SUB-NATIONAL CLIMATE ACTION ON ADAPTATION

Monitoring, Evaluation, and Learning Framework for the State of Telangana

India Phase II

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Subnational Report and MEL Framework for Telangana

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1. Introduction

The changing climate and the risks associated with it make adaptation imperative for all countries. India, being a large country in the tropics with diverse agro-climatic regions and a long coastline, is extremely vulnerable to the consequences of the adverse effects associated with the changing climate. According to the studies cited by the Intergovernmental Panel on Climate Change (IPCC) in its *Sixth Assessment Report* (AR6), climate change and rising demand would lead to at least 40% of the Indian population living with water scarcity by 2050. The dual impacts arising from rising sea levels and groundwater scarcity will have a direct impact on the agriculture sector in India. The IPCC report estimates that yields of wheat, pulses, coarse crops, and cereals in India could fall almost 9% by 2050, which have the potential to cause price spikes. These price spikes would threaten the food affordability, food security, and economic growth of the country. These risks have necessitated the need for extensive resources that are being targeted at not only designing activities and projects specifically addressing adaptation but also at ensuring that adaptation is integrated into the development planning to help reduce risks associated with the climate change.

India's policy landscape on climate change dates back to 2008 with the introduction of the National Action Plan on Climate Change (NAPCC), which, to start with included eight Missions with a focus on both mitigation and adaptation. The National Adaptation Fund for Climate Change (NAFCC) in 2015 extends financial support to all states and union territories (UTs) for various adaptation interventions that have been prioritized by the states. The priority areas for climate resilience under the NAFCC have been outlined along the lines of the NAPCC and the State Action Plan on Climate Change (SAPCC). The National Bank for Agriculture and Rural Development (NABARD) is the implementing agency for NAFCC projects, which is tasked with identification of projects, appraisal, sanction, release of funds, monitoring, and evaluation as well as capacity building of relevant stakeholders. Furthermore, there are various other central- and state-level initiatives which aim to enhance climate adaptation. Some prominent programmes include the National Innovations on Climate Resilient Agriculture (NICRA), State Action Plans on Climate Change (SAPCCs) and Programme on Climate Resilient Agriculture (PoCRA).

While these projects have been established, monitoring and evaluation frameworks that indicate the progress in work related to these projects are needed. The Initiative Climate Action and Transparency on Adaptation (ICAT-A) project seeks to identify some of these projects that are being implemented in the country to monitor, evaluate, and learn from the processes of implementation that are underway.

The Initiative on Climate Action Transparency (ICAT) aims to support countries with custom- made tools and methodologies to create frameworks for effective reporting on climate action while adhering to the country's development priorities. Globally, monitoring and evaluation frameworks are being developed to track the progress of development programmes. They are considered as standardized tools which assist in reporting outputs, outcomes, and impacts of a project and help in establishing accountability. Monitoring and evaluation in adaptation projects not only help in tracking the progress of interventions but also point out needs for adjustments. They

help countries arrive at understanding whether they are doing the right things, doing them correctly and what could have been done differently. Effective frameworks can help governments understand:

- Successful adaptation actions which reduce vulnerability
- Addressing urgent adaptation needs
- Results of climate policies
- Increase in resilience of communities

As adaptation measures and development initiatives are implemented at the state level in India, there is a need to explore the implementation framework as well as identify the key stakeholders this level. The present document entails details of adaptation in the agriculture sector being promoted in the state of Telangana. There are three case interventions that have been selected based on a discussion with the state. This includes the Rain-fed Area Development Programme under the ambit of the National Mission on Sustainable Agriculture (NMSA), the Resilient Agricultural Households (RAH) initiative supported under the National Adaptation Fund on Climate Change and the National Initiative on Climate Resilient Agriculture (NICRA) being implemented by the government-led Council for Scientific and Industrial Research (CSIR). Along with these adaptation initiatives, the document also assesses the mapping of the financial and implementing stakeholders in the state; as well as the needs and capacity of the line departments for the implementation of a monitoring, evaluation, and learning (MEL) framework and of future adaptation initiatives.

1.1 ICAT-A Approach for Stakeholder Engagement

- **Scales of engagement**

Since adaptation is locally oriented and has to be context-specific, there is a need to engage stakeholders' at all possible levels of the implementation process. An effective implementation of any climate change adaptation intervention requires engagement at various scales, starting from individuals to institutions, both horizontally and vertically oriented. The various scales as indicated below apply based on the kind of adaptation intervention being planned/ implemented:

- National: Central Government, other relevant entities in the implementation of these projects, private sector, research institutions, academia and non-governmental organizations (NGOs), financial institutions, etc.
- Subnational: State relevant departments, state research institutions, private sector, academia and NGOs, financial institutions, etc.
- Local: Community-based organizations, gram panchayats, village-level committees
- Beneficiaries: Can be divided based on the basis of social strata—type, class, caste
  - » Type: Households/ individuals groups (farmers, fisher-folk, forest-dependent communities, coastal communities (any other if applicable)
  - » Class: High, mid, low-income groups
  - » Caste: General categories, schedule casts (SCs)/ schedule tribes (STs)

The objective of interactions is to understand, co-produce information that then assists in the learning process of how the implementation is being carried out.

- **Mode of engagement**

The mode of engagement would primarily vary according to the type of stakeholder being taken into consideration and the type of information that needs to extracted. For instance, key person interviews and one-to-one interactions are normally done for establishing interactions with various institutions to garner information on the nature of the intervention, roles, and responsibilities in implementation and understanding the barriers and bridges for implementation. Community interactions are also conducted to understand their perspectives on the nature of impact and the interventions being carried out or proposed. Group discussions, focus group discussions, and surveys are common modes of engagement and collation of information from the beneficiaries.

2. Description of Sub-national Action on Adaptation in the State of Telangana, India

2.1 Geography and Climate of Study area

Telangana is the 29th state of India, which came into existence in 2014. It is situated on the Deccan Plateau and shares its border with Andhra Pradesh, Maharashtra, Karnataka, and Chhattisgarh. Telangana is the 12th largest state in terms of its geographical area and population size. Hyderabad is the largest city as well as the state capital. The state has 10 districts with 459 administrative sub-units below the district administration with 1034 revenue villages.

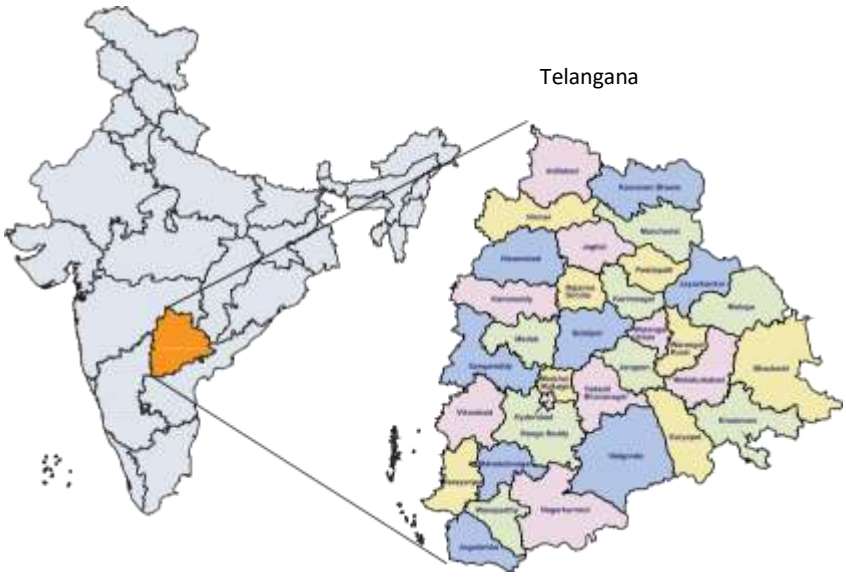

Figure 1 Study state of Telangana

The state is located between 15° 46' and 19° 47'N latitude and 77° 16' and 81° 43'E longitude. The state is predominantly semi-arid and has a hot-dry climate. There are huge differences in the summer-winter temperatures with minimum temperatures in the state shows a marked decline after October. In the month of May, the mean maximum temperature varies from 40-43°C and the minimum temperature ranges in 13-17°C in December and January. The agriculture systems in the state are highly dependent on rainfall where the annual rainfall has been estimated at 906 mm, predominantly received from the south-west monsoon.

In terms of agro-climatic zones, Telangana is categorized into four zones on the basis of rainfall, soil type, and climate characteristics. With the advent of climate change rainfall variability is a key concern for agriculture in the state. Dry spells as a result of persistent heat waves also affects crop productivity in the state.[1] The increasing temperatures and the variability in rainfall result in drought-like conditions in the state. The drought-prone districts of the state include Rangareddy, Mahabubnagar, and Nalgonda.

2.2 Demographic Overview

The state is home to a population of 35,003,674. The sex ratio of the state is 988 females per 1000 males. The decadal growth rate of population stands at 13.58% with a density of 312 people per km^2. A snapshot of the demographic details is presented in Table 1.

Table 1 Telangana state's demographic characteristics

Item	Unit	State
Population	Lakh	350.04
Males	Lakh	176.12
Females	Lakh	173.92
Decadal growth rate	Rate	13.58
Density of Population	Per km2	312
Sex ratio	Ratio	988
Rural population	Lakh	213.95
Urban population	Lakh	136.09
Literacy rate	Rate	66.54

2.3 Socio-economic Characteristics

Despite the economic challenges posed by the pandemic, the state of Telangana has managed to have a positive Gross State Domestic Product (GSDP) of 2.2% at current prices in 2020-21. The agriculture and allied sectors in the economy performed well during the pandemic years and achieved a robust growth in current price gross value added of 12.24% and 9.09% in 2020-21 and 2021-22, respectively. The reasons outlined for this growth include

[1] Agriculture | EPTRI, 2022

domestic state policies such as Rythu Bandhu which is a farmer investment support scheme provides a grant of Rs 5000 per acre per as assistance for purchase of inputs such as seeds, fertilizers, pesticides, labour and other investments twice a year, during the Rabi and Kharif seasons.[2]

In the state industrial sector, a decline in GVA of -1.73% was reported in 2020-21, however the sector grew at 20.23% in the year 2021-22. Lastly, the service sector in the state registered a growth at a rate of 0.9% in 2020-21 and 18.32% in 2021-22.[3]

In addition to economic indicators, human development is considered an important measure of a state's performance. Figure 2 depicts human development index (HDI) across the districts in Telangana over 2004-05 and 20011-12. As shown in Figure 2, the top districts in both the time periods included Hyderabad, Rangareddy, Warangal, and Karimnagar.

