Accelerating the Growth of Rainfed Agriculture - Integrated Farmers Livelihood Approach

Draft Policy Documented by

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Abbreviations

ACZ	Agro-climatic zones
AEZ	Agro-ecological zones
ANB	Atma Nirbhar Bharat
ATMA	Agricultural Technology Management Agency
CHC	Custom-hiring centers
CRIDA	Central Research Institute for Dryland Agriculture
CSB	Community seed banks
CSO	Civil Society Organisations
DFI	Doubling Farmers' Income
DWDU	District Watershed Development Unit
FPO	Farmer Producer Organisations
GP	Gram Panchayats
HYV	High Yielding Varieties
ICAR	Indian Council of Agricultural Research
ICT	Information and Communication Technology
IFS	Integrated farming systems
IMD	India Meteorological Department
IoT	Internet of Things
KVKs	Krishi Vigyan Kendras
M&E	Monitoring and Evaluation
MASL	Metre above sea level
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee scheme
MoEFCC	Ministry of Environment, Forest and Climate Change
MUDRA	Micro Units Development & Refinance Agency Ltd.
NABARD	National Bank for Agriculture and Rural Development
NBSSLUP	National Bureau of Soil Survey & Land Use Planning
NFSM	National Food Security Mission
NLNA	National Level Nodal Agency
NMSA	National Mission for Sustainable Agriculture
NRAA	National Rainfed Area Authority
PDS	Public distribution systems
PIA	Project implementing agency
PMFBY	Pradhan Mantri Fasal Bima Yojana
PMFME	Prime Minister's Formalisation of Micro Food Enterprises
PoP	Package of practices
PWDP	Participatory Watershed Development Plans
RADAR	Rainfed Areas Data Repository
SAPSs	Sustainable agriculture practices and systems
SAU	State Agricultural Universities
SHG	Self-Help Groups
SLNA	State Level Nodal Agency
SRAC	Special Rainfed Areas Cell
WUE	Water use efficiency

1. Introduction

The National Rainfed Area Authority (NRAA) was formed in 2006 as an expert body of the Ministry of Agriculture to provide "knowledge inputs regarding the systematic upgradation and management of the country's dryland and rainfed agriculture." In 2009, NRRA published a vision document, describing the challenges and opportunities of rainfed areas and outlining a pathway to prosperity by 2025. This document recognized that harnessing opportunities in rainfed areas will need "a paradigm shift from a 'Commodity-centered Green Revolution' to an 'Integrated Resource Management and Farming Systems-centered Rainbow Revolution' for inclusive development." It further recognized that a multi-pronged approach was needed to "translate vision into action including prioritization of rainfed watersheds, region specific strategies, prioritization of region-specific high impact interventions, diversification of improved livelihoods, policies, institutions and capacity building and innovative pilot for inclusive development of rainfed areas.

This policy document builds upon NRAA's vision as outlined above and incorporates integral policy measures for sustainable rainfed agriculture, inclusive of recognizing new vulnerabilities such as climate change, farmers' distress resulting in seasonal migration, severe malnutrition in rainfed areas, and India's commitment to the UN Sustainable Development Goals, in addition to various international commitments. The commitment to SDGs 2030 will reiterate the concerns, relating to farmers' income & their purchasing power, as also nutrition security and ecological sustainability.

1.1 The context of rainfed agriculture

Currently, rainfed agriculture, which is rain-dependent, accounts for 55 per cent of the net sown area (139.42 M ha), and 61 per cent of India's farmer population. Rainfed agriculture is crucial to the country's economy and food security. Presently, it accounts for around 40 per cent of the total food grain production, (85, 83, 70 and 65 per cent of nutri-cereals, pulses, oilseeds and cotton, respectively); supports two-thirds of livestock and 40 per cent of the human population. Further, the livelihoods of 80 per cent of small and marginal farmers is impacted.

Crop diversity in rainfed regions is striking with almost 34 major crops grown annually compared to 4 to 5 major ones in irrigated areas. Rainfed farmers follow a diverse portfolio of economic activities including horticulture, agroforestry, seed spices, medicinal & aromatic plants, fishery, livestock and beekeeping etc,. This diversity in the production system imparts greater resilience to the country's rainfed agriculture, and diversifies the consumption plates necessary to address concerns of malnutrition. Rainfed agriculture is practised under a wide range of soil types, agro-climates, topography and rainfall conditions ranging from 400 mm to 1600 mm per annum. India's rainfed regions are characterized by complex climatic challenges, manifested as water scarcity for rainfed crop production. Rainfall is highly unreliable, both in time and space, with strong risks of dry spells at critical growth stages even during good rainfall years. Rainfed crops are prone to breaks in the monsoon during the crop growth due to water stress.

According to the report ”Prioritization of Districts for Development Planning in India – A Composite Index Approach(2020)” published by NRAA , 168 districts based on composite score are identified as high priority vulnerable rainfed districts requiring immediate interventions to enhance natural resources and livelihood outcomes. The distribution of rainfed areas can be broadly classified into: arid, semi-arid, dry, sub-humid and humid regions, with 15 million ha of rainfed cropped area lying in the arid region receiving less than 500 mm annual rainfall, another 15 million ha in 500-750 mm annual rainfall zone, and 42 million ha is in the 750-1100 mm rainfall zone. Out of 127 agroclimatic zones in India, 73 are predominantly rainfed. Soil conditions also vary from one rainfed region to another. This variability calls for a differentiated location-specific approach.

1.2 Defining rainfed agriculture

Rainfed areas are defined as areas that are primarily dependent on rainfall, and suffer from undependable groundwater for agriculture and allied activities. The rainfed areas shall accordingly include:

- Rainfed cultivated area as the difference between Net Sown Area (NSA) and Net Irrigated Area (NIA)
- Irrigated area with undependable groundwater
- Permanent pastures and other grazing lands
- Cultivable waste lands
- Current fallows
- Other fallow lands

1.3 The need for a novel game-changing policy

1.3.1. A different policy framework than that of the dominant green revolution(GR) paradigm

The Green Revolution was designed around growing high-yielding varieties of wheat and paddy that responded to intensive use of water and agro-chemicals. The rainfed area were an obvious casuality. The entire Green Revolution framework designed to fit the context of dependable availability of water is not a sustainable option in the rainfed system. Ironically, its adoption by farmers in rainfed areas due to the lure of assured markets, has only resulted in further ecological degradation and malnutrition. The agro-ecological and economic consequences of “a conscious Green Revolution strategy of ‘betting on the strong’ have long been clear”, but to redress these persistent imbalances will require a strong, conceptually clear, game-changing policy that is grounded on empirical data from the field.

1.3.2. The nutritional imperative

Despite overall economic growth in recent years, pockets of the Indian population predominantly in rainfed region, suffer from hunger and malnutrition. The Global Hunger Index reveals that since 2016, hunger in India is growing and its 2021 rank is 101 out of 116

countries. India counts among the 31 nations in the world where hunger has been classified as "serious." Nutrition challenges that India faces, especially its women and children are expressed as low body mass index, under nutrition, anemia, wastage, stunting, and high infant mortality.

1.3.3. Farmers' distress and the need for taking local, indigenous knowledge into account

The rainfed areas of India are the most variable and unpredictable environments which render rainfed agriculture a risky proposition. Yet, there is enough evidence to show, that traditionally, the rural communities knew how to harness this variability to support their economies, societies, and agro-ecosystems, carefully breeding livestock and varieties of crops that can thrive in these areas. Resource use practices and knowledge regarding the behavior of complex ecological systems in diverse locations, that have evolved over generations through observation, verification and validation within communities, need to be integrated as crucial inputs for decisions on rainfed agro-ecosystem. With ignorance of this wealth of knowledge within the policy framework, the general thrust of public investments into agriculture in India and market forces have led to a replacement of traditional land use practices with modern techniques. The nominal income returns and the risks associated in rainfed agriculture are seen to be resulting in seasonal distress migration as they realize higher income from wages in alternate non-farm activities.

