability of produce back to individual farmers. In addition, Intelligent Vision Capabilities may also be devised to pave the way for the sorting

of fruits, vegetables, and staples based on buyer specifications. The Committee desire that Fintech products that integrate warehousing with Credit and Insurance need to be developed, technological advancements need to be deployed to offer modular and energy-efficient storage systems at the farm level at affordable prices and a combination of machine learning data systems, blockchain, IoT and sensors utilized to create end-to-end traceability within the Food Supply Chains. The Committee do feel that all Agricultural markets across the country may be linked to e-NAM portal at the earliest to ensure seamless transactions and to create a win-win situation for both the farmers who can sell their produce to fetch good prices and the buyers who purchase produce of their choice at competitive rates.

11. Need for promotion of Forest conservation and Natural wetlands

Forests are the best shield against Climate Change and act as carbon sinks. Their role in segregating and absorbing carbon from the atmosphere is *non pareil*. They form the first line of defence against Climate Change and hence need to be given utmost prominence. Forests have long been part of Indian society & culture and have been eulogized for their importance in human lives.

Wetlands, such as swamps and marshes, are renowned for being ecosystems abundant in wildlife, making them some of the most bio diverse habitats on Earth. These wetlands possess shallow waters and thrive plant life, providing sustenance for a wide array of organisms ranging from insects to water fowls and so on. These wetlands, along with lakes, rivers, and other aqueous environments worldwide, face imminent threats. Many of these areas have fallen victim to pollution and degradation, a consequence of both climate change and human development. Safeguarding and rehabilitation of Natural habitats is not only imperative for the preservation of biodiversity but also as a means to combat the climate crisis.

In November 2022, the Ramsar Convention on Wetlands elevated the prominence of wetlands and underscored their pivotal role in attaining the Sustainable Development Goals, which serve as humanity's blueprint for a more promising future. The subsequent month, at the United Nations Biodiversity Conference, countries achieved a groundbreaking agreement to protect nature. This accord encompassed a provision to restore a minimum of 30 percent of deteriorated inland water bodies and to preserve healthy freshwater ecosystems in an equitable manner.

It is noteworthy that coastal and freshwater wetland ecosystems harbour a significant percentage of the world's biodiversity. In particular, peatlands, a distinct type of vegetated wetland, possess the capacity to store twice as much carbon as the entirety of the world's forests. Despite these remarkable attributes, wetlands have been subjected to drainage for agricultural purposes or to facilitate infrastructure development over the past two centuries.

Therefore, the Committee strongly recommend that as Forests and wetlands are of profound ecological significance, concerted efforts are imperative to safeguard these invaluable habitats which would overtly and covertly assist Agriculture to stand up against extreme phenological events. The rights of forests communities also need to be taken care of while formulating policies. Also, the goals and vision of Sub-Mission on Agroforestry and Green India Mission need to be popularized and advertised more prominently to create awareness among different stakeholders, seeds & saplings provided at affordable rates to Farmers especially in High Risk Prone Areas/Districts affected or likely to be affected from Climate Change and even financial incentives be provided to them to make these Programmes a success and as such will ensure farmers with additional source of income which is an avowed objective of the present Government policies. The Committee desire that sustainable forest management needs to be done in an integrated and inclusive manner, while combating climate change and using biodiversity in a sustainable way.

12. Promotion of Millets and Coarse grains

The proposition of Indian Government to designate 2023 as the International Year of Millets(IYM) has been well acknowledged by the United Nations. The International Year of Millets (IYM 2023) presents an occasion to enhance awareness regarding the nutritional and health advantages of millets, while also directing policy focus towards their cultivation in adverse and evolving climatic conditions. Millets possess the capacity to thrive in arid lands with minimal resources and exhibit resilience towards climate variations. Consequently, they offer an ideal solution for nations seeking to augment self-sufficiency and diminish reliance on imported cereal grains.