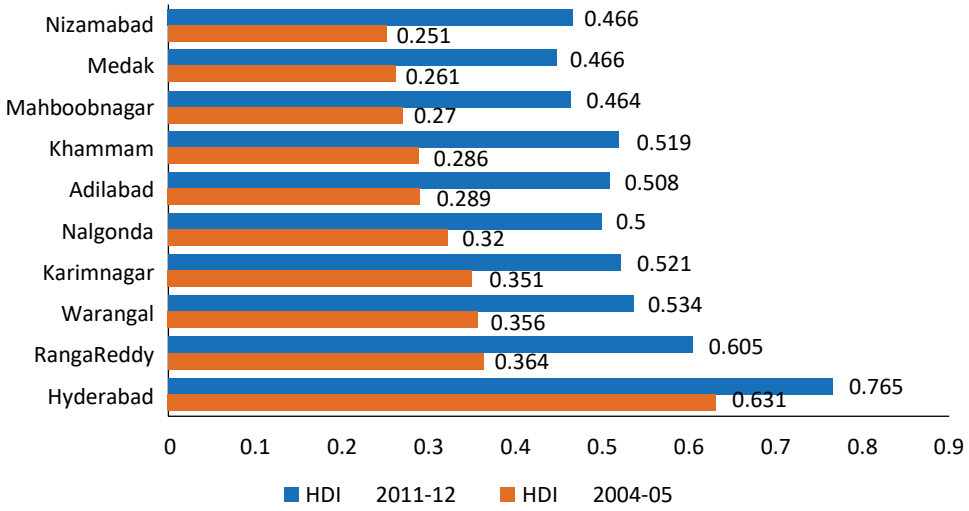

Figure 2 HDI across districts in Telangana 2004-5 and 2011-12[4]

2.4 Natural Resources

The state is endowed with roughly 20% of the country's coal deposits. The Singareni Collieries Company Limited (SSCL) utilizes the state's coal reserves for thermal power generation and the state's industrial requirements. The state is also rich in mineral resources such as limestone, bauxite, and mica.

The state has less than 25% of its geographical area under forests. Majority of this forest area comprise reserved forests while the remaining are protected forests. The predominant forest types include tropical moist deciduous, tropical dry deciduous, littoral and swamp, tropical thorn and dry evergreen.

[2] Planning Department, Government of Telangana, 2022

[3] Ibid.

[5] Telangana State Action Plan on Climate Change, 2017

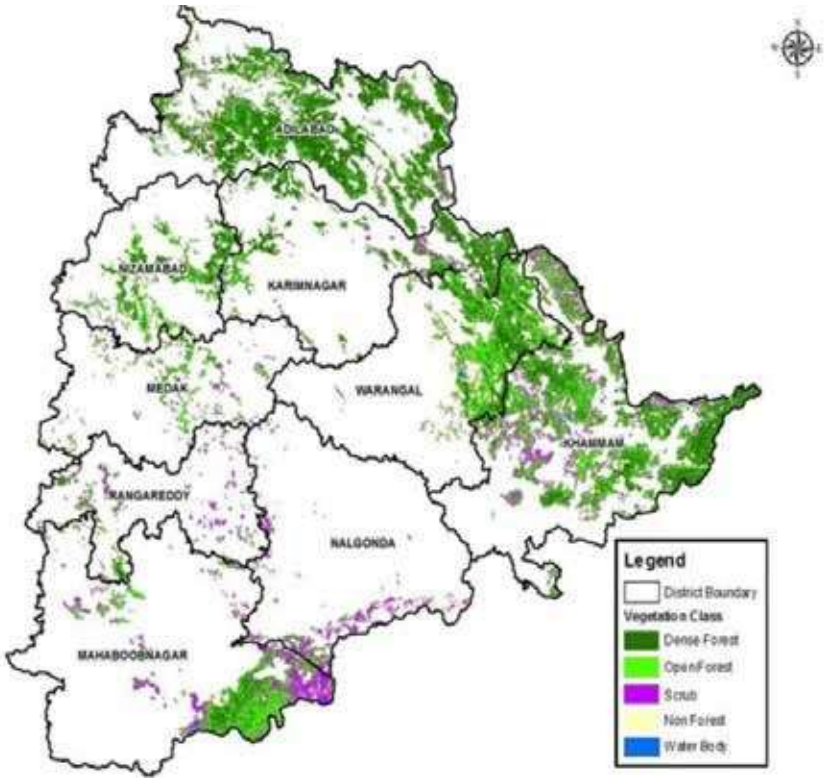

Figure 3 Geographical distribution of forests in Telangana[5]

Two major catchments—the Krishna and The Godavari—feed the State. However, since the state lies in the downstream stretch the availability of water resources is limited and therefore many areas are rain-fed.

3. Climate Change Risks and Impacts in Telangana

Climate projections for India suggest that impacts are likely to be varied and heterogeneous, with some regions experiencing more intense rainfall and flood risks, while others encountering sparser rainfall and prolonged droughts including spatial shift in the pattern of rainfall. A snapshot of the observed and projected changes in the climate has been conducted by Kadiyala *et al.*, 2020 and presented here. The impacts are grouped into observed and anticipated climate and extreme weather events.

[5] Ibid.

3.1 Observed and Anticipated Climate of Telangana

Parameter	Observed	Anticipated (for 4 climate scenarios -cool wet, cool dry, hot wet and hot dry)
Surface temperature	Maximum temperature observed in the state was 33.7°C and minimum temperature was 22.1°C	All the four scenarios of future change considered predict a positive increase in temperature over all districts by mid-century. For the four climate scenarios, climate scenarios of maximum and minimum temperatures features an increment of up to 2.5°C and 3.2°C during the mid-century.
Rainfall and rainy days	The average annual rainfall received over Telangana state in the period 1980-2009 is 955 mm	Future climate projections for mid-century period for Telangana indicate wide variation in annual rainfall. The future projected changes in annual rainfall over the Telangana state exhibited reduction in annual rainfall from – 11.1 to + 64.4% during the near-term and 0 to 67.1% increase during mid-century. There is a projected increase in rainfall across the state in all scenarios except hot-dry scenario.
Monsoon rainfall	The state of Telangana receives 758 mm of rainfall under the south-west monsoon.	Monsoon rainfall is also expected to vary widely under future climate projections during both near- and mid-century time slices. Rainfall in Telangana is projected to increase 1.8 to 64.5% during mid-century. Except hot-dry scenario, all other scenarios project an increase in rainfall over Telangana.

3.2 Extreme Weather Events: observed and anticipated

Parameter	Observed	Anticipated (for four climate scenarios—cool wet, cool dry, hot wet, and hot dry)
High rainfall events	A historical analysis of rainfall over Telangana exhibited an average of 1 to 3 heavy rainfall events (based on 30 years of observed data) annually and particularly during south-west monsoon season.	Hot-wet scenario shows highest increase in high-rainfall events
Heat wave	Historical data shows that the region experiences an average of 3 to 12 heat wave events annually.	Future climate projections indicate an increase in the number of heat wave days. In mid-century, a minimum of 11 to a maximum of 35 heat wave events have been projected.
Severe heat wave	The observed data of severe heat waves over Telangana state displayed an average of 1 to 3 events annually.	In mid-century, a minimum of 3 to a maximum of 23 severe heat wave events were projected across districts in Telangana
Consecutive dry days	A minimum of 8 to a maximum of 11 consecutive dry days annually were observed across Telangana in the last 3 decades.	Future climate projections indicate negligible or no change in the dry day's length in early and mid-century periods.
Long dry spells	All districts of Telangana state have witnessed long dry spells in the past 30 years, with about 2 to 6 events annually.	Future projections infer nearly similar number of events would occur in mid-century.
Consecutive wet days	During monsoon period, the districts of Telangana experiences 10 to 21 consecutive wet days per year.	Future projections for the mid-century indicate an increase in the number of consecutive wet days. Overall, 8 to 37 consecutive wet events during mid-century were projected

In terms of temperatures, future projections for both the maximum and minimum temperatures predict a positive increase in all districts in both near and mid-century. Rainfall projections for the state exhibited reduction in annual rainfall from − 11.1 to + 64.4% during the near-term and 0 to 67.1% increase during mid-century. Rainfall projections in all scenarios except hot-dry scenario, project an increase in rainfall across the state.