1.3.4. A holistic policy for accelerating the growth of rainfed agriculture

Ecological resilience, sustainable economic development, and social equity are the inter-connected pillars on which new policies and programmes must be leveraged. And the practice or implementation of these programmes must be based on local expertise, location-specific information, participation of historically marginalized communities, and institutional support. These however need to be integrated with demand-led production and management practices. This entails adoption of Agricultural Value System (AVS) that links farm gates with markets. It also necessiates deployment of digital technology all along the value chain. The National Rainfed Area Authority proposes a new policy for accelerating the growth of rainfed agriculture through a comprehensive approach for combating climate change, securing livelihoods, and improving nutrition. This policy will give direction to design programmes specifically for rainfed agriculture. Proportionate investments would be needed for the agricultural transformation of rainfed areas. **The 3Es, namely Ecology, Economics, and Equity will guide the aims and objectives of this new policy**. A robust policy and a structured framework for public investments would bring about an agricultural regeneration of rainfed areas resulting in multiple social co-benefits such as growth of agricultural income and generation of rural employment as well as reduction of poverty and malnutrition. The concomitant advantage expected is the reduced stress on irrigated systems, which are now asked to meet the increasing demand for foodgrains, which obviously results in resource extraction beyond sustainable levels.

2. Issues & Challenges for Rainfed Agriculture

The state of rainfed agriculture is precarious and the problems associated with it are multifarious. India ranks first among the rainfed countries in the world in terms of extent of

rainfed area, but ranks among the lowest in rainfed yields (<1tonne/hectare). Rainfed areas are characterized by water-scarcity, fragile environments, and drought conditions. These unfavourable conditions results in low productivity, low cropping intensity, high cost of cultivation, poor adoption of modern technology, uncertainty in output, inadequate institutional credit & public investment and high incidence of rural poverty. Some of the major factors that have aggravated these challenges are discussed in the following sub-sections:

2.1 Lack of targeted approach to development

Schemes and programs in rainfed regions follow a blanket approach, neglecting region-specific natural resource endowment, agro-climatic conditions and topography. One key reason behind this is an unclear definition of what constitutes a rainfed region and, a lack of an effective segmentation or typology of the region to enable targeted governance, i.e. customizing the policies and instruments for specific types of rainfed region. Prior efforts to target governance based on agro-climatic zones (ACZs) or agro-ecological zones (AEZs) have not yielded desired outcomes due to implementation challenges that transcend jurisdictional boundaries.

2.2 Disproportionate government support:

Rainfed areas, despite supporting 80 per cent of marginal farmers, seem to have received lower preference due to perceived nature of these areas being drought-prone, riskier and low in overall yields. A serious policy bias exists, when it comes to public funding/support to rainfed farming and farmers. According to the estimates of the Centre for Budget and Governance Accountability (CBGA), for the period 1997-98 to 2011-12, rainfed agriculture received merely 1 per cent of the total expenditure on agricultural subsidies of about Rs. 11.5 lakh crore. The rest was on intensive agriculture – divided into price support/food (38 percent), fertilizer (37 per cent), irrigation (21 per cent) and electricity (3 per cent). Major investments relating to management of water resources are also mostly focused on creating irrigation sources, providing subsidised electricity for groundwater use and recharging groundwater, while programs focused on rainfed systems which possess little scope for benefitting from dependable water sources are minimal. The investments for these regions mostly comes through programmes such as Watershed programme & MGNREGS.

2.3 Rainfed agriculture bypassed by technologies

Evidence largely points out to wide disparities created by GR technology between irrigated and rainfed regions to the disadvantage of the latter. Past strategies aimed at enhancing productivity through increased use of quality seeds, irrigation, fertilizer, and agro-chemicals were confined to a few states in the north and command area elsewhere. These technologies were imposed on rainfed areas without proper planning to address the specific problems of rainfed areas. For instance, the majority of conventional irrigation and biochemical technologies are not appropriate for rainfed farming. The heavily supply-driven technology approach had a lesser understanding of local context and the extension system followed similar package of practices (PoPs) for farmers in irrigated and rainfed regions. The

similarity in schemes rolled out and a linear transfer of technology approach without understanding diverse agro-ecological and social context resulted from inadequacy of the R&D and extension systems in appreciating the rainfed regions. This is further exacerbated by a lack of adequate support from the extension system as the ratio of agricultural extension manpower to operational agricultural households in India was only 1:1162. Only a few states including Punjab, Haryana, and Maharashtra have adequate extension personnel.

2.4 Yield variability

In several disadvantaged rainfed areas, large yield gaps still remain in several crops and regions between yields obtained at research stations and on farmers' fields. This is despite the average per hectare productivity levels increasing in rainfed areas from 0.6 tonnes in 1980s to 1.1 tonnes at present. Crop yields vary for different crops and regions in rainfed and irrigated regions, though broadly the productivity of rainfed areas is around 1.1 tonnes/hectare, as against an average of 3 tonnes/ hectare in irrigated areas.

2.5 Land degradation and poor productivity

The intensive approach to agricultural production system has not focused adequately on conservation of natural resources, and sustainable technologies needed for rainfed production system. As a result, the natural resource base including in rainfed areas has got severely compromised and has led to soil erosion and loss in soil fertility. Soils in rainfed areas are subject to a prolonged double exclusion, being unable to gain from chemical fertilizers and receiving no support for local practices like crop residue incorporation, composting, farmyard manure application, etc that build soil health naturally.

Soil fertility variation and its depletion due to inadequate nutrition management is another important factor contributing to yield instability in rainfed areas. Soil degradation comes in several forms, including erosion by wind or water, and chemical deterioration such as loss of nutrients or salinization. The multiple nutrient deficiencies in soils of rainfed field and horticulture crops are estimated to be 89 per cent for N; 80 per cent for P; 50 per cent for K; 41 per cent for S; 48 per cent for Zn; 33 per cent for B; 12 per cent for Fe; 13 per cent for Mo and 5 per cent for Mn. The soil organic carbon (SOC) is about 5 g/kg, whereas the desired level is 11 g/kg. Although about 80 MTs of crop residues are produced annually in rainfed areas, the recycling is not done due to competitive uses and burning. Severe soil erosion by water is reported in northeast hill ecosystems, and parts of central and northern India. According to NBBSLUP (2019) average annual rate of soil erosion in the country is 16.35 tonnes per hectare. Other causes of soil degradation include rapid depletion of soil organic matter (SOM) because of improper crop management practices, salt accumulation, and contamination of soils with heavy metals. Large areas are affected by toxic levels of iron, aluminium and manganese in eastern and north-eastern regions, especially in waterlogged or poorly drained soils such as vertisols of Madhya Pradesh and Maharashtra during the rainy season (June-September).

2.6 Climate risks

Climate change and climate variability impact Indian agriculture and more so in rainfed agriculture. Long-term data for India indicates, that rainfed areas experience 3 to 4 drought years per decade. Of these, two to three are moderate and one or two are severe in intensity. Rainfed crops are likely to be worst hit due to limited options of coping with variability of rainfall and temperature resulting in a shift in sowing time and shorter growing season, which may necessitate effective adjustment in sowing and harvesting dates. Increasing intra-seasonal variability of rainfall has become a major concern. In several meteorological divisions, the rainfall distribution is becoming more skewed with a smaller number of rainy days and higher intensity of rainfall causing more soil erosion. The coefficient of variation of decadal rainfall distribution is increasing in several meteorological divisions indicating inter-annual variability. This has implications on the length of dry spells in rainfed regions.

2.7 Poor productivity of livestock

Animal husbandry is an integral component of rainfed farming systems and, is a significant revenue stream for farmers. As rainfed agriculture is risk-prone, possession of livestock - both large and small ruminants, serves as a source of liquidity and an economic cushion for rural farming communities. Livestock contribute 10 to 45 per cent to the agricultural GDP in the developing world and it is one of the fastest growing sub-sectors in agriculture (World Bank, 2009). They play an important multifunctional and socio-economic role. It is estimated that 70 to 90 per cent of the ruminant livestock (buffaloes, cattle, goats and sheep) are found in the rainfed mixed farms. The low productivity of livestock in rainfed agriculture is due to water scarcity resulting from the collapse of traditional water harvesting systems, and shrinking of common grazing resources leading to scarcity of fodder. The IGFRI,2019 reported that the shortage in fodder availability is a major reason of Indian livestock's milk productivity being lower by 20-60 per cent compared to the global average. Low production potential of the native breeds, non-availability of services (veterinary, credit, seed, feed, market) in time, high incidence of diseases and high cost of maintenance are also other reasons for low productivity of livestock. The policies on livestock also exclusively focus only on improvement of cows and buffaloes, while other livestock including sheep, goat, poultry and pig, which are integral to many rainfed areas go unnoticed, or get lesser than deserving attention.