The Committee note that unlike rice and wheat, which thrive in irrigated environments, millets flourish in marginal ecologies, which expand the range of options available for swift and adaptable adaptation in the face of uncertain future conditions. These coarse grains need to be part of Public Distribution System which would encourage farmers to do their cultivation.

The Committee express happiness over the fact that the due importance given to coarse grains within policy frameworks by the Government, would yield benefits for both human health and the Climate since they require lesser amount of pesticides and fertilizers, enhance crop diversity and also provide protection against soil erosion. The Committee strongly feel that farmers who switch from growing traditional crops like rice and wheat to millets or coarse grains, need to be given financial protection as incentives for initial two years minimum to boost their confidence.

13. Carbon market in Agriculture

The escalating global population has led to an increased demand for food, consequently resulting in the emission of Carbon dioxide from agricultural activities, which continues to have a detrimental impact on the environment. Over the previous decade, there has been a notable increase in interest and discourse encompassing carbon markets, indicating the potential for a robust global market for carbon and emissions. In India, both the Public and Private sectors have continued to establish standards for emissions reduction and advance efforts in Voluntary Carbon Markets (VCM), scrutiny of carbon market practices and the associated climate impact has intensified. Specialized carbon markets that cater to farming and agricultural activities are emerging, garnering growing interest from farmers, the Private sector, and Governments worldwide.

Although agriculture is a contributing factor to this issue, it also possesses the potential to be part of the solution. In the developed nations, as custodians of the land and agricultural resources, farmers and ranchers are actively engaging in carbon sequestration through the implementation of sustainable practices in soil management, crop cultivation, livestock rearing, and agroforestry.

Conversely, Private Sector investments in carbon markets are gaining traction and are primarily driven by three factors namely -(i) Legal obligations (ii) Voluntary goals, such as corporations, industrial entities, or municipal operations aiming to fulfill publicly stated environmental targets (iii) Shareholder or consumer expectations.

The government plays a crucial role in establishing protocols and certifying mechanisms to accurately verify efforts in carbon offsetting.

The growth of the Carbon Market will necessitate the involvement of various stakeholders *viz*. farmers, industry and so on. Alternatively, in certain cases, the Committee feel that offerings that fail to promote collaboration or support a transparent, consistent, efficient, and high-quality Carbon Market in Agriculture will become obsolete in the next phase of Carbon Market expansion, while those who successfully mitigate current uncertainties could derive significant benefits and generate substantial impact.

14. Availability of information regarding Latest Technological advances and conduct of training workshops for Farmers

The implementation of AI(Artificial intelligence) in agriculture holds immense potential to revolutionize the industry by increasing productivity, reducing costs, promoting sustainability, and addressing the challenges posed by climate change and resource scarcity. AI is reshaping every aspect of agriculture be it increased productivity, enhanced efficiency, promotion of sustainability, and reduction of waste. AI will assist the industry in adapting to

climate change by analyzing historical climate data to predict weather patterns, thereby optimizing water usage and reducing emissions.

AI-powered farm management software will streamline farming operations by integrating data from various sources, optimizing resource allocation, and enhancing productivity and profitability. The integration of AI and computer vision into self-driving machines will revolutionize agriculture by automating essential tasks such as ploughing, planting, and harvesting. This transformation promises heightened productivity, reduced labor costs, and optimized resource utilization. AI-driven analytics and decision support systems will aid farmers in making informed choices by processing extensive amounts of data, including weather patterns and soil conditions .Through the incorporation of AI, plant health sensors will enable real-time monitoring of crops, detecting diseases, nutrient deficiencies, and pest infestations for timely intervention. Drones and robots equipped with AI capabilities will provide precise insights into crop conditions and perform labor-intensive tasks, thereby reducing the requirements for manual labor. AI will assist the industry in adapting to climate change by analyzing historical climate data to predict weather patterns, thereby optimizing water usage and reducing emissions.