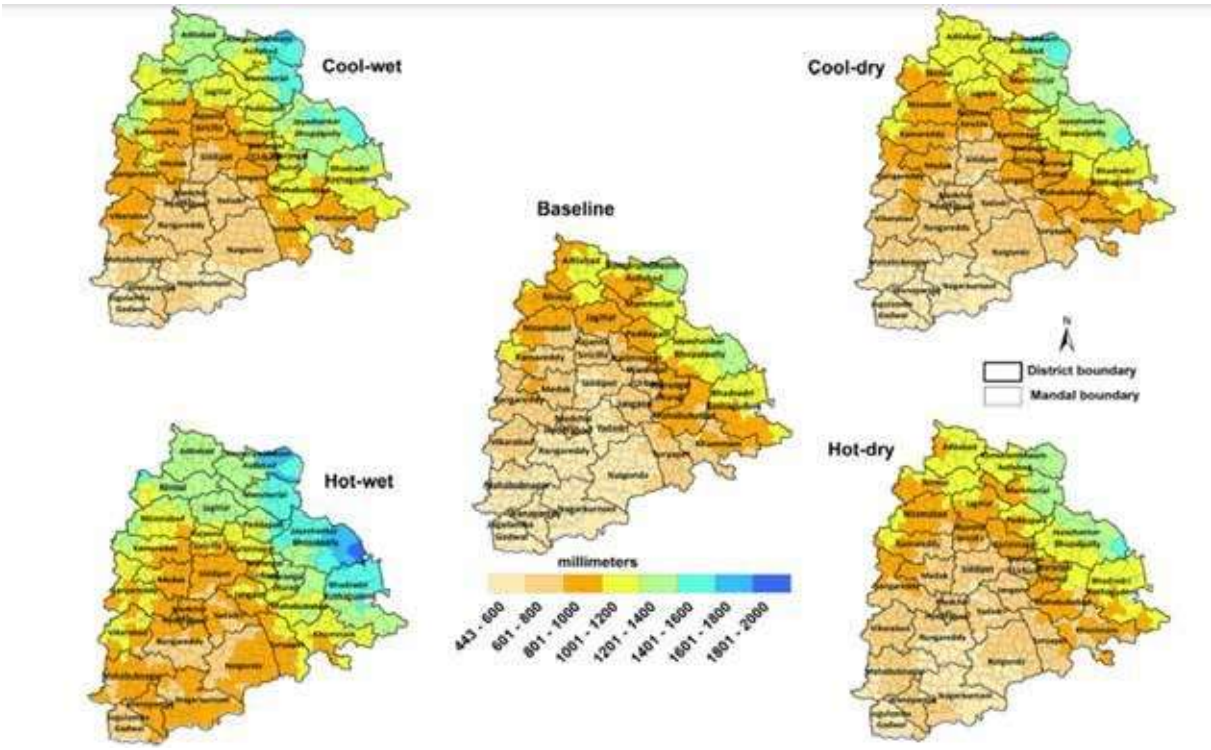

Figure 4 Spatial distribution of annual rainfall over Telangana in baseline and future climate change scenarios in during mid-century period (RCP 8.5)[8]

The state of Telangana is home to a population predominantly dependent on agriculture. More than half[6] of the state's population derives its income from agriculture and allied sectors. As mentioned in Section 2.1 (Geography and Climate of the Study Area), the state has hot and dry climate, with extremely hot summers and milder winters. The mean maximum temperature, in the month of May, varies from 40°C to 43°C and the minimum temperature ranges from 13°C to 17°C in the winter months of December and January. The agriculture systems in the state are highly dependent on rainfall where the annual rainfall has been estimated at 906 mm, predominantly received from the south-west monsoon. The dominant soil types in the state are chalkas, red sandy soils, dubbas, deep red loamy, and very deep black cotton soils that are suitable for planting mangoes, oranges, and flowers. Around 48% of the state's area is covered by red soils. The other soil types include black cotton soils, alluvial, rocks, and boulders. In terms of nutrients, soils in Nizambad, Warangal, and Nalgonda have indicated nitrogen deficiency. Likewise, phosphorus deficiency has been reported in the districts of Adilabad, Medak, Mahabubnagar, and Nizambad.

[6] Agriculture | EPTRI, 2022

Traditional crops of the state include rice, maize, jowar, redgram, and green gram. In terms of horticulture crops, the state is the largest producer of turmeric and the third-largest producer of fruits. Major fruits and vegetables grown in the state are mango, citrus, banana, guava, and papaya, tomato, brinjal, okra, and various varieties of gourds chillies. Lastly, coconut, cashew, and oil palm constitute major plantation crops. Cropping intensity is considered as a good measure of the productivity of land and indicates the number of crops from the same field during one agricultural year. Cropping intensity of the state was found to be roughly 1.27 in 2013–14. The lowest cropping intensity was reported in the district of Adilabad (1.09) and highest in Nizambad district (1.67). Similarly, the state has a large livestock population, supporting roughly 29 lakh families.

There is adequate evidence linking the impacts of climate change on agriculture and allied sectors. These developments in the state along with climate projections indicate a need to align agriculture policy and planning with the current and projected changes in the climate system. Periodic vulnerability assessments would help in identification of locations and crops requiring adaptation support. Being a predominantly agricultural state with a high proportion of small holder farmers, such assessments and analysis are crucial and would better inform targeted adaptation interventions in the agriculture sector.[7]

4. Adaptation Interventions in Telangana under Various Initiatives

The report has identified three interventions in the state of Telangana which address climate risks to the agriculture sector. A brief description of each initiative is provided below:

- **Rain-fed Area Development Programme (RADP):** The RADP under the National Mission on Sustainable Agriculture (NMSA), is a sub-section of eight national missions declared by the Government of India under the National Action Plan for Climate Change (NAPCC) in 2008. The NMSA was initiated to ensure sustainability in the agriculture sector, through emphasis on natural resource conservation. Within NMSA, the component on RADP includes a range of measures for integrated farm development, value addition, and farm development activities. Since, agriculture in the state of Telangana is heavily dependent on rainfall, a thorough understanding of the on- ground implementation of the RADP and its components was considered for development of the MEL framework.
- **Resilient Agricultural Households (RAH):** The RAH initiative is supported under the National Adaptation Fund on Climate Change (NAFCC). Although the funds under this initiative are being routed through the Centre, it is a state-driven initiative which identifies state priorities for action for adaptation on the ground. The project uses a bottom-up approach in understanding how the interventions are structured and being implemented with the engagement of a range of stakeholders including state and non-state entities.
- **National Initiative on Climate Resilient Agriculture (NICRA):** The third case NICRA, is a national initiative which aims to enhance resilience of Indian agriculture to climate change and climate vulnerability through research and technology demonstration. The research component of the project covers crops, livestock, fisheries and

[7] Kadiyala, et al., 2020

natural resource management. The project consists of four components, namely, strategic research, technology demonstration, capacity building and sponsored/competitive grants which are implemented through modules on natural resource management, livestock and fisheries, crop production and institutional interventions. Being a flagship programme of the Government of India focusing specifically on climate resilience in agriculture across the country, NICRA was selected to develop the MEL framework.

The agriculture sector of the state is dependent on monsoon rainfall which is increasingly variable. Agricultural production is further aggravated by increasing pressure of population, declining soil health and resource degradation. Through the above-mentioned programmes and initiatives, the aim is to embrace an integrated approach to promote crop diversification, soil health management, water resource management and capacity building of farmers to enhance climate resilience to agricultural communities.

4.1 Rain-fed Area Development Programme under the NMSA

4.1.1 Climate Context for the Rain-fed Area Development Programme

Rain-fed areas are uniquely positioned in terms of ecology, agricultural productivity, and livelihoods for majority of agricultural households in Telangana. Rain-fed agriculture is a complex, diverse, and risk-prone activity; with the potential for high crop losses and other adverse effects due to droughts, floods, and uneven rainfall patterns. A considerably high share of Telangana's farmlands (63%) are rain-fed; leading to severe impacts on the agriculture sector if corrective and adaptive measures are not undertaken in a changing climate. The problem of water shortage is further aggravated by the cultivation of water-intensive crops in the state; which is a further strain on the land as more than 54% of the land in the state has been classified as 'dry land'.

Owing to the dependence of agriculture on rainfall, changing rainfall patterns from climate change have an enormous impact on the agricultural productivity of the land and the livelihoods of the local farmers. Such changes can also lead to extreme weather events, such as droughts and floods. Both events have the potential to wipe out crops; leading to the exacerbation of poverty and food shortage in the local communities. Eventually, increased frequency of such events may even lead to further adverse impacts, such as the fallowing of productive agricultural land; leading to farmer migration.

4.1.2 Rain-fed Area Development Programme

Rain-fed Area Development Programme is one of the key mission interventions under the NMSA that was launched in 2011-12 as a sub-scheme under the Rashtriya Krishi Vikas Yojana (RKVY)[8] initiative of the Government of India. It aims at improving the quality of life of farmers', particularly the small and marginal farmers by facilitating access to a set of activities to maximize the farm returns for augmenting their food and livelihood security.[9] The RAD component involves watershed development and soil conservation activities/interventions and

[8] The RKVY Scheme was introduced in 2007, for development in the agriculture and allied sectors. The scheme allows flexibility to the state to choose activities as per the state requirements, priorities and agro-climatic conditions.

[9] Department of Agriculture and Farmers' Welfare, n.d.

includes convergence with activities in other schemes including MGNREGS, NWDPRA, RVP&FPR, RKVY, IWMP, etc. These agricultural practices will span across agriculture and allied sectors including horticulture, livestock, fishery, forestry with agro-based income-generating activities and value addition. This programme spans across all the states and union territories of India, covering more than 700 districts and an area of about 99,236.23 hectares in the financial year 2018–19.[10] As per the data for the financial year 2018–19,there are 31 districts of Telangana under the umbrella of the RADP. These districts cover an area of about 4671 hectares with a total of 61 clusters in the respective districts.[11]

The Programme focuses on integrated farming systems (IFS) which include multi-cropping, rotational cropping, inter-cropping, mixed-cropping practices. In continuation it will also establish suitable farming systems mainly by assimilating several components of agriculture such as crops, horticulture, livestock, fishery, forestry with agro-based, income-generating activities that will aid in maximizing farm returns for sustaining livelihoods and also mitigate the impacts of extreme weather events. Additionally, it also proposes to consider soil testing/soil health cards for crop nutrition, farmland development, resource conservation and crop selection suitable for agro-climatic conditions. The objectives of the RADP are listed below:

1. Increasing agricultural productivity of rain-fed areas in a sustainable manner by adopting appropriate farming system-based approaches.
2. To minimize the adverse impact of possible crop failure due to drought, flood or un-even rainfall distribution through diversified and composite farming system.
3. Restoration of confidence in rain-fed agriculture by creating sustained employment opportunities through improved on-farm technologies and cultivation practices.
4. Enhancement of farmers' income and livelihood support for reduction of poverty in rain-fed areas.
5. Convergence of relevant developmental programmes in project area for optimal utilization of resources by establishing an integrated and coordinated system involving different sectors and institutions.