2.8 Resource poor farmers and inadequate credit availability

Marginal and small farmers are dependent mostly on informal sources of credit in almost all the states. The percentage of investment credit that is met from informal sources is 40.6 per cent, 52.1 per cent, and 30.8 per cent, for the landless, marginal farmers, and small farmers, respectively. This shows a lack of access to credit facilities and formal financial mechanisms for the majority of rainfed farmers who need it the most.

2.9 Poor market linkages

Smallholder farmers in rainfed areas not only suffer from many production risks due to climatic vulnerability, but are also subject to market risks (high market and price fluctuation) that lead to unstable incomes. Further, farmers often sell their produce at low or sub-optimal prices due to unreliable market channels and unregulated markets and their poor withholding capacity arriving from their low rate of savings. This is further compounded by inadequate post-harvest handling and storage facilities which prevent farmers from stocking up and selling at the right time and accessing other markets. This necessitates strong infrastructure, institutional mechanisms, and support systems from alternate marketing options including e-marketing and MSP based procurement.

2.10 No reliable data for rainfed in central database systems

Standardized agronomic, soil, water, market-related, and socioeconomic datasets for agriculture are essential for real-time decision making and sustainability. Despite the substantive scale of rainfed agriculture that exists in terms of cultivation area and the farmer population, huge gaps persist in data availability and data quality. In addition, existing datasets also lack standardization as it prevents interoperability and decision-making. A proper mechanism to assess the impact of schemes and funding allocations in rainfed regions is also missing. This creates a huge bottleneck to assess the economic opportunity of action and cost of inaction in these regions that is important for policymakers.

3. Vision, Goals and Objectives of the Policy

The biggest policy shift that is needed in favour of rainfed agriculture is moving away from the present agricultural paradigm of piecemeal interventions to comprehensive treatment for strengthening the agro-ecosystem holistically. The present agricultural paradigm, which subsidises chemical inputs to maximize yields, was initially designed for the Green Revolution, but then came to encompass all crops and livestock. Experience has shown that the current agricultural paradigm has only hastened the degradation of production systems in rainfed areas leading to diminished returns on investment and inadequate average incomes. Policies and programmes for rainfed agriculture should adopt a different paradigm, one that measures success in terms of inclusive and sustainable growth with regards to system-based alternative output in contrast to season-based productivity. The guiding elements needed are nutrition for the consumers, income for the farmers and health of the production system. It is important to promote resilience of the diverse production systems that define rainfed agro-ecosystems and not merely in terms of productivity.

3.1 Vision

The vision of the national rainfed policy is to “make rainfed agriculture sustainable, remunerative and equitable”.

3.2 Goals

The policy goal is to accelerate the growth of rainfed agriculture through a comprehensive approach for combating climate change, securing livelihoods, and improving nutrition. The

policy seeks to maximize gains in ecology, economy, and equity in rainfed areas.

3.3 Objectives

3.3.1 *Ecological objectives*

- Reversing unsustainable trends by stemming land degradation by adopting practices that improve soil health and sustainable water management
- Promoting diversified sustainable production systems that are suited to the agro-ecosystem and are integrated within the farm and the landscape
- Promoting a holistic approach of reducing risks and making farms and landscapes climate resilient

3.3.2 *Economic objectives*

- *Inclusive growth with focus on circular local economies*: Promoting rural livelihoods through product and service innovation in circular localised food systems leading to improved agricultural incomes. A co-benefit of this objective is supply of locally grown crops to meet local demand to strengthen local food security and nutrition.

3.3.3 *Equity objectives*

- Catering to the special needs of districts in rainfed areas prioritized for development
- Catering to specific vulnerabilities faced by women farmers, pastoralists, nomadic tribes and landless labourers in rainfed areas
- Reducing malnutrition among the inhabitants in rainfed areas

3.4 Enabling enviornment

- Focusing rainfed areas for achievement of Sustainable Development Goals (SDG), 2030 and Land Degradation Neutralities (LDN)
- Promoting bioeconomy-based developmental model
- Redistributing production pressures through appropriate agri-food system
- Embedding nutrition goals into rainfed agriculture and rural development

4. Proposed Approaches for achieving the Goals and Objectives

4.1 Improve cropping systems and practices in rainfed agriculture

4.1.1 *Release new climate-resilient varieties suited for rainfed regions*

- Release of cultivars with high resilience and yield potential is essential, especially for smallholders through decentralized seed system. A suitable delivery mechanism that ensures timely and cheaper availability of seeds to replace older/less beneficial ones is needed.

- Community seed banks (CSBs) in villages are key to providing quality seeds of diverse crops and varieties at affordable prices at the right time. This will aid in adaptive capacity against the contingencies of climate risks, such as repeat sowing in case of crop failure. Besides, they will ensure in conserving and mainstreaming the local crop varieties with inbuilt tolerance to various biotic/abiotic stresses in rainfed regions. Seeds with medicinal/therapeutic properties can be mainstreamed by integrating them into the formal and informal seed chains while preserving genetic purity.

4.1.2 *Promoting integrated farming systems (IFS)/integrated livelihood system (ILS)*

- Promoting IFS, which synergistically integrates two or more enterprises (agronomic crops, horticultural crops, livestock, aquaculture, poultry/ducks, apiculture, and mushroom cultivation), can offer improved income, resilience, and soil carbon sequestration potential. IFS systems need to be planned according to characteristics of ACZs and followed according to the model approach indicated by the All India Coordinated Research Project (AICRP-ICAR) across 15 agro-climatic regions. This will require a shift from the centrally determined approach of single commodity intensification to location-specific farming systems intensification approach which focuses on system (more than one season in a year) productivity instead of season-based crop productivity (tonnes/hectare)
- Incentivise pulse, oilseeds and millet-based cropping systems to check shift to cotton and other higher water duty monocropping practices in rainfed regions. Non-conventional legume varieties like rice bean, faba bean, moth bean etc. can be incentivised for their tremendous potential in rainfed areas, in addition to popularly grown varieties
- Dryland horticulture needs to be promoted and a shift to horti-millet cropping systems will translate into more nutrition options, income diversity and better market prices
- Diversification through kitchen/nutritional gardens in farming and non-farming families can also be encouraged and promoted in rainfed regions through incentives
- Integration of higher tock (both large and small ruminants), poultry, fishery activities will help generate jobs, enhance incomes and minimize enterprise risks
- Adopt Secondary Agriculture that includes activities like bee keeping, cultivation of mushrooms etc.; primary processing of main(primary) produce post-the-harvest; and value addition to both primary & by-products which will create local jobs and supplementary incomes

4.1.3 *Improve system productivity*

- Increasing demand for food and processed commodities with a faster demand for high-value commodities (such as horticulture, herbal & medicinal, dairy, livestock, and fish) will require a shift from season-centric productivity enhancement to system- production through a holistic research and development approach

- Climate-resilient HYVs of crops that can withstand biotic (pest & disease attacks), abiotic stress (drought, waterlogging etc.), and long-term impacts (salinity) are critical to minimize crop failures in rainfed areas. Releasing suitable varieties of particular rainfed crops (millets, pulses, oilseeds, and dryland herbal, medicinal & horticultural crops) will help in obtaining efficient and successful crop production. Research needs to be undertaken for varieties with high yield potential, drought tolerance, high response to nutrient supply, high water use efficiency, and moderate resistance to pests and diseases.
- Establish crop zones by targeting revenue boundaries like blocks/sub-divisions for better alignment of crops and agricultural practices in synch with the available local resources, rainfall, soil resources, and other agroecological characteristics of the area, inturn improving the resource efficiency and production potential.
- Low cost protected cultivation (greenhouses, shade-net house, tunnels and plant protection nets) that grow plants in protected environments to regulate climatic conditions deserve to be upscaled in rainfed regions to protect crops and improve yields. Crops can be shielded from extremes (droughts, evaporation) which are the hallmark of rainfed areas and thus avoid economic losses. This can also reduce use of pesticides since plants are protected from external environments. While doing so biodegradable plastics should be preferred from the perspective of ecological health.