The Committee strongly feel that the integration of AI with the Internet of Things (IoT) will automate and optimize farming operations, leading to higher yields, resource conservation, enhanced sustainability and AI will enhance the resiliency of agricultural supply chains by providing predictive insights, optimizing logistics, and reducing wastage & also expedite agricultural biotechnology by accelerating breeding processes and facilitating gene editing techniques to develop more resilient and high-performing crops. Therefore, the Committee do recommend that Farmers and FPOs may be trained in KVKs and other relevant training institutes in all latest adaptative and mitigative technologies providing them the essential know how thereby enabling to use these for their own betterment and in larger societal & national interests.

15. Reduction in emission of Green House Gases (GHG) from Agriculture in a time bound manner

India is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), as well as its Kyoto Protocol (KP) and the Paris Agreement (PA). As a participant in the UNFCCC, India regularly submits its National Communications (NCs) and Biennial Update Reports (BURs) to the UNFCCC, which include a National Greenhouse Gas (GHG) inventory, containing information on Methane emissions. Under the Paris Agreement, India has submitted its Nationally Determined Contribution (NDC), which does not impose any Sector-specific mitigation obligation or action. However, India remains steadfast in its commitment to formulating and implementing measures to address climate change.

The Committee are optimistic that nationwide implementation of National Mission on Sustainable Agriculture (NMSA), which incorporates Climate-Resilient practices that contribute to significant Methane reduction in rice cultivation be accorded priority. The technologies such as System for Rice Intensification(SRI) and Direct Seeded Rice(DSR) developed by Indian Council of Agricultural Research (ICAR) under the National Innovations in Climate Resilient Agriculture (NICRA) Project, aimed at mitigating methane emissions from rice cultivation be made available provided across the country. System for Rice Intensification(SRI), has the potential to increase rice yield by 36-49% while using 22-35% less water than conventional methods while Direct Seeded Rice(DSR) reduces methane emissions by eliminating the need for raising nurseries, puddling, and transplanting.

National Livestock Mission, being implemented by Department of Animal Husbandry and Dairying (DAHD), which includes initiatives for breed improvement and balanced rationing, by feeding livestock with high-quality balanced rations, which helps reduce methane emissions from the livestock sector needs to implemented expeditiously .

The production of green fodder, silage making, chaff cutting, and total mixed ration under the National Livestock Mission being promoted by the Union Government, with the aim of reducing methane emissions from livestock, needs to be implemented at a faster pace nationwide, at the earliest.

Initiatives such as the 'Gobar Dhan' (Galvanizing Organic Bio-Agro Resources) - Scheme and the New National Biogas and Organic Manure Programme incentivize the utilization of cattle waste, while also promoting the production of clean energy in villages. The Gobar Dhan Scheme which specifically supports the recovery and conversion of biodegradable waste into resources, leading to a reduction in Methane emissions needs to be more popularized across the country for the benefit of farmers as well as the society at large. The Committee strongly recommend that while formulating and implementation Schemes to reduce GHG(Green House Gases) emissions, legitimate interests of vulnerable sections and those communities/segments residing in remote areas, also need to be given priority and safeguarded.

16. Increasing budgetary allocation for Ministry of Agriculture & Farmers Welfare

Agriculture sector in India is now at the cusp of a transformation backed by Union Government initiatives such as Digital Public Infrastructure, Agriculture Infrastructure Fund schemes and so on. The scalability of these Schemes needs to be enhanced so that their impact is more tangible and areas across the country start getting benefits simultaneously. The Committee feel that without adequate financial support and backing by the government, most of the Schemes will not be able to create the desired impact.

The Committee, therefore, recommend that budgetary allocation of the Ministry of Agriculture & Farmers Welfare needs to be enhanced to boost public spending in Agriculture & Allied Sectors, to tackle issues related to Climate Change as India is among the top ten countries to be affected by extreme meteorological events, to train farmers and FPOs in the latest technological advances to combat adverse impact of phenological events, to ensure farm inputs across the length and breadth of the country, invest more in research in farm methods and technologies & related demands of Allied Sectors and so on.