4.1.3 Governance Structure

Rain-fed Area Development is a centrally mandated programme under the Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India. The State Agriculture Department is the nodal agency for the implementation of RADP which will be in a project mode. As per the guidelines, a state-wise or district-wise RADP projects are to be drafted for approval by the state-level sanctioning committee. The Principal District Agriculture Officer/ Joint Director along with Agricultural Technology Management Agency (ATMA) are assigned the responsibility to ensure coordination in the project preparation and execution. State Agricultural Universities (SAUs), Indian Council of Agricultural Research (ICAR) centres, and other professional institutes/agencies are deployed in the project formulation and implementation which include tasks of development of model farming

[10] National Mission for Sustainable Agriculture, 2022

systems suitable to the agro-ecology of a district for demonstration purposes. The structure of the governance of the project formulation and implementation is tabulated below:

Governance structure	Entities
Funding agency	Ministry of Agriculture, Government of India
National executing entity	Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India
State executing entity	State Agriculture Department
State-level steering committee	State-level sanctioning committee
Project preparation and coordination	Principal District Agriculture Officer /Joint Director and Agriculture Technology Management Agency (ATMA)
Project formulation and implementation	State Agricultural Universities (SAUs), Indian Council of Agricultural Research (ICAR) centres Other professional institutes/agencies
Beneficiaries	General public, farming community

4.1.4 Description of the Project Components of the Adaptation Intervention

Output-based activities

- Promotion of integrated farming systems for diversification of livelihoods: horticulture, livestock, and fisheries
- Value adaptation and farm development creation: Construction of greenhouses and silo-pits, water harvesting structure, vermi-composting, and multiple natural resource conservation and management activities
- Capacity building and training of farmers for resilient agriculture practices in rain-fed areas

4.1.5 Qualitative estimates of the expected impact of the intervention

- Improvement in agricultural productivity in rain-fed areas
- Crop diversification
- Livelihood diversification
- Increase in farmers' incomes

Key stakeholders for the adaptation intervention: identification of stakeholders, roles, and responsibilities:

Stakeholder	Stakeholders' interest (low, medium, high)	Stakeholders' influence on intervention (low, medium, high)
Indian Council of Agricultural Research (ICAR)	High (ICAR is responsible for climate change-related monitoring, feedback, knowledge networking and skill development)	Low (ICAR plays a limited role in the actual on ground implementation of the interventions)
Ministry of Agriculture (MoA) (Department of Agriculture Research and Education)	High (The Department co-ordinates, guides and manages research and education as well implementation in agriculture and allied sectors in India)	Low (Conducts routine review of work being implemented in coordination with other stakeholders)
Agricultural Technology Management Agency (ATMA)	High (ATMA has been constituted mainly to address the constraints faced by extension systems	High (ATMA is responsible for technology demonstrations at district level and below in order to move towards an integrated extension delivery)
Department of Irrigation and CAD	High (Responsible for expansion of irrigation in water-scarce areas and strengthen existing irrigation networks)	High (Primary entity for introduction and implementation of new and improved irrigation practices in the state)
State (DoA)	High (The State DoA will be selecting schemes from the national portfolio and coordinating implementation at the sub-national level)	High (The State DoA is responsible routine review of on ground implementation of the interventions)
State Agricultural Universities (SAUs)	High (To conduct research on climate change as per the requirements of the state)	High (SAUs will be responsible for training activities as well pilots and demonstrations conducted with farmers)
Farmers	High (To receive benefits of schemes that intend to make them resilient to the existing and future climate stresses)	High (The planning and uptake of the program is heavily dependent on interest of farmers)

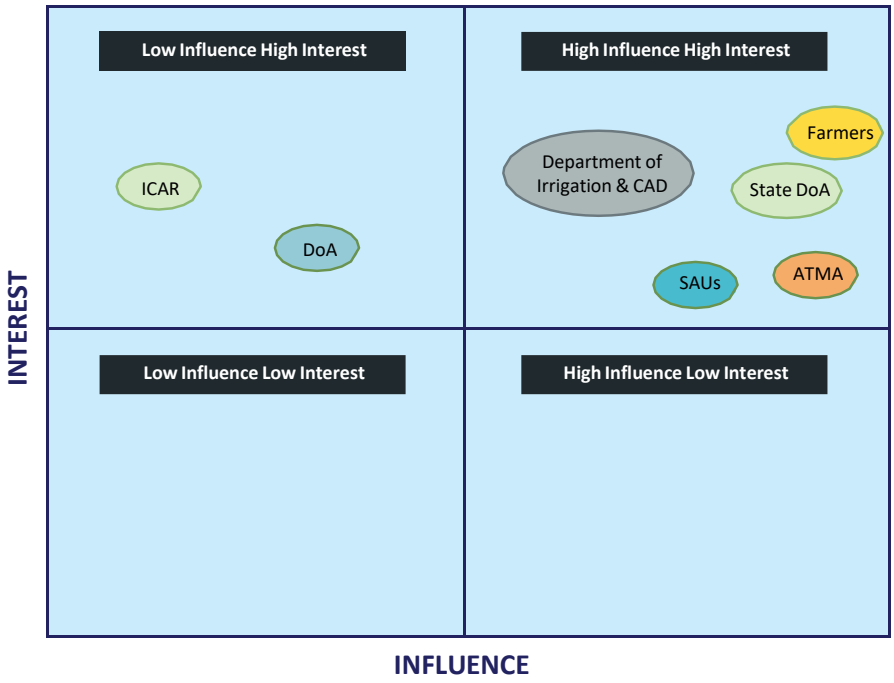

Figure 5 Stakeholders' interest and influence matrix for rain-fed area development

4.1.6 Stakeholder Analysis: relevance and impact

The primary beneficiaries of the project are the farmers. The implementation of the RAD, under the NMSA will depend on farmers' adoption of the interventions under RAD. Along with the farmers, stakeholders with high influence and high impact include the State Department of Agriculture, Department of Irrigation and CAD, State Agricultural Universities and the Agriculture Technology Management Agency (ATMA). On the contrary, stakeholders with low influence but high interest at stake are the national entities including the ICAR and the Department of Agriculture, Ministry of Agriculture and Farmers' Welfare.

4.1.7 Proposed Monitoring, Evaluation and Learning Framework for the Adaptation Intervention

Component 1: RAD aims at promoting integrated farming system (IFS) with emphasis on multi-cropping, rotational cropping, inter-cropping, mixed-cropping practices with allied activities such as horticulture, livestock, fishery, agroforestry, apiculture, conservation/promotion of non-timber forest products (NTFPs), etc. to enable farmers in maximizing returns from the farms and simultaneously minimize and mitigate impacts of extreme climate events.

Rain-fed Area Development Programme (under NMSA)			
Component 1: Promoting integrated farming system (IFS) emphasizing multi- cropping, inter-cropping and mixed cropping practices			
Climate risk	**Outcome 1**	**Outcome indicators**	**Unit of measurement**
Increase in surface temperatures, number of heat waves, variation in monsoon rainfall, variation in annual rainfall and number of rainy days	Increased returns from the farms through sustainable livelihood options which help in reducing the impacts of increase in temperature, drought and other extreme weather events	Percentage of land under multi-cropping to minimize livelihood risks from climate induced crop failure	Per cent
		Change in cropping intensity as a result of integrated farming practices	Per cent
		Crop diversification	Per cent
		Change in area under horticulture as a result of increased cultivation of horticulture crops	Per cent
		Number of farmers practising livestock rearing for livelihood diversification	Number
		Number of farmers practising fisheries to supplement incomes from agriculture to minimize climate risks	Number
		Change in agricultural yield and productivity due to adoption of diverse cropping practices	Per cent
	Output 1	**Output indicators**	**Unit of measurement**
	Promotion of integrated farming systems for diversification of livelihoods	Number of horticulture-based farming systems which have received assistance in each cluster	Number
		Number of diversified cropping systems which have received assistance in each cluster	Number
		Number of livestock-based farming systems which have received assistance in each cluster	Number

Rain-fed Area Development Programme (under NMSA)			
Component 1: Promoting integrated farming system (IFS) emphasizing multi- cropping, inter-cropping and mixed cropping practices			
		Number of fisheries-based farming systems which have received assistance in each cluster	Number
	Impact	**Impact indicators**	**Unit of measurement**
	Improved awareness and uptake of integrated farming practices among farmers to enhance preparedness to climate variability under RAD	Per cent of farmers/households aware of Integrated Farming System approach under RAD	Per cent
		Per cent of farmers/households adopting integrated farming system practices under RAD	Per cent
		Change in agricultural productivity in cluster areas due to adoption of diverse cropping practices	Per cent
		Change in farm income due to diversification of livelihoods to livestock farming and fisheries	Per cent

Component 2: RAD also includes overall farm development activities which are location- specific, for example, resource conservation, rainwater harvesting structures, development of river valley projects and improving last-mile connectivity for farmers. Other interventions within this would include setting up of farmers' producer companies/organizations which may engage in growing organic crops, reclamation of problem soils.

Farmland development through location-specific interventions, for example, resource conservation, rainwater harvesting, land development in river valley project and flood-prone river areas, last-mile connectivity, etc. Farmers' companies, farmers' producer companies/organizations, registered farmers' societies, farmers' cooperatives would also be eligible for developing a cluster.