4.1.4 *Improve farm power and mechanization*

- Develop and adopt strategies to raise farm power consumptions to 2.5 kW/hectare in rainfed areas with at least 70-80 tractors (or equivalent) per 1,000 hectare to assure timeliness and quality in field operations. Providing access to farm-power, for small and marginal farmers with an equal emphasis on tractors/ power tillers or equivalents and bullocks, as per the local context needs to be ensured. Besides custom-hiring centres (CHCs) and entrepreneurial startups that provide farm power on hire & lease, it necessary to promote farming as a service (FaaS). Under this, the farmers should be able to access not just devices and machinery but total service including operations. Further, the service that offers cluster-based support in preference to individual farms should be incentivized.
- While animal draught power is reducing, institutional innovations on strengthening bullock power ecosystem, including finding off-season usage for animals and cheaper feed supplement be explored. This calls for designing of bullock-compliant farm machineries based on use of solar and electric power.
- Farm mechanisation research should focus on developing farmer-friendly, location-specific and easy-to-manage customized tools (tillers, drill ploughs, plough planters, manual weeders, bullock drawn weeders). In particular, innovative and appropriate mechanisation solutions such as machines to prepare organic/natural farming inputs, technologies to apply inputs effectively and judiciously (e.g., automated micro-irrigation) are required. A CHC system, with at least one CHC per gram panchayat, is essential. Supporting local technical innovations at the block level involving farmers' organizations, PACS/other

cooperatives, local industry and building on the already existing innovations on the ground is the way forward.

- Solar-based irrigation systems can provide irrigation at a very low cost to rainfed farmers. It will raise farmer incomes by providing opportunities to grow high-income horticultural crops in the rabi season fetching better market prices and profits for rainfed farmers. Government schemes for irrigation pumps and community-based lift irrigation systems like PM-KUSUM can be leveraged to establish community-scale solar irrigation projects in rainfed regions. Area-specific strategies, depending on groundwater availability, cropping pattern, size of farmer community need to be planned for increasing adoption of appropriately sized solar irrigation systems while avoiding adoption in water scarce regions

4.1.5 *Revival of millet-based cropping systems*

Millets can be cultivated and they are adaptable to a wide range of climatic conditions and marginal conditions of soil and irrigation. The alarming levels of malnutrition in the country, particularly in rainfed areas demand a **"millets for millions"** program linking production and consumption in the same region. Bringing back millets into the country's food systems is critical and can be taken up in a phased manner. Introducing millets into state nutrition programs (mid-day meal, ICDS, welfare hostels) can create bulk demand to drive the transition. Introduction of millets in PDS in a phased manner leading to substitution of high water duty commodities like rice and wheat will reduce the "water footprint" that now describes the country's public distribution of food. Decentralization of PDS through inclusion of millets also reduces the "carbon footprint" due to shorter supply chains.

Elements of millet production and consumption program need to undertake the following steps:

- Mapping the Community Development Blocks having a recent history of millet consumption and production
- Investing on seed systems
- Improved agronomical practices
- Clean harvesting that meet fair and assured quality standards
- Local processing and scientific post harvest management (PHM)
- Consumption campaigns
- Development of markets through processing and value-addition
- Establishment of integrated aggregation platforms at the local levels as envisioned under the concept of GrAMs (Gramin Agriculatural Markets)

4.2 Promote efficient natural resource management in rainfed agriculture

4.2.1 *Improve water use efficiency*

Investments in water resource management in rainfed areas have the potential to be highly inclusive, resulting in high social rate of returns, besides addressing multiple issues of droughts, low productivity, insecurity against unreliable rainfall, poverty, and nutrition. According to the studies of NRAA, a wide variation is noticed in rainfall effectiveness and water productivity across states and type of crops. Water balance analysis based on macro data at district level in rainfed areas reveals a poor level water productivity vis-a-vis major rainfed

crops in India. The study observed water productivity in the range of 106 to 280 gms per 1000 liter of water for predominant rainfed crops like jowar, maize, bajra, pulses, oilseeds and rice. This indicates that water productivity of major rainfed crops in India is very low as compared to that of irrigated system and global average. For example the global average water productivities of rice and maize range from 600-1600 gm/m3 and 1100-2700 gm/m3 respectively, both of which mostly count for irrigated system. Yet, the logic highlights the scope that exists for improvement in water productivity by adopting suitable crop diversification, crop alignment, water harvesting, in-situ moisture conservation, on farm water management, appropriate soil health management and optimal use of available water synergizing production system.

- **Improve effective rainfall :** As rainfall is the major source of water for rainfed regions, 'Effective Rainfall' as an approach can harness more rainfall for achieving food security and better livelihoods. Specific technologies that can be integrated within the local context from improving soil organic matter to harvesting and retaining moisture through farm ponds, conservative use etc., combined with a scientific and participatory mapping of resources, water budgeting, mobilisation of community to establish usage and extraction norms
- **Precision water management practices:** Adopting micro-irrigation technologies in Rainfed agriculture - which include drip/trickle systems, surface and sub-surface drip tapes, micro-sprinklers, sprayers, micro-jets, spinners, rotors, bubblers, etc., must be prioritized and incentivized through existing schemes/programmes. Studies report that micro irrigation systems deliver water saving upto 40 per cent over conventional flood irrigation as well as productivity and income enhancement upto 48 per cent. It also facilitates application of controlled quantities of water and nutrients in the vicinity of each plant. It is estimated that replacement of Conventional-irrigation by Micro-irrigation practices to the level of 50 per cent will bring additional cultivation area of 15 per cent in kharif and 23 per cent in rabi season. At an adoption level of 25 per cent, the estimated additional coverage is 8 per cent in kharif and 12 per cent in rabi. It is advisable to promote women and youth-led solar driven mobile pump-set based micro-irrigation services for protective irrigation in critical periods using the limited available water locally or arranging water from external sources in extreme conditions. This will minimize production losses and consequential losses.
- **Crop diversification for water intensive crops**: According to the studies of NRAA, about 6.72 per cent of rice cultivated area comprising 68 districts and 12.9 per cent of sugarcane cultivated area encompassing 91 districts are not suitable for cultivation of the said crops. Persistence with these crops has been causing a rise in the gap between demand and supply of water much beyond the effective rainfall, available surface water sources and replenishable ground water, resulting in rapid decline in water table, as also ater quality. Adopting in these districts a policy that supports optimum cropping pattern utilizing available water resources in a most efficient manner is need of the hour. Crop diversification from rice and sugarcane to low duty crops such as pulses and oilseeds would facilitate cultivation of these crops benefiting more number of small and marginal farmers. Cultivation of water guzzling crops in these areas may be further discouraged by shrinking the access to input and energy subsidies, as also procurement

etc. in a phased manner. Likewise facility of crop insurance may be made available at higher level of premium as a disincentive to adopting non-suitable crops.

4.2.2 *Minimizing soil degradation and restoring/rehabilitating degraded soils*

It is important to adopt suitable soil conservation measures based on land capability classes, and landscape planning approach. Soil rehabilitation and/or soil restoration should also be a priority, returning degraded soils to productivity, especially in historically sound agricultural or other production systems currently under threat. Reversing the soil degradation due to low SOC is essential to build back soil carbon, enhance agronomic productivity and aid in sequestering carbon. Strategies for improving SOC require improving water and nutrient use efficiencies by decreasing losses and increasing biomass production. Farming practices like conservation tillage, mulch farming, cover crop, mixed farming/cropping, agroforestry, ley farming (putting the land under pastures and hay after growing grain crops), utilising organic manures (vermicompost, green manure) are ways to increase SOC and carbon sequestration. There is significant opportunity to enhance income if farmers are compensated for generating SOC and sequestering carbon.

4.3 Enhance investment ability and financial security of farmers

4.3.1 Improve access of rainfed farmers to institutional credit

The role of the finance sector to enhance rainfed farmers' growth is extremely critical. From this perspective, their role needs to be redefined to enable upliftment of rainfed farmers. Some suggestions are:

- Farmers in rainfed regions need access to banking finances and better rural banking infrastructure to benefit from government schemes (through DBT, crop and weather insurance, etc), and minimized risks from dependence on informal credit sources. Financial institutions need to be set up in these regions to engage small-scale producers and encouraged with government benefits like provision of venture capital.
- Finance sector could support rainfed farmers in the form of micro-capital assistance. For instance, allow SHGs to take land/equipment on lease for cultivation purposes. Financial institutions could help farmers in gaining access to remunerative online trading markets like e-NAM. In this way, they could help break the cycle of indebtedness for needy farmers who lack access and knowledge to these resources.
- Explore the possibility of the finance sector to act as a mediator between the private/public sector enterprises and farmers to finance carbon projects or open up newer avenues for sustainable procurement ventures to rainfed farmers.