17. Issue of Manpower in Research Institutes and bodies attached to Ministry of Agriculture & Farmers Welfare

A robust and strategic knowledge system is imperative for the identification, formulation, planning, and execution of policy-driven measures, while upholding the requisite rate of economic growth. This strategic knowledge system, aimed at informing and supporting actions sensitive to climate change, must encompass several objectives. These objectives entail addressing climate science through modeling specific to regions; evaluating various technological scenarios and alternatives to meet national objectives; harnessing international cooperation and enhancing our endeavors to select and develop new technologies for adaptation and mitigation; and ensuring the bridging of knowledge gaps. It is of utmost importance to sustain the vitality of the knowledge enterprise that addresses Climate Change issues through the promotion of human and institutional capacity-building. Such measures are indispensable in the crafting of policy responses and implementation approaches at the national level and in providing inputs for negotiations at the international fora by designated Departments. The role of Research Institutes in sustaining the vitality of knowledge systems, ICAR in the present context, is of immense importance in combating the effects of Climate Change. Manpower is the most important asset of any organization and more so, in the case of research institutes such as ICAR, Coconut Development Board (CDB) and so on.

The Committee note that the Posts are lying vacant in certain crucial Research Institutes like Coconut Development Board (CDB), Central Instituteof Fisheries Training (CIFT) and Central Marine Fisheries Research Institute (CMFRI), *etc.* The Committee feel that the Recruitment Processes need to be expedited and Officials appointed to increase the efficiency of the functioning of all the Research Institutes.

NEW DELHI
06 February, 2024
17 Magha, 1945 (Saka)

P.C. GADDIGOUDAR
Chairperson,
Standing Committee on Agriculture,
Animal Husbandry and Food Processing

Annexure- I

Climate Resilient Varieties (Abiotic stress tolerant)

Traits	Crops (no. of varieties)
A. Flood/ water submergence/water logging tolerant varieties (72)	Rice (49), Maize (2), Sorghum (1), Jute (4), Rice bean (1), Sugarcane (15)
B. Drought/moisture stress /water stress tolerant varieties (217: Field Crops– 214; Potato - 3)	CEREALS (114):Rice (51), Wheat (17), Maize (18), Sorghum (7), Pearl Millet (10), Little millet (3), Kodo millet (3), Finger Millet (5)
	OILSEEDS (22): Soybean (5), Groundnut (4), Sesame (2), Indian Mustard (6), Niger (1), Toria (3), Taramira (1)
	PULSES (31): Urdbean (2), Pigeonopea (15), Horse gram (2), Cluster bean (1), Chickpea (5), Lentil (2), Cowpea (2), Mothbean (1), Faba bean (1)
	FIBER CROPS (9): Cotton (6), Roselle (2), Jute (1)
	FORAGES (15): Pearl Millet (2), Forage Sorghum (1), Forage Maize (1), Napier Bajra Hybrid (1), Cowpea (1), Fescue Grass (1), Guinea Grass (2), Rice bean (2), Marvel Grass (1), Anjan Grass (1), Forage Sewan Grass (1), Setaria Grass (1)
	SUGARCROPS (23): Sugarcane (23)
	VEGETABLES (3): Potato (3)
C. Salinity/Alkalinity/Sodic soils tolerant varieties (49)	Rice (28), Wheat (2), Barley (3), Indian Mustard (3), Lentil (2), Sesbania (1), Sugarcane (10)
D. Heat stress/ high temperature tolerant varieties (49: Field Crops – 47; Potato – 2)	Cereals (34): Rice (9), Maize (4), Pearl Millet (4), Wheat (17)
	Oilseeds (6): Sesame (1), Indian Mustard (4), Yellow Sarson (1)
	Pulses (4):Chickpea (1), Lentil (3)
	Fiber Crop (3):Cotton (3)
	Vegetable crops (2):Potato (2)
E. Cold tolerant/Frost/ winter chilling tolerant field crop varieties (13)	Cereals (7): Rice (5), Maize (2)
	Pulses (1):Lentil (1)
	Forage Crops (3):Setaria Grass (1),Fescue Grass (1), NepierBajra Hybrid (1)
	Fiber Crop (2): Cotton (2)