Component 2: Encouraging value addition and farm development activities			
Climate risk	**Outcome 2**	**Outcome indicators**	**Unit of measurement**
Increase in surface temperatures, number of heat waves, variation in monsoon rainfall, variation in annual rainfall and number of rainy days	Enhancing climate adaptation through value adaptation and farm development	1. Change in farm income due to uptake of apiculture	Per cent
		2. Change in availability of green fodder and improvement in livestock production as a result of farm development	Per cent
		3. Change in crop production due to increase in number of greenhouse structures	Per cent
		4. (a) Change in groundwater table due to soil and water conservation measures	Per cent
		(b) Change in area under irrigation due to uptake of water conservation measures	Per cent
		(c) Change in availability of water for agricultural water use as a result of increase in number of water harvesting structures	Per cent
		5. Change in land area under NRM conservation through in-situ moisture conservation, vegetative nitrogen fixing, crop protection, contour bunding, gully and control bunds and spill ways	Per cent
		6. (a) Change in production of vermi-compost through increase in number of vermi-composting pits to enhance soil fertility from production of organic manure	Per cent

Component 2: Encouraging value addition and farm development activities			
Climate risk	**Outcome 2**	**Outcome indicators**	**Unit of measurement**
		(b) Change in production of organic input and green manure for improved soil nutrition	Per cent
		7. Change in post-harvest and storage/value addition of NTFP addressing perishables	Per cent
		8. Change in quantity of processed and packaged food by food processing units addressing perishables	Per cent
		9. Number of farmer producer organizations functional with better access agricultural support infrastructure and facilities to produce better quality seeds	Number
		10. (a) Area under soil treatment	km2
		(b) Area of fallow/wasteland reclaimed which can be used for agriculture	km2
		11. Number of farmers aware of integrated farming, climate change adaptation, good agriculture practices on soil, water and crop management which can help in reducing risks during droughts and floods	Number
	Outputs	**Output indicators**	**Unit of measurement**
	1. Uptake of Apiculture activity - livelihood diversification	Number of bee-keeping units per farm	Number
		Increase in supplementary farm income from bee keeping	Per cent

Component 2: Encouraging value addition and farm development activities			
Climate risk	**Outcome 2**	**Outcome indicators**	**Unit of measurement**
	2. Silo pits	Number of silo pits constructed of 2100-2500 cubic feet with brick and cement mortar; either below ground or above for increased availability of green fodder around the year	Number
	3. Construction of greenhouses - use of technology for enhancing production	Number of greenhouses constructed (including naturally ventilated tubular structure; naturally ventilated wooden structure; plastic tunnels) which can act as nurseries for temperature sensitive crops	Number
	4. Construction of water harvesting structures to support irrigation	Number of water harvesting structures constructed (including the ponds/ dug-wells and tanks) for individuals which increase agriculture water availability	Number
		Lining of existing tanks/ponds to enhance storage of water	Number
		Number of water harvesting structures constructed (including the ponds/ dug wells and tanks) for communities to ensure improvements in water availability	Number
		Number of shallow/medium tube wells and bore wells constructed for improving farm water access	Number
		Number of small tanks restored/ rejuvenated to meet farm water requirements during water scarce periods	Number
		Number of defunct bore wells recharged for improving ground water access	Number

Component 2: Encouraging value addition and farm development activities			
Climate risk	**Outcome 2**	**Outcome indicators**	**Unit of measurement**
		Number of pipe/pre-cast distribution systems installed to optimize irrigation practices	Number
		Number of water-lifting devices installed for farm irrigation	Number
		Number of community tube well(s) /water sources electrically connected for providing access of water to agricultural households and farms	Number
	5. Enhanced resource conservation	Per cent of land under practices for in-situ moisture conservation (land levelling, field bunding, mulching, broad bed and furrow system, ridge and furrow method, saucer basins/ semi-circular bunds, compartmental bunding, tied ridges)	Per cent
		Per cent area under vegetative nitrogen fixing hedge for improved soil nutrition	Per cent
		Per cent area under crop protection such as mixed use protective fencing and critical barriers to avoid crop losses due to pest and animal attacks	Per cent
		Per cent area under soil and water conservation by employing contour / graded / staggered bunding / trenching/ bench terracing /zing terracing/ gully and control bunds to reduce soil erosion	Per cent
		Number. of spill ways constructed (including drop, chute, spur, retaining wall) for safe discharge of excess water or flood water	Number

Component 2: Encouraging value addition and farm development activities			
Climate risk	**Outcome 2**	**Outcome indicators**	**Unit of measurement**
	6. Production of vermi-compost and organic inputs	Number of units for vermi-composting for organic farm waste management	Number
		Number of organic input and green manure production units	Number
	7. Post-harvest and storage/value addition of NTFP	Number of small village-level storage/ packaging/processing units for value addition to farm products for better economic returns	Number
	8. Formation and strengthening of farmer producers organizations for better seed development to improve on seed production and use	Number of farmer producers organizations constituted	Number
		Number of farmer producers organizations trained	Number
	9. Reclamation of problem soil	Per cent of area under alkali/saline soil treated for improved soil health	Per cent
		Per cent of area under acid soil treated for improvements in soil health	Per cent
	10. Training and capacity building	Number of training and capacity building programmes conducted for awareness on climate change adaptation	Number
		Number of demonstrations conducted for hands on experience and capacity building on climate resilience	Number
		Number of field visits conducted for awareness and exposure	Number

Component 2: Encouraging value addition and farm development activities			
Climate risk	**Outcome 2**	**Outcome indicators**	**Unit of measurement**
	11. Post-harvest market linkages to reduce food loss and enhance livelihoods	Number of farmers and agro processing units with market linkages in a cluster	Number
	Impact	**Impact indicators**	**Unit of measurement**
	Natural resource management through soil and water management techniques and infrastructure development	Change in agricultural productivity in cluster areas as a result of improved availability of water, improved soil health and resource conservation	Per cent
		Increase in incomes as a result of sustainable livelihood practices	Per cent
		Overall development of farms in each cluster (to cover water harvesting structures, organic and vermin-composting units, greenhouse units, etc.)	Descriptive/ checklist

Table 2 is a compilation of the MEL Framework covering all components of the adaptation intervention.

Table 2 Compilation of the MEL Framework covering all components of the adaptation intervention

Climate risk	Project components	Output	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
Increase in surface temperatures, heat waves, variation in monsoon rainfall, variation in annual rainfall and number of rainy days	Component 1: Promoting integrated farming system emphasizing multi-cropping, inter-cropping and mixed cropping practices	Promotion of integrated farming systems for diversification of livelihoods	Number of Horticulture based farming systems which have received assistance in each cluster	Increased returns from the farms through sustainable livelihood options which help in reducing the impacts of increase in temperature, drought and other extreme weather events	Per cent of land under multi-cropping to minimize livelihood risks from climate induced crop failure	Improved awareness and uptake of integrated farming practises among farmers to enhance preparedness to climate variability under RAD	Per cent of farmers/ households aware of integrated farming system approach under RAD
			Number of diversified cropping systems which have received assistance in each cluster		Change in cropping intensity as a result of integrated farming practices		
			Number of livestock based farming systems which have received assistance in each cluster		Change in area under horticulture as a result of increase cultivation of horticulture crops		Per cent of farmers/ households adopting integrated farming system practices under RAD
			Number of fisheries-based farming systems which have received assistance in each cluster		Change in area under silvi-pasture to support livestock activities		Change in agricultural productivity in cluster areas due to adoption of diverse cropping practices

Table 2 Compilation of the MEL Framework covering all components of the adaptation intervention							
Climate risk	**Project components**	**Output**	**Output indicators**	**Outcomes**	**Outcome indicators**	**Impact**	**Impact indicators**
					Number of farmers practising livestock rearing for livelihood diversification		
					Number of farmers practising fisheries to supplement incomes from agriculture to minimize climate risks		Change in farm income due to diversification of livelihoods to livestock farming and fisheries
					Change in agricultural yield and productivity due to adoption of diverse cropping practices		
Increase in surface temperatures, heat waves, variation in monsoon rainfall, variation in annual rainfall and number of rainy days	Component 2: Encouraging value addition and farm development activities	Uptake of apiculture activity	Number of bee-keeping units per farm; increase in supplementary farm income from bee- keeping	Enhancing climate adaptation through value adaptation and farm development	Change in farm income due to uptake of apiculture	Natural resource management through soil and water management techniques and infrastructure development	Change in agricultural productivity in cluster areas as a result of improved availability of water, improved soil health and resource conservation

Table 2 Compilation of the MEL Framework covering all components of the adaptation intervention

Climate risk	Project components	Output	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
							Increase in incomes as a result of sustainable livelihood practices
							Overall development of farms in each cluster (to cover water harvesting structures, organic and vermin-composting units, greenhouse units, etc.)
		Silage making	Number of silo pits constructed of 2100–2500 cubic feet with brick and cement mortar; either below ground or above for increased availability of green fodder around the year		Change in availability of green fodder and improvement in livestock production as a result of farm development		

Table 2 Compilation of the MEL Framework covering all components of the adaptation intervention							
Climate risk	**Project components**	**Output**	**Output indicators**	**Outcomes**	**Outcome indicators**	**Impact**	**Impact indicators**
		Construction of greenhouses	Number of greenhouses constructed (including naturally ventilated tubular structure; naturally ventilated wooden structure; plastic tunnels) which can act as nurseries for temperature sensitive crops		Change in crop production due to increase in number of greenhouse structures		
		Construction of water harvesting structures	Number of water harvesting structures constructed (including the ponds/ dug-wells and tanks) for individuals which increase agriculture water availability		(a) Change in groundwater table due soil and water conservation measures		
			Lining of existing tanks/ponds to enhance storage of water				

Table 2 Compilation of the MEL Framework covering all components of the adaptation intervention

Climate risk	Project components	Output	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
			Number of water harvesting structures constructed (including the ponds/ dug wells and tanks) for communities to ensure improvements in water availability				
			Number of shallow/medium tube wells and bore wells constructed for improving farm water access				
			Number of small tanks restored/ rejuvenated to meet farm water requirements during water scarce periods				
			Number of defunct bore wells recharged for improving ground water access				