4.3.2 Encourage allied agricultural activities in rainfed regions

i. **Enhancing income through animal husbandry in rainfed regions**

- The development of the livestock sector in rainfed regions has to be based on a multi-pronged strategy covering production, conservation, medical support infrastructure and marketing.
- Identify exclusive schemes and programs for small ruminants (pigs, goats, sheep), as also poultry, camels and yaks; and tailor interventions based on local resource availability and the socioeconomic status of the farmer. For example,

emerging innovations like goat banks which provide ruminants at a very low cost to women and marginal farmers need scaling up and integration with women's development schemes.

- Build adequate veterinary infrastructure for the rainfed livestock ecosystem which at present is concentrated in irrigated districts and for mostly cattles.
- Provide tailored insurance schemes to livestock rearers for reducing the investment risk faced by them.
- With more than 27 major traditional pastoralist communities inhabiting 15 states with an estimated population of about 3.4 crores, special policy and funding focus for pastoral ecosystems needs to be developed. Policies to ensure the protection of commons that offer grazing areas and programs for livestock, credit access, and avenues for selling cow dung on scale need to be planned and implemented.
- Adopt integrated Pastoralism System Development project on the lines of 'Integrated Watershed Development Project' for sustaining the livelihood of migrant pastoralist communities
- Develop efficient pasture and fodder production systems in rainfed areas through fodder production on arable lands (encouraging farmers to use at least 10 per cent of their land for fodder production); integrated fodder production system (integrate rearing of ruminants with trees in the form of Silvi-pastoral, Agri-Silvi-pastoral, and Horti-pastoral systems) and improving and safeguarding Common Property Resources (CPR) for fodder availability.

ii. **Enhancing income through dryland horticulture in rainfed regions**

- Horticulture is emerging as the main growth engine of Indian agriculture and has been defined as Sunrise Sector by the Doubling Farmers Income (DFI) Committee, as it contributes more than a third of the agricultural GDP, though it occupies less than a fifth of the cultivated area.
- Horticulture crops generate employment, provide raw material to various food processing industries, and generates higher farm profitability due to higher production and export earnings from foreign exchange.
- Diverse agro-climatic conditions in India enable production of all types of fresh fruits, vegetables, herbal and medicinal plants in different parts of the country. Health consciousness among people is growing alongside increase in their purchasing power. With expected diversifications of consumption pattern in favour of micro-nutrient carrying agri-horti-produce, the demand for horticultural produce will see a rise, and exists to produce more horticultural crops.
- The comparative production per unit area of horticultural crops is higher than field crops, e.g., currently paddy crop gives an average of only 30 q/ha, while banana crop gives 300–450 q/ha and grapes 90–150 q/ha. The technical yield potential of fruits is 19-20 tons/ha and that of vegetable is 20-30 tons/ha. These potential yield levels are much higher than that of field crops.
- Difficult rainfed areas like the slope lands with uneven or undulating topography are suitable only for horticultural crops. Some fruit trees can also be grown in culturable wasteland or possessing poor quality soil.

- In addition to increased farm income, nutritional security and other export potential, horticultural systems generate several positive environmental impacts in rainfed areas. Carbon sequestration is one such.
- Efforts should be more towards promotion of agri-horticultural Integrated Farming System suitable to the agro climatic condition which can bring certain level of resilience to the production system as well as create higher income avenues.

4.3.3 *Establishing bio-economy in rainfed regions through promotion of secondary agricultural activities*

Secondary agriculture is a strategic intervention for rainfed area to process both primary and by-products of the agriculture sector into value added products and thereby create gainful employment, and supplementary income for the farmers. It can also serve as a mitigation mechanism during periods of extreme weather events, crop losses, and price volatility of agricultural produce. Following strategies can be adopted to boost secondary agricultural activities in rainfed regions:

- Identify potential secondary agricultural activities that involve value addition of primary agricultural produce (processing, nurseries, biofertilizers, and biopesticide production etc.), alternative enterprises (beekeeping, sericulture, organic/indigenous seed production, biochar, bio pelletisation etc.), and income generation activities through agricultural residues/wastes (vermicompost, organic manure, biopesticides, and fiber products etc.).
- Provide specialized technical support (capacity building programs, low-cost skilling, and training programs for farm families) and financial support (institutional credit) for allied agricultural enterprises.
- Insurance against business risks can be provided for rural income generation activities that are dependent on agricultural production activities.
- Priority sector status can be accorded to secondary agriculture to ensure institutional credit access and to fastrack benefit transfer under ongoing schemes related to skill & enterprise promotion.
- Specialized agro products from micro and small-scale enterprises can be identified for Geographical Indicator (GI) labels to build brands, improve marketability and tap export potential.
- Prioritise processing equipments/machineries that operate on decentralized renewable energy to ensure a reliable supply, which is the second major challenge for rural microenterprises.

4.3.4 Introduce comprehensive Insurance and weather-based instruments

Weather events like excess rains/droughts have a direct and systemic impact on the economic activities of the rained areas. Therefore few strategies to mitigate the risk suggested are:

- Safeguard rainfed farmers through financial infrastructure in the form of credit flows (production and post production financial tools) and insurance cover. Crop insurance packages must also be made more comprehensive and pervasive as there is low coverage in rainfed and remote areas under the ongoing PMFBY owing to the lower number of bids from implementing agencies and quoting of high premiums. Thus,

additional incentives are required to encourage the adoption of the PMFBY scheme in rainfed regions.

- Access of small and marginal farmers to institutional credit, and insurance for non-loanee farmers needs to be improved. The present process of enrolment through an application needs to be overhauled and a mechanism for enrolment of non-loanee farmers under PMFBY promptly explored.
- A robust data management system to ensure efficiency in insurance schemes, enrolment of farmers, price discovery, selection of implementing agencies through bidding, estimation of crop loss, and timely payment of claims is esstential.
- Weather risk management instruments such as weather-based crop insurance schemes can be scaled up in rainfed regions as they provide a viable alternative to traditional crop insurance schemes. It uses weather parameters as a "proxy" for crop yields (which is more verifiable), and is therefore preferable to crop cutting experiments (CCE) in assessing the loses for compensating the cultivators for deemed crop losses. Weather index derivatives not only help mitigate the high risk faced by vulnerable households and economic agents within the rural sector, but also reduce/rationalize the Government's cost of natural disaster aid. As extreme weather events are expected to rise, rainfed farmers should receive a comprehensive risk cover package under Restructured Weather-based Crop Insurance for drought, untimely rainfall, and other weather-led events.
- Institutional mechanisms to provide timely weather-related information to rainfed farmers, especially on the onset of monsoon, unseasonal rain, and drought will be important to cope with climate change. High spatial and temporal resolution data can be collected by setting up extensive weather monitoring systems on the ground. This can be leveraged to provide customized short and long-term meteorological forecasts to the farmers. This will enable rainfed farmers to make the right decisions on crop selection, sowing, harvest time, etc., at the right time for reducing crop losses and improving crop yields.

4.4 Improve infrastructure & organizations to enhance economic gains

Poor market linkages and lack of rainfed farmers' ability to negotiate market prices call for enhancing their capacity to capture the value of the product through strategies that include:

- To reduce the high transaction (during sales, input procurement, etc.) costs per unit of produce borne by small and marginal rainfed farmers in particular, aggregation is essential. A cluster of 100 hectares or more of rainfed farms within close proximity could be apt for aggregating economic activities. Appropriate integrated farming systems can also be identified and adopted for clusters by measuring soil quality, rainfall, irrigation facility, and market access. Dedicated FPOs formed by farmers in each cluster can be leveraged to source low-cost and quality inputs (seeds, fertilizers), farm mechanization tools, post-harvest infrastructure (transportation, cold storage), and provide better market access.
- Setting up rural-based low-cost small-scale agro-industries (food and non-food) in rainfed areas to process the marketable surpluses can improve farmers income. Creation of multi-purpose low-cost rural-based agro-processing complexes/parks can

also be prioritised to directly reach large private players. FPOs, Farmer SHGs/Cooperatives could be leveraged to set up these models in a Public-private partnership (PPP) mode for establishing processing and value addition units at strategic places in the rural areas for pulses, millets, fruits, vegetables, dairy, fisheries, and poultry.