Annexure- II

Details of biotic stress tolerant field crop varieties developed

Crop Name	Number of total varieties released during 2014 – 2022	Number of Biotic Stress tolerant varieties
Kharif Season		
Cereals		
Rice	516	435
Maize	183	152
Sorghum	64	55
Pearl Millet	66	61
Little Millet	17	11
Proso Millet	6	3
Kodo Millet	10	9
Finger Millet	39	36
Foxtail Millet	10	7
Brown top Millet	1	0
Barnyad Millet	5	3
Total Kharif Cereals	917	772
Oilseeds		
Soybean	80	74
Groundnut	55	48
Sesame	23	19
Niger	10	9
Sunflower	18	14
Castor	15	15
Total Kharif Oilseeds	201	179
Pulses		
Mungbean	46	44
Urdbean	45	42
Pigeonpea	55	53
Cowpea	22	19
Horsegram	9	8
Rajmash	7	7
Cluster bean/Guar	4	4
Faba bean	4	4
Moth bean	1	1
Indian bean	2	2
Total Kharif Pulses	195	184
Forage Crops		
Forage Pearl Millet	13	10
Forage Maize	4	4
Forage Oats	1	1

Forage Sorghum	22	16
Forage Cowpea	8	7
Guinea grass	3	3
Fescue grass	1	0
Rice bean	5	4
Marvel grass	4	4
Anjan grass	4	3
Dhaman grass	2	2
Setaria grass	1	0
Ryegrass	2	2
Black Kolukattai grass	1	1
Bajra Napier Hybrid	8	5
BundelBajraSquamulatum	1	1
Aparajita	1	1
JawaharVicia	1	0
Forage Sewan grass	2	2
Sesbania	1	1
Total Kharif Forages	85	67
Fibre crops		
Cotton	122	100
Bt Cotton	121	121
Jute	17	15
Mesta (Roselle)	9	7
Mesta (Kenaf)	7	7
Sunhemp	2	1
Ramie	1	0
Fibre flax	1	0
Total Fibre Crops	279	251
Sugarcane	68	64
Other crops		
Grain Amaranth	9	5
Kalingada seed	2	1
Quinoa	1	0
Asalio	1	1
Buckwheat	1	0
Winged bean	1	0
Broad bean	1	1
Total Other Crops	16	8
Total	**1761**	**1525**
Rabi Season Varieties		
Cereals		
Wheat	156	149
Barley	20	12
Oilseeds		
Indian Mustard	49	24

Yellow Sarson	5	1
Brown Sarson	3	2
GobhiSarson	7	5
Toria	13	9
Taramira	3	1
Karan Rai	1	1
Linseed	40	38
Safflower	21	17
Pulses		
Chickpea	87	68
Lentil	36	32
Field pea	24	22
Lathyrus	1	1
Forage Crops		
Oats	36	31
Lucerne	5	5
Hedge Lucerne	1	1
Berseem	9	8
Other Crop		
White Clover	1	1
Total	**518**	**428**
Grand Total	**2279**	**1953**