Table 2 Compilation of the MEL Framework covering all components of the adaptation intervention							
Climate risk	**Project components**	**Output**	**Output indicators**	**Outcomes**	**Outcome indicators**	**Impact**	**Impact indicators**
			Number of pipe/pre-cast distribution systems installed to optimize irrigation practices				
			Number of water-lifting devices installed for farm irrigation				
			Number of community tube well(s)/ water sources electrically connected for providing access of water to agricultural households and farms				

Table 2 Compilation of the MEL Framework covering all components of the adaptation intervention

Climate risk	Project components	Output	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
		Enhanced resource conservation	Per cent of land under practices for in-situ moisture conservation (land levelling, field bunding, mulching, broad bed and furrow system, ridge and furrow method, saucer basins/ semi-circular bunds, compartmental bunding, tied ridges)		(b) Change in area under irrigation due to uptake of water conservation measures		
			Per cent area under vegetative nitrogen fixing hedge for improved soil nutrition				
			Per cent area under crop protection such as mixed use protective fencing and critical barriers to avoid crop losses due to pest and animal attacks				

Table 2 Compilation of the MEL Framework covering all components of the adaptation intervention							
Climate risk	**Project components**	**Output**	**Output indicators**	**Outcomes**	**Outcome indicators**	**Impact**	**Impact indicators**
			Per cent area under soil and water conservation by employing contour / graded / staggered bunding / trenching/ Bench Terracing / Zing Terracing / gully and control bunds to reduce soil erosion				
			Number of spill ways constructed (including drop, chute, spur, retaining wall) for safe discharge of excess water or flood water				
		Production of vermi-compost and organic inputs	Number of units for vermi-composting for organic farm waste management		(c) Change in availability of water for agricultural water use as a result of increase in number of water harvesting structures		

Table 2 Compilation of the MEL Framework covering all components of the adaptation intervention

Climate risk	Project components	Output	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
			Number of organic input and green manure production units				
		Post-harvest and storage/ value addition of NTFP	Number of small village-level storage/ packaging/ processing units for value addition to farm products for better economic returns		Change in land area under NRM conservation through in-situ moisture conservation, vegetative nitrogen fixing, crop protection, contour bunding, gully and control bunds and spill ways		
		Formation and strengthening of farmer producers organizations	Number of farmer producers organizations constituted		(a) Change in production of vermi-compost through increase in number of vermi-composting pits		
			Number of farmer producers organizations trained				

Table 2 Compilation of the MEL Framework covering all components of the adaptation intervention							
Climate risk	**Project components**	**Output**	**Output indicators**	**Outcomes**	**Outcome indicators**	**Impact**	**Impact indicators**
		Reclamation of problem soil	Per cent of area under alkali/ saline soil treated for improved soil health		(b) Change in production of organic input and green manure for improved soil nutrition		
			Per cent of area under acid soil treated for improvements in soil health				
		Training and capacity building	Number of training and capacity building programmes conducted for awareness on climate change adaptation		Change in post-harvest and storage/value addition of NTFP		
			Number of demonstrations conducted for hands on experience and capacity building on climate resilience				
			Number of field visits conducted for awareness and exposure				

Table 2 Compilation of the MEL Framework covering all components of the adaptation intervention

Climate risk	Project components	Output	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
		Post-harvest market linkages	Number of farmers and agro-processing units with market linkages in a cluster		Change in quantity of processed and packaged food by food processing units		
					Number of farmer producer organizations functional with better access agricultural support infrastructure and facilities		
					Area under soil treatment		
					Area of fallow/ wasteland reclaimed which can be used for agriculture		
					Number of farmers aware of integrated farming, climate change adaptation, good agriculture practices on soil, water and crop management which can help in reducing risks during droughts and floods		

4.2 Resilient Agricultural Households

4.2.1 Climate Context for Resilient Agricultural Households

The climate resilient agricultural households project was planned for Mahabubnagar district. The district is bound by Rangareddy district in the North, Nalgonda, and Guntur districts in the east, the River Krishna/Tungabhadra in the south, Raichur, and Gulbarga districts of Karnataka state in the west. The district falls in the rain shadow region and is classified as a drought-prone district. The average rainfall received has been estimated at 651 mm, most of which is received from June to September. Climate data analysis of historical patterns of rainfall indicated a declining trend of dependable rainfall for the months of June, July, and September. Additionally, rainfall trend in the district has been declining since the 1990s, thereby threatening the livelihoods of farmers in the district. With declining rainfall patterns, dependence on groundwater resources has increased, leading to depletion of groundwater resources.

Climate projections for the district indicate a warming trend with increases in both maximum and minimum temperature thresholds. Majority of the models under CMIP5 highlights an increase in rainfall received in the district in the monsoon months. An increase in evenly distributed rainfall may have a positive impact on crop yields, since the district is often categorized as drought prone.

Prominent crops grown in the district include paddy, jowar, ragi, bajra, vegetables, pulse (redgram, greengram) and millets. Commercial groups of Mahabubnagar include groundnut, castor, and sugar cane. The district also grows horticulture crops such as mango, sweet orange, acid lime, guava, sapota, and papaya. The district reports among the lowest cropping intensities in the district, estimated at 1.11%. The groundwater deposits, which are meeting the major agricultural water demands are declining and need to be restored for better surface and groundwater management in the district. This would involve restoration and rejuvenation of tanks, leading to an improvement in the irrigation potential in the region.

4.2.2 Resilient Agricultural Households Project

The Resilient Agricultural Households through Adaptation to Climate Change is a four-year project initiated in 2016 by the Environment, Protection, Training and Research Institute in association with Department of Agriculture, Professor Jayashankar, Telangana State, Agricultural University NABARD and ICRISAT under National Adaptation Fund for Climate Change, Ministry of Finance (MoF). The overall objective of the project is to enhance livelihoods of the farming communities based in the Mahabubnagar district of Telangana by making agriculture more resilient to climate change. During the preparation of the Detailed Project Report the project targeted three clusters in the district of Mahabubnagar, namely, Jadcherla, Bijinapally, and Ghanpur. It is worth mentioning, after Telangana was formed as a separate geographic entity, the clusters of Jadcherla, Bijinapally, and Ghanpur were reorganized as a part of Nagarkurnool, Mahabubnagar, and Wanaparthy districts, respectively.

The project has been implemented in 3 clusters of the district, which include 15 villages (5 villages per cluster). Villages selected under the project lack adequate infrastructure for water harvesting/ water storage for agriculture water use, leading to poor crop productivity and substitution of local adaptive crops with commercial crops. The most commonly found water structures used for agriculture include water tanks, as well as some farm ponds.

With the background given, the project objectives are appended below:

1. Promoting and implementing science-based suitable climate smart adaptation strategies such as developing farm ponds, promoting drought and heat-tolerant crop varieties, micro-irrigation, inter-cropping, etc. for resilience of agricultural households to climate variability and change.
2. Developing and implementing an information system for providing seasonal climate forecast and weather-based agro advisories for farmers.
3. Enhancing the capacities of stakeholders for implementing and sustaining the climate change adaptation strategies.
4. Improving the alternate livelihoods options such as livestock rearing, vermicomposting and value chain integration (for example, decentralized dal mill, millet processing unit), etc.
5. Mainstreaming adaptation strategies into policies and programmes through better knowledge management and sharing.

The objectives reflect a clear focus on enhancing climate resilience with scientific assessments in place including vulnerability analysis, ground-level consultations and assessments. As a result of the scientific approach, the project has received funds from the National Adaptation Fund on Climate Change (NAFCC). The outlined objectives offer climate adaptation strategies in combination with livelihood alternatives for which a subsidy of 75% has been extended to approximately 2000 vulnerable households. Key components of work under the project/programme are:

1. Finalizing household-level adaptation interventions (baseline households survey, finalization and communication of adaptation interventions for each target community and household).
2. Developing and implementing information system for 'seasonal climate forecast' and 'weather based agro advisories'.
3. Enhancing capacities of stakeholders for developing and implementing climate change adaptation strategies.
4. Implementation of the suitable portfolio of adaptation strategies to climate change in the target villages and farm households.
5. Knowledge management and mainstreaming adaptation strategies.

In terms of extending support to the communities and households, the project identifies scope of convergence and alignment with existing policies and programmes at the state and central levels. Some of the schemes and policies with linkages include Andhra Pradesh Drought Adaptation Initiative (APDAI), Andhra Pradesh Farmer Managed Groundwater Systems Project (APFAMGS), Integrated Watershed Management Program (IWMP), Telangana.

4.2.3 Governance Structure

Governance Structure	Entities
Funding agency	National Bank for Agriculture and Rural Development (NABARD)
Implementing entity (state level)	Environment Protection, Training and Research Institute (EPTRI)
Technical support	ICRISAT
Implementing entity (local level)	1. Department of Agriculture (DoA), Telangana: works with beneficiaries at the village and household levels 2. Professor Jayashankar Telangana State Agricultural University (PJTSAU: building capacities of line departments and farmer communities
Beneficiaries	General public farming community

4.2.4 Description of the Project Components of the Adaptation Intervention

Quantitative and qualitative estimate of the expected impact of the adaptation intervention.