- Learning from the successful milk cooperative movement of India, appropriate models of Farmer Producer Organizations (FPOs) need to be structured and tailored to suit needs of rainfed areas. Significant investment is needed to capacitate FPOs in playling an effective role that goes beyond aggregation focused functions, such as marketing and value addition.
- Establish decentralized aggregation and market platforms to facilitate marketing of surpluses in close proximity to farmgates. Integrated markets called 'Gramin Agriculture Markets (GrAMs) may be established.
- At the GrAMs, provide for the needed agri-logistics including community cold storage facilities whereat individual farmers can hire required space akin to the locker system available at the banks.

4.5 Encourage private sector investment in rainfed regions

There exists great scope for the private sector to enable rainfed agriculture to reach its potential and they need to be encouraged and incentivized to prioritize interventions in this direction. Private sector investment and collaboration are key to developing a sustainable agriculture system. Private sector will be incentivized and facilitated to:

- Develop innovative support mechanisms (quality inputs, cost-effective credits, certification and audits, capacity building trainings etc.) to ease the transition of farmers to sustainable practices
- Drive adoption of sustainable agriculture practices and systems (SAPSs) in their supply chains (domestic and global) via suitable existing/new supply chain assurance and traceability mechanisms
- Address the business opportunities created by the shift to sustainable agriculture in rainfed regions e.g. develop and commercialize farm implements to ease laborious sustainable practices; production and supply of special or new types of inputs (biopesticides, precision tools, etc) and digital tools for decision-making.
- Reorient the R&D to build solutions for sustainable agriculture in rainfed regions and rely on scientific assessment of the impact of sustainable agriculture practices in rainfed regions for sound evidence-backed scale up.

According to the Ministry of Corporate Affairs, a sum of more than Rs. 3,500 crore has been invested in agriculture and rural development sectors under the purview of corporate social responsibility (CSR) during the period of 2015-16 to 2019-20. There is no organized mechanism to evaluate the importance and priority of the identified projects, monitoring or, their contribution/ supplementation to national initiatives/commitments. An Integrated platform with a robust MIS is required to be established to facilitate building sound proposals for inviting and guiding interested agencies/companies, selection of priority area/ projects and implementing agencies, undertaking periodic monitoring and technical supervision for best

use of these resources. Putting in place a suitable system can benefit of CSR partnership for initiatives in rainfed regions on a sustainable basis.

4.6 Improve knowledge transfer services in rainfed regions

4.6.1 *Strengthen Extension services in rainfed regions*

- With extension services mostly geared towards irrigated agriculture, the extension functionaries should be reoriented and trained to serve various agro-ecologies adequately in rainfed regions. The proposed ratio between extension functionaries to farmers based on an optimal blending of manpower and ICT is 1:1000 for rainfed regions and the gap between the aspired and current ratio needs to be bridged.
- Extension workers/technical functionaries should be trained on the latest advances in rainfed agriculture technologies and on SAPSs for adopting resilient cropping systems and improving productivity. Special exposure training of short duration is also required for the grassroots level personnel involved in the implementation of the watershed and rainfed agriculture development programs in various states
- Model/ Adarsh watersheds are key for scaling up successful watershed approaches. The model watersheds are intended to demonstrate successful watershed management approaches and serve as 'Pilot Replicable Watersheds' at district scale. The model watershed interventions need to be developed by consortium of various local institutions such as research, development, government, civil society and these necessarily need to be scalable. Science-backed analysis and interventions/best solutions at the level of model watersheds should be integrated with wide extension activities and all the extension institutes should adapt model watersheds for scaling mechanisms of interventions.

4.6.2 *Leverage Information and Communication Technology (ICT) in rainfed regions*

Technology adoption in rainfed regions is low and ICT can be capitalized, as technology adoption rates are higher when ICT and traditional extension systems are blended, in comparison to dependence on the latter alone. ICT can be leveraged for providing information on several key fronts, including but not limited to:

- Agronomy-related customized information (crop production, protection, disaster management),
- Market-related information including prevalent and future commodity prices in both near-and far-range markets, demand forecast during harvesting seasons, warehousing and cold storage availability etc.
- Resource and climate-related (weather information, pest & diseases, allied sector resources, agri-input availability and management) and
- Governance related information (e-Governance, schemes) for specific rainfed ecosystems.

To fully capture the potential of ICT, infrastructure must be upgraded and capacity-building programs provided to extension personnel in multiple dimension of ICT usage.

- IoT (Internet of Things) technology can be utilised in rainfed agriculture to ensure optimum application of resources, achieve higher crop yields, and reduce operational costs through real-time monitoring of rainfall, soil health, livestock health and productivity, crops, and status of pest & diseases. Besides crop production, IoT will provide a smoother flow of agriculture logistics during the post-production phases and, ensure better market prices for farmers through real-time market price monitoring.
- Establishing an accessible online data information platform for farmers which provides real-time critical information on weather, pest & disease, and market-related information will be useful in making critical decisions such as sowing, harvesting, and selling time. Additionally, IoT can also be leveraged by providing temperature & moisture-related information in grain storing warehouses to farmers to monitor the quality of their produce in cold storage/warehousing

4.7 Dynamic Data Portal and Decision Support Tools

- Developing a dynamic data portal for rainfed regions to enable decision making and to improve transparency and accountability is crucial. This will enable better risk mitigation, customised solutions, and course corrections for region-specific climate and related risks.
- Scaling up the 'Unified Farmer Service Platform (UFSP)' which can act as a central agency and repository in the agri-data ecosystem will bring a paradigm shift in data-based decision making.
- The Task force constituted by NRAA (2020) envisaged development of a Centralized Database on Rainfed Agriculture - **Rainfed Areas Data Repository (RADAR**). It is a centralized database on various parameters which can serve the agencies responsible for planning, research and development. The proposed database will encompass parameters of agriculture production, availability of water resources, metrological data, soil characteristics, available technologies (including varieties) input availability, infrastructure/agri-logistics facilities, procurement etc. in addition to socio-economic parameters like income, health & education, migration, rural work force, etc.

4.8 Provide Targeted Governance for Rainfed Regions

4.8.1 *Develop specific ecosystem-based solutions*

Rainfed ecosystems are home to a wealth of region-specific indigenous knowledge, seeds, farming/cultural practices, and systems that can be leveraged for scaling up sustainable agriculture. Different context-specific SAPSs (traditional as well modern) are piloted in the rainfed regions. Facilitated by ecosystem-focused scientific cells, an ecosystem-specific scientific Package of Practices (PoPs) could be developed that capitalize on **a)** the indigenous knowledge system; **b)** modern science; and **c)** experience from existing projects focused on sustainable agriculture**.** Recognition and certification of unique agricultural heritage systems as Globally Important Agricultural Heritage Systems (GIAHs) by the Food and Agriculture Organization needs to be encouraged and pursued in rainfed areas. This will protect, nurture and help boost agri-tourism.

- A renewed way of looking at rainfed regions can be envisioned by dividing it into a manageable number of segments (ecosystem) using the following parameters:

  i. **Rainfall patterns**
     a. Dryland areas with arid conditions: <500 mm
     b. Low-to-medium rainfall: 500-1000 mm
     c. Medium-to-high rainfall: 1000-1500 mm
     d. Very high rainfall (Forest-hilly): ≥1500 mm

  ii. **ACZs delineation** (considers regional similarity in terms of crops grown, rainfall; temperatures; soil types, etc)

  iii. **Economic profiling** (considers sustainable livelihood activities with potential for market demand/value chain development)

  iv. **Terrain (**groups similar terrains delineated by ACZ into pockets of Gangetic plains, plains, plateaus, hills, high mountains, coastal plains and islands)

  v. **Aspirational districts-** 117 Aspirational Districts have been identified by NITI aayog based upon composite indicators associated with health & nutrition, education, agriculture & water resources, financial inclusion and skill development and basic infrastructure which have an impact on Human Development Index (HDI)**.**

4.8.2 *Rational allocation of resources*

Rainfed agriculture needs to get a fair and proportionate share of the public investments to enable full realisation of its potential. The aim should be to render the rainfed system economically viable (adequate capital flow, market support, remunerative and sustainable livelihoods); ecologically resilient (natural resource efficiency, land, and crop productivity) and equitable in developmental processes (access to banking finance, inclusive programs). By repurposing/restructuring/reforming the existing policies, programs, schemes and/or creation of new rainfed agriculture-focused ones, a more rational reallocation of public resources may be done based on **a)** the size of the population supported by and land under rainfed agriculture, and **b)** the level of investment necessary to alleviate poverty and stimulate growth in this population/land base. The ecosystem-centric governance approach can further rationalize resource allocation based on the specific needs of different rainfed ecosystems**.**

It is challenging to target public investment programs, very precisely as rainfed and irrigated areas coexist in every village. The following are some of the potential strategies to ensure that the quantum of resource allocation to the rainfed region is fair:

- Use of price policies to target rainfed specific crops
- Emphasizing rainfed regions in public investment in infrastructure development, poverty alleviation programs, and other related policy and institutional reforms

- Emphasizing rainfed regions in watershed management schemes, which have a track record of lower spending in rainfed regions compared to lands irrigated through big dams and canal networks
- Significantly uphaul investment on government procurement of nutri cereals, which is much lower as compared to wheat and rice spending
- Upgrade agri-logistics and market infrastructure to support post harvest management of agri-commodities (agronomic, horticultural & livestock) specific to rainfed regions
- Make specific and dedicated allocations to undertake R&D activities in respect of indentified rainfed region problems/challenges

Other than the quantum of investments, even their nature or investment types that go into rainfed agriculture warrant reforms. For instance,

- programs that focus on input resources mainly seeds, fertilizers, hybrid seeds, soil health cards spill over to rainfed regions without taking into consideration their actual requirement. Instead, the incentives can be provided to livestock rearing farmers and channelise investments in distributing indigenous seeds, organic manure, etc.