Annexure- III

Location specific technologies developed and their benefits

Technology	Productivity gain (%) over farmers' practice	Income gain (Rs./ha) over farmers' practice
Trench cum bunding	10-15	9250
Conservation furrow	23-63	22200
Land shaping in Sundarban area of West Bengal	85-112	112500
Farm bunding	12-22	8250
Ridge and furrow	15-24	10500
Summer deep ploughing	15-30	11250
Broad bed furrow	21-33	21000
Efficient utilization of harvested water by drip and sprinkler	30	28000
Artificial ground water recharge for open well and bore well	20-28	15000-28000
Conservation tillage	10	10450
Rainwater harvesting by farm ponds	25-80	30000-75000
Jalkunds	50-120	20000-54000
Rainwater harvesting by check dams	30-112	20000-52000
Rainwater harvesting by sand bag check dams	28-65	30000-66000
Short duration and drought escaping varieties	20-28	7800-11000
Drought tolerant crops and varieties	15-25	7000-10000
Intercropping systems	18-55	12000-18000
Flood tolerant varieties	33	10000-12200
Salt tolerant varieties	33-52	25000
Contingency crops suitable for delayed sowing	30-50	9000
Cropping intensification	60	15000
Heat tolerant varieties	25-45	8000
Protected cultivation	35	72000
Direct seeding of rice/ Drum seeding of rice	10	8000
System of rice intensification	10-12	12000

Zero till wheat sowing	15-18	8000
Crop diversification	25-45	18000-25000
Foliar spray to mitigate the dry spells	10-12	10000
Dryland horticulture crops	40-60	12000-35000
Improved shelter to animals	25-45	Rs.5000/animal
Improved breeds -Goatery	35	Rs.5000/animal
Mineral mixture supplementation	10-12	Rs.4000/animal
UMMB blocks	10-12	Rs.5000/animal
High yielding green fodder varieties	15-18	Rs.5000/animal
Silage making	25-30	Rs.5000/animal
Backyard poultry	10-15	Rs.250/bird
Backyard duckery	10	Rs.350/bird
Integrated farming systems	25-45	Rs.55000/module
Fisheries: Composite fish culture	30	Rs.75000
Custom hiring centers	15-50	Rs.15000-35000

STANDING COMMITTEE ON AGRICULTURE, ANIMAL HUSBANDRY AND FOOD PROCESSING (2022-23)

MINUTES OF THE FIFTH SITTING OF THE COMMITTEE

*****

The Committee sat on Tuesday, the 31st January 2023 from 1500 hours to 1640 hours in Committee Room 'C', Parliament House Annexe Building, New Delhi.

PRESENT

Shri P.C. Gaddigoudar – *Chairperson*

Members

Lok Sabha

2. Shri Afzal Ansari
3. Shri Abu Taher Khan
4. Shri Mohan Mandavi
5. Shri Devji Mansingram Patel
6. Smt. Sharda Anilkumar Patel
7. Shri Shriniwas Dadasaheb Patil
8. Shri Vinayak Raut
9. Shri Pochha Brahmananda Reddy
10. Shri Virendra Singh

Rajya Sabha

11. Smt. Ramilaben Becharbhai Bara
12. Shri Masthan Rao Beeda
13. Dr. Anil Sukhdeorao Bonde
14. Shri S.Kalyansundaram
15. Shri Kailash Soni
16. Shri Ram Nath Thakur

Secretariat

1.	Shri Shiv Kumar	-	Additional Secretary
2.	Shri Naval K. Verma	-	Director
3.	Shri Uttam Chand Bharadwaj	-	Additional Director

2. At the outset, the Chairperson welcomed the Members of the Committee to the Sitting convened for having a Briefing by the Representatives of the Ministry of Agriculture and Farmers Welfare (Department of Agriculture and Farmers Welfare) on the Subject 'Promotion of Climate Resilient Farming'. Thereafter, the Representatives of the Department of Agriculture & Farmers Welfare and Indian Council of Agricultural

Research (ICAR) were called in. The Chairperson welcomed the Representatives and apprised them of the provisions of Directions 58 of the Directions by the Speaker, Lok Sabha, regarding Confidentiality of the Proceedings.