The following impacts are likely to be achieved through the intervention:

Quantitative	Qualitative
Enhance climate resilience of more than 2000 most climate vulnerable households	Understanding of climate risks and vulnerabilities in Mahabubnagar district Designing targeted adaptation strategies for the project households Training and capacity building of households covered under the project Promotion of soil and moisture conservation Promotion of water harvesting Improvement in agricultural yields
Build capacities to manage climate risks by conducting training programmes for 1000 men and women farmers	
Bring about 400 hectares of land under soil and moisture conservation work	
Increase the household-level income through a targeted increase of 10% in agricultural yield	

Key stakeholders for the adaptation intervention: identification of stakeholders, roles, and responsibilities:

Stakeholder	Stakeholder interest (low, medium, high)	Stakeholder influence on intervention (low, medium, high)
NABARD	High (Objective of the entity is to increase channelization of NAFCC funds towards adaptation oriented projects)	Low (Regulates fund disbursement for project implementation)
EPTRI	High (Provide training, and research services in the area of environment and sustainable development)	Medium (borderline) (To oversee both fund management and technical execution under RAH in consultation with other stakeholders)
DoA	High (Responsible for introducing schemes that promote welfare of farmers)	High (Provides technical inputs in the planning phase as they directly implement RAH)
ICRISAT	High (Research organization that aims towards contributing towards research and implementation of projects that cater to crop studies in semi-arid regions)	Low (Provides inputs regarding progress of RAH and hurdles faced during the process)
PJTSAU	High (To provide agriculture training and research services for empowering farmers)	High (Responsible for conducting capacity building activities and providing technological inputs that are crucial for RAH implementation)
Farmers	High (To receive benefits of schemes that intend to make them resilient to the existing and future climate stresses)	High (The planning and uptake of the programme is heavily dependent on interest of farmers)

4.2.5 Stakeholder Analysis: relevance and impact

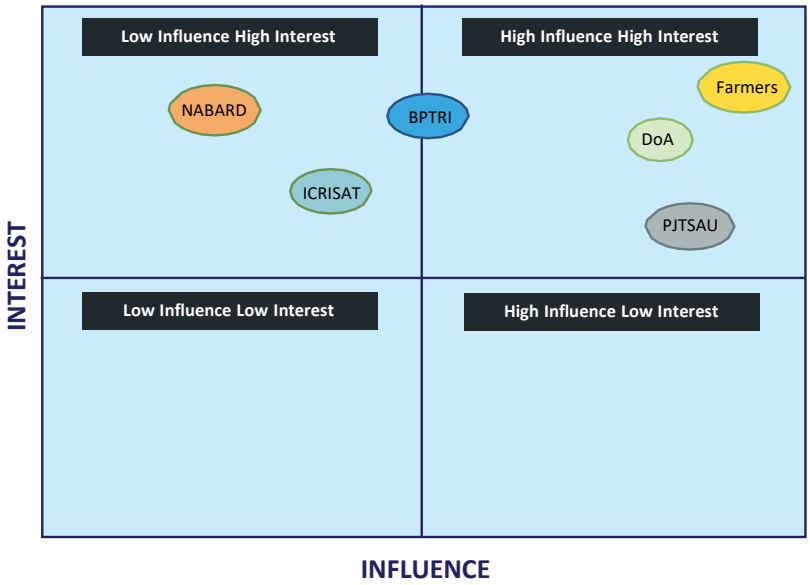

Figure 6 Stakeholders' interest and influence matrix for RAH

The primary beneficiaries of this project are the farmers. The actual uptake of the schemes is contingent upon the farmers, it is the farmers who enrol in schemes that would help in enhancing their resilience to climate their interest

The influence-impact matrix helps understand which stakeholders have the maximum influence and the impact that they can make towards the success of the project. Influence indicates the stakeholders' level of involvement in the project and impact indicates their ability to bring about the desired change. If a stakeholder in the high influence and high impact quadrant does not perform optimally, it will affect the overall implementation and progress of the project. Whereas the performance of the stakeholders with low influence and low impact does not have a significant effect on the implementation and progress of the project.

4.2.6 Proposed Monitoring, Evaluation and Learning Framework for the Adaptation Intervention

Component 1: Understanding household-level adaptation interventions (baseline households survey, finalization, and communication of adaptation interventions for each target community and household)

This component was aimed at improving the understanding of the stakeholders in order to identify specific vulnerabilities and implement adaptation interventions. This was done conducting baseline surveys which covered household's socio-economic characteristics, climate change perceptions, and traditional coping and adaptation strategies, current adaptation mechanisms to climate variability and change. The results of the activities of this component were then planned to be discussed in a workshop with all stakeholders for validation.

Since, the actual design and implementation of interventions commences from Component 2, the indicators for implementation have been designed Component 2 onwards, which are largely based on the information gathered under Component 1.

Component 2: Developing and implementing information system for 'seasonal climate forecast' and 'weather-based agro advisories'

An information system for 'weather-based agro advisories' provides regular weather-based agro advisories based on the medium range weather forecast received from India Meteorological Department (IMD). These advisories are useful for farmers to plan their day to day weather dependent activities. Additionally, set up of village-based weather stations with manual operated rain gauge were set up in each target study village. The regular display of the observed rainfall in the village are expected to help farmers take up critical operations like sowing, application of fertilizers or pesticides or provide irrigation to their crops.

Component 2: Developing and implementing Information System for 'seasonal climate forecast' and 'weather-based agro advisories'			
Climate risk	**Outcomes**	**Outcome indicators**	**Unit of measurement**
Variation in annual rainfall and rainy days, variation in monsoon rainfall and heat waves	Farm planning and operational decisions based on the climate forecast.	Per cent of farmers utilizing weather and agro-based advisories and adopting preventive measures for averting crop losses from climate risks	Per cent
	Reduction of crop losses due to climatic factors	Economic losses prevented due to cropping system adjustments based on climate forecast and weather-based agro advisories	INR
	Climate forecast provided for the target villages.	Service providers of climate forecast public versus private	Per cent
		Seasonal climate forecasts issued to farmers	Yes/No
		Per cent of farmers/villages receiving climate forecast which can help in changing cropping practises	Per cent
	Improved weather-based agro advisories through information and communications technology	Total number of village-based weather stations established for disseminating advisories	Number

Component 2: Developing and implementing Information System for 'seasonal climate forecast' and 'weather-based agro advisories'			
	Impact	**Impact indicators**	**Unit of measurement**
	Enhanced preparedness of farm households to climate variability	Well-knit network of weather- based agro-advisories and systems which can disseminate information to farmers in the project area	Yes/No
		Change in households' awareness of changes in climate which can help in enhancing preparedness	Per cent
		Change in share of households adopting coping/adaptation techniques to different scenarios (based on traditional knowledge)	Per cent

Component 3: Capacity development interventions are an integral part of the project occurring at various levels through the entire period of the project implementation. For the selected bundles of adaptation measures to be implemented technical institutional capacities of participant departments and communities need to be developed.

The department staff are required to train and supervise the farmers' adoption of adaptation measures. Prior to the actual implementation of adaptation measures in each of the target villages, communities were mobilized through raising awareness on climate change impacts and possible solutions.

Component 3: Enhancing capacities of stakeholders for developing and implementing climate change adaptation strategies			
Climate risk	**Outcome 1**	**Outcome indicators**	**Unit of measurement**
Increase in surface temperatures, heat waves, variation in monsoon rainfall, variation in annual rainfall and number of rainy days	State government officials and farmers will be trained to implement climate change adaptation measures	Number of farmers in project villages trained to implement climate adaptation measures	Number
		Total line department staff capacitated to implement climate adaptation measures.	Number

Component 3: Enhancing capacities of stakeholders for developing and implementing climate change adaptation strategies		
Output 1	**Output indicators**	**Unit of measurement**
Training and capacity building modules/ manuals for agronomic, NRM and economic adaptation measures developed and piloted.	Number of training modules developed for trainings and workshops on natural resource management	Number
	Number of pilot capacity-building programmes which can enhance resilience of farming communities	Number
Capacity-building workshops for stakeholders conducted	Number of days dedicated for training and capacity building	Number
	Number of training of trainers (TOTs) programmes conducted for technical institutions and participating departments	Number
	Number of capacity-building workshops organized for farmers and communities	Number
Impact	**Impact indicators**	**Unit of measurement**
Stakeholders capacitated to implement climate adaptation measures.	Change in awareness on climate change and adaptation measures among farmers and communities	Per cent
	Change in awareness levels of technical institutions and participating departments on climate change and adaptation measures	Per cent

Component 4: Implementation of the suitable portfolio of adaptation strategies to climate change in the target villages and farm households

The staff of the Department of Agriculture, Telangana in the target villages is capacitated to train and implement the adaptation measures. The selected measures are planned to be implemented in a phased manner.

Component 4: Implementation of the suitable portfolio of adaptation strategies to climate change in the target villages and farm households			
Climate risk	**Outcome 1**	**Outcome indicators**	**Unit of measurement**
Variation in monsoon rainfall, variation in annual rainfall and number of rainy days	1. Increased crop productivity, Increase in money savings from use of micro-irrigation	Enhancement of crop yield in micro-irrigation areas	Per cent
		Average money savings due to adoption of micro-irrigation	INR
	2. Increase in crop water availability	Increase in amount of water available for crop production due to construction of farm ponds and water storage structures	Per cent
		Increase in water use efficiency as a result of micro-irrigation systems	Per cent
	3. Water availability increases due to groundwater recharge	Change in groundwater level through recharge of bore well	Metres below ground level (Mbgl)
	4. Growth of drought resistant crops like pulses/oilseeds	Change in the net sown area of pulses with improved access to water	Per cent
		Change in the net sown area of oilseeds with improved access to water	Per cent
		Change in the net sown area of other drought resilient crops as a result of increase in water availability	Per cent
	5. Livelihood diversification through backyard poultry	Change in poultry production	Per cent
		Increase in the income of farmers due to sale of poultry products	INR
	6. Reduce dependency on crops by exploring alternate source of livelihood	Change in quantity of meat products due to rearing of small ruminants	Per cent
		Increase in income generated from rearing small ruminants	INR
		Increase in income generated from production of fodder crops	INR