4.8.3 *Policy reorientation*

4.8.3.1 ***Restructuring of schemes and programmes***: There is need for restructuring of schemes and programmes to make them farmer friendly, particularly in accessing all related support for a production system under one platform. For example the National Mission for Sustainable Agriculture (NMSA) may function as an umbrella scheme accommodating supports for integrated farming, integrated livelihood; natural farming, organic farming & other conservation agriculture systems; dryland horticulture; agroforestry; national bamboo mission etc. One MIS and reporting system to capture farmers' registration and requests for support under different scheme interventions along with progress monitoring would not only bring synergy among the schemes, but also reduce the botheration of farmers to seek support from different programmes to accomplish their requirements associated with one's production system. Similar efforts need to be made for livestock and fishery sector. The current education system in agriculture and allied sectors focuses mostly on sectoral expertise and does not take an integral approach to agriculture systems as a whole. This need to be reconfigured and reoriented.

4.8.3.2 ***Policies for pastoralism***: Currently, there are no official policies or social and economic development programs aimed exclusively at the communities actively engaged in pastoralism in India. The livestock sector is more focused towards dairy animals with little emphasis on small ruminants, fodder production and migratory animal folks. This anomaly needs to be corrected by adopting dedicated policies and programmes for pastoralists.

4.8.3.3 ***Integration of programmes at Panchayat level***: In the agriculture and rural development sector, lot of programmes and schemes are being implemented by different departments/ministries and agencies which are closely correlated, but executed through isolated windows reducing their expected efficacies, loosing the synergy and coherence in many instances. To encourage decentralized & bottom-up

approach, integration of all these programmes at Panchayat Raj Institutions (PRI) level is very much essential. Sub-district level agencies in conjunction with Grama Sabha/ NGOs execute Water and Agriculture plans/feasibility checks, which can be made more effective if appropriate systems are grounded. Real-time IT and GIS-based two-way Decision support systems (DSS) can be implemented with District-Sub district machinery in conjunction with state and central level agencies.

4.8.3.4 ***Effective integration of agricultural institutes with premier technological institutes:*** State Agricultural Universities (SAU) need to be integrated with premier technological institutes (IIT's, IIIT's, IISER"s, NIT's, Technological universities and ICAR centres) for adaption of inter disciplinary and state–of-the-art technologies/curriculum. The subject electives of technical and other science courses can include rainfed agriculture for awareness among other disciplines. Higher/ Upper primary school subject electives/ quizzes/ fairs/ symposiums/ exhibitions with focus on rainfed agriculture can be a key catalyst for promotion of rainfed agriculture systems among youth.

4.8.4 Regulatory Acts/Reforms – suggestions

4.8.4.1 ***Land ownership and farm productivity is inter linked*** -In India, considerable amount of land ownership is in the hands of urban dwellers, working and business professionals who are not full time agriculture practitioners /farmers. The non engagement of these groups in full time agrarian activities greatly affects the agriculture productivity and sustainability. The land is considered as an asset and possessed or transferred from ancestors whose livelihood is not dependent on agriculture. Since land lease is not legal in most states yet, a substantive percentage of land is seen to be remaining fallow. And, when it is leased based on oral agreement the lessee is seen not to consider the ecological and sustainable management practices needed while cultivating. Further the lessee being ineligible to directly access government/institutional support, the cultivation stands to lose from needed interventions causing less than normal productivity. Hence there is need for legalising land lease (based on Model Land Lease Act, 2016 of NITI Aayog). Further, as recommended by the DFI Committee, the definition of farmer may be delinked from land ownership status and, the actual cultivation during the current season made entitled to governmental and institutional support. This entails maintenance of a digitally enabled dynamic database of the farmers.

4.8.4.2 ***Judicious use of the groundwater is a critical intervention*** needed for sustainable rain fed agriculture. Groundwater governance entails the focus of political, social, economic, and administrative systems. Water governance in India being a state subject, legislations in state legislative assembly on groundwater will be a critical catalyst in the success of rainfed agriculture programs. Studies show a rapid decline in usable groundwater between 2005 and 2019 in the States of Punjab, Rajasthan, Maharashtra and Telangana leading to the risk of severe food crisis and drinking water scarcity for rainfed regions of the country. Limiting subsidized electricity and adoption a mechanism of pricing for groundwater usage will be a critical reform in the domain of conjunctive use of groundwater for rainfed agriculture.

4.8.4.3 ***Dedicated water related Policy/Advisories for rainfed areas***: Rainfed areas need a differentiated focus on water management (policy, investment, technology, institutions) based on a framework of dedicated water-related policies. As of now, the national water policy for agriculture sector is mostly oriented towards irrigation. **Gauging and volumetric**

measurements of micro-watersheds at the outlets of catchments is necessary to assess the water use at micro-watershed scale and suggest management approaches. **Water Foot Print demarcation** for rainfed agriculture products offers an objective indicator to quantify the volume of water utilization per unit of harvest. Region-specific Water foot print quantification of rainfed agriculture crops is to be standardized with specific Guidelines. The water foot printing will be a critical developing strategy to study about the water consumption and distribution in the rainfed regions.

4.8.4.5. ***Land ownership for women in rainfed agriculture***-Women play a vital role in wide range of agriculture activities contributing to inclusive agricultural growth in rainfed regions. Women's land title ownership may be promoted by linking of additional subsidies and benefits to women farmers, as it enhances their status/ decision-making power in the household. In addition, promotion of women-friendly farm implements, enhanced subsidies to women owned startups, strengthening of SHG's, encouraging Women FPOs, skill-oriented trainings on scientific livestock management and utilization of non-degradable farm-waste etc. be encouraged to address the gender equity issues in rainfed areas.

4.8.5.5 ***Regulation for mining of soils***: Considerable extent of productive and potential agricultural lands are being utilised by brick making industry. Brick Industry (BI) generates employment but contributes to soil loss as the brick industry relies on clay-rich soil. Silt from the excavation / screening process results in chocking of fields, Salinization of lands, and effects the natural breeding grounds of fishes, aquatic lives and loss of biodiversity. Economic returns of BI are much higher than agriculture/allied activities, but leads to environmental non-sustainability in the long run. Hence the urgent need for regulating mining of soils from brick fields. Simultaneously, use of alternative construction materials such as fly ash bricks, modification of brick processing by vertical shaft brick kilns may be promoted to combat the adverse effect of brick making on potential agricultural lands.

4.8.5.6 ***Supportive policies towards crop diversification:*** Interlinking of crop diversification and policies/programmes is very much essential for dissuasion of farmers from growing water intensive crops. According to the studies, sizeable extent of paddy and sugar cane cultivation is practised in regions that are not compatible in terms of available water resources. It is necessary to adopt a policy that dis-incentivises cultivation of agro-ecologically non-suitable crops and is incentivising of agro-ecologically suitable crops.

4.8.5 *Targeted schemes for vulnerable and disadvantaged group*

Landless farmers, women, youth, and various socio-economically disadvantaged population segments, especially the tribal and indigenous communities face more severe constraints compared to others in accessing productive resources, markets, and services. A high proportion of the tribal population is found in rainfed and upland areas in the central and mountainous regions of the country. These challenges impede their productivity and ability to contribute to their individual development and broader social and economic goals.