3. After introduction, the Chairperson initiated the discussion, followed by a Power-point Presentation by the Representatives of the Department. The Chairperson and Members of the Committee raised *inter-alia* several issues / points, as briefly mentioned below and sought clarifications / information from the Department :

i) Impact of Climate Change on various sectors of economy and the demand for adaptation of practices especially in Agriculture.

ii) Measures taken by the Department to involve the farmers and make them aware of the likely adverse impact.

iii) Steps taken for promotion of varieties of indigenous breeds of crops, livestock and fisheries in building resilience and application of traditional knowledge to improve their growth, productivity and nutritional value.

iv) Measures taken for farm mechanization and agro advisory services including promotion of location specific climate resilient technologies to ensure sustainable agriculture.

v) Steps taken by the Department to make Agriculture Climate neutral and build up resilient food system which are vital for food and nutrition security

vi) Promotion of Organic Farming and Value Chain marketing to extend green cover of farmlands

vii) Role of Krishi Vigyan Kendras (KVK) as force multiplier and making it a more potent to deliver tangible benefits to farmers.

4. The Representatives of the Department responded to most of the queries raised by the Members. The Chairperson, then, thanked the witnesses for sharing valuable information with the Committee on the Subject and directed them to send, in writing, the requisite information on points / items, which were not readily available with them, to the Committee Secretariat by 10th February, 2023.

The Meeting then adjourned.

[A copy of the verbatim proceedings of the Sitting has been kept separately.]

STANDING COMMITTEE ON AGRICULTURE, ANIMAL HUSBANDRY AND FOOD PROCESSING (2022-23)

MINUTES OF THE TWENTIETH SITTING OF THE COMMITTEE

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The Committee sat on Thursday, the 24th August 2023 from 1100 hours to 1305 hours in Committee Room 3, First Floor, Extension to Parliament House Annexe Building, New Delhi.

PRESENT

Shri P.C. Gaddigoudar – *Chairperson*

Members

Lok Sabha

2. Shri A Ganeshmurthi
3. Shri Devji Mansingram Patel
4. Smt. Sharda Anilkumar Patel
5. Shri Bheemrao Baswanthrao Patil
6. Shri Devendra Singh *alias* Bhole Singh
7. Shri Ram Kripal Yadav

Rajya Sabha

8. Smt. Ramilaben Becharbhai Bara
9. Dr. Anil Sukhdeorao Bonde
10. Shri Surendra Singh Nagar
11. Shri Kailash Soni

Secretariat

1. Shri Uttam Chand Bharadwaj - Director
2. Shri Sanjeev Kumar - Executive Officer

2. At the outset, the Chairperson welcomed the Members of the Committee to the Sitting convened for taking Oral Evidence of the Representatives of the Ministry of Agriculture and Farmers Welfare (Department of Agriculture and Farmers Welfare) on the Subject 'Promotion of Climate Resilient Farming'. Thereafter, the Representatives of the Department of Agriculture & Farmers Welfare, Indian Council of Agricultural Research (ICAR), Ministry of Environment, Forests & Climate Change and Agrometeorological Advisory Services, Division of IMD were were called in. The Chairperson welcomed the Representatives and apprised them of the provisions of

Directions 58 of the Directions by the Speaker, Lok Sabha, regarding Confidentiality of the Proceedings.

3. After introduction, the Chairperson initiated the discussion, followed by a Power-Point Presentation by the Representatives of the concerned Department. The Chairperson and Members of the Committee raised *inter-alia* several issues / points, as briefly mentioned below and sought clarifications / information from the Department :

i) Steps taken by the Department to enhance Climate Resilience by implementing short and long term Climatic mitigation and adaptation strategies.

ii) the impact of Climate Change on Crops as also with special reference to Sustainable Development Goal (SDG)-13 related to Climate Action.

iii) Contribution of Agriculture as such to emission of Green House Gases in Indian context.

iv) Objectives of National Innovations in Climate Resilient Agriculture(NICRA) Programme, District Agriculture Contingency Plans (DACP) and achieving resilience under various Climatic conditions be it Heat or Cold Wave, drought prone and Flood Prone regions.

v) Minimizing impact of Climate Change on Livestock sector, increase in Sea Surface Temperature(SST) affecting Spatial Distribution and Phenology of Fish.

vi) Promotion of Micro Irrigation- Per Drop More Crop(PDMC) to counter challenges of Micro irrigation in Himalayan States and Hilly Districts in other States of the Country.

vii) Rainfed Area Development and Infrastructure development for Climate Resilient Sustainable Integrated Farming Systems.

viii) Growing of Millets as solution for Food & Nutritional Security and interventions across the value chain in Millets.

ix) Natural Farming, Sustainable Soil Health for Global Food Security & Community based Climate Resilient Agriculture,

x) Sustainable Agriculture & Carbon Market including establishing Carbon Neutral Villages through adoption of Climate Resilient Technologies.

xi) Agri Stack and its various components, Digital Crop Survey, Krishi-DSS(geo spatial Decision Support System), Salient Features of Krishi MApper- both Mobile and Web Platform, Integrated Command and Control Centre(ICCC), Mobile Face Authentication App for e-KYC in PM KISAN Mobile App.

4. The Representatives of the Department responded to most of the queries raised by the Members. The Chairperson, then, thanked the witnesses for sharing valuable information with the Committee on the Subject under examination and directed them to send, in writing, the requisite information on points / items, which were not readily available with them to the Committee Secretariat by 04th September, 2023.

The Meeting then adjourned.

[A copy of the verbatim proceedings of the Sitting has been kept separately.]

Standing Committee on Agriculture, Animal Husbandry and Food Processing (2023-24)

Minutes of the Fifth Sitting of the Committee
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The Committee sat on Tuesday, the 06th February, 2024 from 1500 hrs. to 1530 hrs. in Office of Chairperson, Room No. 103, Block-B, Extension to Parliament House Annexe, New Delhi.

Present

Shri P. C. Gaddigoudar – Chairperson

Members

Lok Sabha

2. Shri Horen Sing Bey
3. Shri Kanakmal Katara
4. Shri Mohan Mandavi
5. Smt. Sharda Anilkumar Patel
6. Shri Bheemrao Baswanthrao Patil
7. Shri Shriniwas Dadasaheb Patil
8. Shri Devendra Singh *alias* Bhole Singh
9. Shri Ram Kripal Yadav

Rajya Sabha

10. Smt. Ramilaben Becharbhai Bara
11. Shri Masthan Rao Beedha Yadav
12. Dr. Anil Sukhdeorao Bonde
13. Shri Kailash Soni
14. Shri Ram Nath Thakur
15. Shri Vijay Pal Singh Tomar
16. Shri Harnath Singh Yadav

Secretariat

1.	Shri Shiv Kumar Wadhawan	–	Additional Secretary
2.	Shri Khakhai Zou	–	Director
3.	Shri Prem Ranjan	–	Deputy Secretary
4.	Shri Anil Kumar Sanwaria	–	Deputy Secretary

2. At the outset, the Chairperson welcomed the Members to the Sitting of the Committee. Thereafter, the Committee took up for consideration and adoption of Draft Reports on the following Subjects:

*(i) XXXX XXXX XXXX XXXX XXXX

(ii) Promotion of Climate Resilient Farming [Ministry of Agriculture and Farmers Welfare (Department of Agriculture and Farmers Welfare)]

*(iii) XXXX XXXX XXXX XXXX XXXX

*(iv) XXXX XXXX XXXX XXXX XXXX

3. After some deliberations, the Committee adopted the Draft Reports without any modification. The Committee also authorized the Chairperson to finalize and present the Report to Parliament.

The Committee then adjourned.

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*Matter not related to this Report.