Inclusive and targeted policies consisting of incentives and rewards need to be developed aiming at maximal participation of disadvantaged population segments, promoting gender equality, and retaining youth in agriculture. The following are some of the strategies that may be explored:

- Tribal population can be effectively targeted by the strategic implementation of tailored/customisd programs/schemes in regions inhabited by tribal communities.
- For women in agriculture and allied activities, Mahila Kisan Mandal (Women Farmers' Cooperative) may be established in villages to educate them on several fronts. Tools and implements need to be designed for the women community to allevicatetheir on-farm drudgery and help them realize higher efficiency and productivity. Women-run cooperatives could lead to greater sensitization among women farmers and increase participation rates in utilizing farm machinery. All policies and programs need to be reoriented to incorporate a gender-sensitive and pro-women approach.

4.8.6 Enabling science-led development capitalizing upon indigenous knowledge system

- ***Consortium of research and development institutes***
  ICAR Centres, State Agricultural Universities, Central and private Agricultural research institutes, KVKs and Civil Society Organizations working for a particular ecosystem can be grouped into an institutional system to collate and analyze local knowledge/practices/systems, data and schemes to develop and standardize context-specific solutions.
- ***Conservation of Indigenous landraces and agro biodiversity***
  Local landraces in tribal and agro biodiversity-rich regions which possess desirable qualities including resistance to biotic and abiotic stresses, pest & disease resistance, and therapeutic/medicinal value, must be integrated into the seed chain through community seed banks (CSBs) and Nursery banks to ensure wider adoption by farmers.
- ***Scientific decision making***
  Long-term multidimensional research is needed to establish economic (yield, income); social (women participation, nutrition); and environmental (water and soil health, biodiversity) impact of the practices relevant for rainfed agriculture. This will provide scientific evidence for scaling up SAPSs to other relevant parts.
- ***Standardizing Indigenous Technical Knowledge (ITKs)***
  Scientific and traditional knowledge need to be standardised and technologies upgraded so that farmers can adopt at a larger scale with confidence.
- ***Sensor based Smart agriculture interventions***
  Sensor based interventions to maximize yields using minimal and timely application of resources such as water, fertilizer, and seeds need to be scaled up. Results of sensor based soil moisture and crop water requirements estimations at micro scale will enable optimum use of available resources and minimize exploitation beyond sustainable limits. The sensor based results need to be integrated and appropriately customized/regionalized for scalable application in similar environments.
- ***Generating evidence on interventions in rainfed ecosystems***
  To enable scientific decision making, long-term multidimensional studies are needed to establish evidence for impact of potential agronomic, environmental and market related practices on various outcomes relevant for rainfed agriculture, such as yield, productivity, water and soil health, climate resilience, women participation and nutrition.
- ***Incubation and scaling of innovations of startups***

Technology and innovation-led initiatives be encouraged across various sub-sectors of the rainfed agriculture systems by integrating with Atal Innovation Mission (Atal Incubation Centres, Atal Tinkering Labs, Start up India, Stand up India, MUDRA, PMFMFE, and various initiatives under Atma Nirbhar Bharat initiatives of the Government).

- ***Participatory groundwater use and monitoring***
  Promotion of user friendly equipment for ground water monitoring and decision support tools for participatory Groundwater monitoring and Community based water mapping for conjunctive use of groundwater and surface water will be a critical catalyst for sustainable Rainfed agriculture Systems. This will promote the practice of water-budget based production system at village level.

5. Institutional Reforms

5.1 Institutional framework

The issues of rainfed agriculture as discussed in the document are multifaceted and require an holistic institutional framework at various levels viz., National, State, District and Village levels to drive the sustainable solutions.

5.1.1 National level Institution

At present, NRAA as a national anchor provides actionable knowledge inputs for systematic up-gradation and management of the country's dryland and rainfed agriculture. NRAA's proposed functions which are iterative and integrated, are listed as follows:

- Formulating and advocating policies and road map
- Recommendations for rationalizing Guidelines for central government schemes/ programs/ other initiatives
- Identifying research gaps and recommending to the Ministry of Agriculture and other concerned ministries to undertake necessary R&D activities
- Identifying constraints in implementation and conducting studies including action research
- Coordinating multilateral and International Cooperation relating to rainfed agriculture systems
- Collating data and publishing ongoing as well as periodical reports
- Undertaking, Monitoring and Evaluation of programs
- Iteratively develop comprehensive knowledge on all aspects of rainfed agriculture in different zones
- Facilitate multilateral and International Cooperation by creating enabling environments for research consortiums in order to recommend evidence-based policy formulation in rainfed areas
- Develop frameworks for assessment of programmes through a rainfed lens
- Facilitate action-research through pilot projects in different agro-ecological zones

- Coordinate and facilitate for systematic convergence of funds available at the level of central & state governments and mainstream into rainfed agriculture

NRAA's institutional framework currently has 5 verticals catering to specific subject domains namely, Water Management, Watershed Development, Agriculture/Horticulture, Animal Husbandry/Fisheries, and Forestry. To encompass the comprehensive development of rainfed areas as illustrated in the policy proposal, there is need to strengthen the expertise/professional skill of NRAA in more cross-cutting dimensions. Important verticals addressing Secondary agriculture, Extension & Farmers organizations and may be supplemented to enhance the service support of NRAA.

5.1.2 State level Institution

At present there is no dedicated state level institution for anchoring rainfed agriculture. The State Government can upgraded their existing Commissionerate/Directorate of Watershed programmes as 'State Rainfed Area Authority (SRAA)' mandated with additional responsibilities to coordinate/drive policies and programmes in respect of rainfed agriculture of the state.

5.1.3 District Level Institution

It is important to assign to a competent agency, the role of coordination for overall development of rainfed agriculture and farmer driven arrangements for technology and policy dissemination. An institution in the form of Agricultural Technology Management Agency (ATMA) already exists at district level. ATMA with active participation of all concerned districts level line departments, farmers/farmer-groups, NGOs, Krishi Vigyan Kendras (KVKs), Panchayati Raj Institutions and other stakeholders operating at district level and below, may be engaged as the district level arm of SRAA with appropriate empowerment and support to focus on rainfed agriculture as a supplemental responsibility.

5.1.4 Village level Institution

At village/panchayat level, the PRIs need to anchor the development agenda of rainfed areas which are mostly driven by programmes of agriculture & allied sector, rural development and a few other departments. To encourage decentralized & bottom-up approach, PRIs are the most relevant institution for effective integration of all these developmental sectors. PRIs need to be facilitated with information support and decision support tools to select need based interventions and farmer statkeholders requiring genuine and immediate attention.

5.2 Network of Institutions and Coordination

5. 2.1 National level Committee

Since comprehensive development of rainfed areas is not limited to agriculture and allied sectors alone, and is also closely associated with interventions, programs of other sectors like Water Resources, Rural Development, Panchayat Raj, Tribal Welfare, Environment and Forests, Science and Technology, Medium and Small Scale Enterprises, Drinking Water and Sanitation, Energy and Power, Skill Development, NITI AYOG. etc, there is need for proper coordination and cohesive developmental approach. This calls for a national level committee to

take on such responsibility. In this context, two following Committees are suggested:

- An Executive Committee under the Chairmanship of CEO, NRAA, with officers (of the level of AS/JS) representing all concerned Ministries/Departments and Agencies (like NABARD, NCDC, SFAC etc.) as members
- An Advisory and Coordination Committee under the Chairmanship of Secretary Agriculture & Farmers Welfare, with secretaries of all concerned Ministries/Departments, CEO, NRAA and heads of concerned Agencies (like NABARD, NCDC, SFAC etc.) as members

5.2.2. **State level Committee**

The institutional system at the state level can be a mirror image of the national level arrangement with appropriate modifications. While the State Executive Committee can function under the Chairmanship of Secretary, Department of Agriculture, the State Advisory and Coordination Committee can be set up under the Chairmanship of Development Commissioner/Additional Chief Secretary/Agricultural Production Commissioner, as the case may be. Both Committees can have officers of relevant departments, institutions and agencies including representatives of the State Agriculture Universities/ Farm Universities.

5.2.3 **District level Committee**

The primary responsibility of District Level Committee is to prepare District Action Plan and implement various programmes, projects and schemes. Hence, the ATMA platform is well equipped to serve as the District Level Committee and may therefore be mandated with execution of rainfed agriculture initiatives.