Component 4: Implementation of the suitable portfolio of adaptation strategies to climate change in the target villages and farm households			
	7. Increase in the productivity of soil	Amount of worm biomass produced from adoption of vermi-composting practices	kg
		Change in soil water retention capacity from improvements in soil health management practices	Per cent
	8. Adoption of weather-based crop insurance products	Number of farmers taking up weather-based crop insurance	Number
	Output(s)	**Output indicators**	**Unit of measurement**
	1. Micro-irrigation in high-value crops	Number of drip irrigation systems installed for high-value crops for enhanced water-use efficiency	Number
		Number of sprinkler irrigation system installed for high value crops for enhanced water-use efficiency	Number
		Per cent of farmers covered under micro-irrigation to ensure more crop per drop	Per cent
		Area of land covered under micro-irrigation	Hectare
	2. Creation of farm ponds	Number of individual farm ponds created for water harvesting	Number
		Number of community farm ponds created to improve access and availability of water for agriculture	Number
		Change in Surface water storage capacity from new farm ponds	Per cent
	3. Bore well recharge structures	Number of water recharge structures constructed for groundwater recharge	Number
	4. Popularization of pulses / oilseed cultivation	Awareness generation activities carried out for promoting drought resistant crops	Number
	5. Adoption of practices such as backyard poultry	Number of farmers adopting backyard poultry practices as a supplementary source of income	Number

Component 4: Implementation of the suitable portfolio of adaptation strategies to climate change in the target villages and farm households			
	6. a. Rearing of small ruminants	Number of sheep being reared by beneficiaries of the project for additional income	Number
		Number of goats being reared by beneficiaries of the project for additional income	Number
		Per cent of landless, tribal and women beneficiaries of the project rearing small ruminants for income diversification	Per cent
	b. Inclusion of fodder crops in the system/ fodder trees on bunds plantation, silage	Area covered for fodder production which supports livelihood diversification through livestock rearing	Hectare
	7. Vermicomposting	Number of households practising vermi-composting	Per cent
		Number of vermi-composting pits	Number
	8. Designing of weather-based crop insurance product	Demonstrations of weather-based crop insurance product to minimize risk of crop failure due to extreme weather events	Number of demonstrations
	Impact	**Impact indicators**	**Unit of measurement**
	Improvement of resilience of farm households to the projected climate change impacts such as drought, heat waves etc. with increase in social and economic benefits.	Number of households with diversified livelihoods which can minimize risks from farm-based activities	Number
		Number of households following adaptation strategies	Number
		Change in household incomes from diversified livelihoods	Per cent

Component 5: Knowledge management and mainstreaming of adaptation strategies

The knowledge generated from different components of the project, namely, vulnerability assessment to climate change and adaptation strategies (development and implementation) suitable to the region as well as relevant knowledge from other initiatives and sources would be compiled using a knowledge-based advisory system for integrating climate change adaptation strategies at various levels.

Component 5: Knowledge management and mainstreaming of adaptation strategies			
Climate risk	**Outcome**	**Outcome indicators**	**Unit of measurement**
Increase in surface temperatures, heat waves, variation in monsoon rainfall, variation in annual rainfall and number of rainy days	Open access to knowledge-sharing platforms (portals, repository)	Stakeholders in study region use the knowledge sharing platforms for climate risk management	Per cent
	Output	**Output indicators**	**Unit of measurement**
	Central knowledge repository on climate change adaptation to enable evidence-based policy and programme formulation in agriculture	Central knowledge repository in place which helps in managing research and project outcomes	Descriptive
		Number of climate adaptation research studies undertaken for knowledge strengthening under the project	Number
	Impact	**Impact indicators**	**Unit of measurement**
	Knowledge-based advisory system integrated into climate change adaptation strategies at various levels	Incorporation and use of climate data into adaptation and development practices and strategies	Descriptive

Table 3 is a compilation of the MEL Framework covering all components of the adaptation intervention under the RAH project.

Table 3 Compilation of the MEL Framework covering all components of the Adaptation Intervention

Climate risk	Project components	Output	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
Variation in annual rainfall and rainy days, variation in monsoon rainfall and heat waves	Component 2: Developing and implementing information system for 'seasonal climate forecast' and 'weather-based agro advisories'	Climate forecast provided for the target villages	Service providers of climate forecast public versus private	Farm planning and operational decisions based on the climate forecast.	Per cent of farmers utilizing weather and agro-based advisories and adopting preventive measures for averting crop losses from climate risks	Enhanced preparedness of farm households to climate variability	Well-knit network of weather-based agro-advisories and systems which can disseminate information to farmers in the project area
			Seasonal climate forecasts issued to farmers	Reduction of crop losses due to climatic factors	Economic losses prevented due to cropping system adjustments based on climate forecast and weather- based agro advisories		Change in households' awareness of changes in climate which can help in enhancing preparedness
			Per cent of farmers/ villages receiving climate forecast which can help in changing cropping practices				

Table 3 Compilation of the MEL Framework covering all components of the Adaptation Intervention

Climate risk	Project components	Output	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
		Improved weather- based agro advisories through ICT	Total number of village-based weather stations established for disseminating advisories				Change in share of households adopting coping/ adaptation techniques to different scenarios (based on traditional knowledge)
Increase in surface temperatures, heat waves, variation in monsoon rainfall, variation in annual rainfall and number of rainy days	Component 3: Enhancing capacities of stakeholders for developing and implementing climate change adaptation strategies	Training and capacity building modules/ manuals for agronomic, NRM, and economic adaptation measures developed and piloted.	Number of training modules developed for trainings and workshops on natural resource management	State government officials and farmers will be trained to implement climate change adaptation measures.	Number of farmers in project villages trained to implement climate adaptation measures	Stakeholders capacitated to implement climate adaptation measures	Change in awareness on climate change and adaptation measures among farmers and communities
		Capacity-building workshops for stakeholders conducted	Number of pilot capacity- building programmes which can enhance resilience of farming communities		Total line department staff capacitated to implement climate adaptation measures.		Change in awareness levels of technical institutions and participating departments on climate change and adaptation measures

Table 3 Compilation of the MEL Framework covering all components of the Adaptation Intervention							
Climate risk	**Project components**	**Output**	**Output indicators**	**Outcomes**	**Outcome indicators**	**Impact**	**Impact indicators**
			Number of days dedicated for training and capacity building				
			Number of training of trainers (TOTs) programmes conducted for technical institutions and participating departments				
			Number of capacity-building workshops organized for farmers and communities				
Variation in monsoon rainfall , variation in annual rainfall and number of rainy days	Component 4: Implementation of the suitable portfolio of adaptation strategies to climate change in the target villages and farm households	Micro-irrigation in high-value crops	Number of drip irrigation systems installed for high value crops for enhanced water-use efficiency	Increased crop productivity, Increase in money savings from use of micro- irrigation	Enhancement of crop yield in micro-irrigation areas	Improvement of resilience of farm households to the projected climate change impacts such as drought, heat waves, etc. with increase in social and economic benefits	Number of households with diversified livelihoods which can minimize risks from farm-based activities

Table 3 Compilation of the MEL Framework covering all components of the Adaptation Intervention

Climate risk	Project components	Output	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
					Average money savings due to adoption of micro-irrigation		
			Number of sprinkler irrigation system installed for high value crops for enhanced water-use efficiency				Number of households following adaptation strategies
			Per cent of farmers covered under micro-irrigation to ensure more crop per drop	Increase in crop water availability	Increase in amount of water available for crop production due to construction of farm ponds and water storage structures		Change in household incomes from diversified livelihoods
			Area of land covered under micro-irrigation		Increase in water-use efficiency as a result of micro-irrigation systems		
		Creation of farm ponds	Number of individual farm ponds created for water harvesting	Water availability increases due to groundwater recharge	Change in groundwater level through recharge of bore well		
			Number of community farm ponds created to improve access and availability of water for agriculture				

Table 3 Compilation of the MEL Framework covering all components of the Adaptation Intervention

Climate risk	Project components	Output	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
			Change in surface water storage capacity from new farm ponds	Growth of drought-resistant crops like pulses/ oilseeds	Change in the net sown area of pulses with improved access to water		
					Change in the net sown area of oilseeds with improved access to water		
		Bore well recharge structures	Number of water recharge structures constructed for groundwater recharge		Change in the net sown area of other drought resilient crops as a result of increase in water availability		
		Popularization of pulses /oilseed cultivation	Awareness generation activities carried out for promoting drought-resistant crops	Livelihood diversification through Backyard poultry	Change in poultry production		
					Increase in the income of farmers due to sale of poultry products		
		Adoption of practices such as backyard poultry	Number of farmers adopting backyard poultry practices as a supplementary source of income				

Table 3 Compilation of the MEL Framework covering all components of the Adaptation Intervention

Climate risk	Project components	Output	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
		Rearing of small ruminants	Number of sheep being reared by beneficiaries of the project for additional income	Reduce dependency on crops by exploring alternate source of livelihood	Change in quantity of meat products due to rearing of small ruminants		
					Increase in income generated from rearing small ruminants		
			Number of goats being reared by beneficiaries of the project for additional income		Increase in income generated from production of fodder crops		
			Per cent of landless, tribal and women beneficiaries of the project rearing small ruminants for income diversification	Increase in the productivity of soil	Amount of worm biomass produced from adoption of vermi-composting practices		
		b) Inclusion of fodder crops in the system/ fodder trees on bunds plantation, silage	Area covered for fodder production which supports livelihood diversification through livestock rearing		Change in soil water retention capacity from improvements in soil health management practices		

Table 3 Compilation of the MEL Framework covering all components of the Adaptation Intervention

Climate risk	Project components	Output	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
		Vermicomposting	Number of households practising vermi-composting				
			Number of vermi-composting pits				
		Designing of weather-based crop insurance product	Demonstrations of weather-based crop insurance product to minimize risk of crop failure due to extreme weather events	Adoption of weather- based crop insurance products	Number of farmers taking up weather-based crop insurance		
Increase in surface temperatures, heat waves, variation in monsoon rainfall , variation in annual rainfall and number of rainy days	Component 5: Knowledge management and mainstreaming of adaptation strategies	Central knowledge repository on climate change adaptation to enable evidence-based policy and programme formulation in agriculture	Central knowledge repository in place which helps in managing research and project outcomes	Open access to knowledge-sharing platforms (portals, repository)	Stakeholders in study region use the knowledge sharing platforms for climate risk management	Knowledge-based advisory system integrated into climate change adaptation strategies at various levels	Incorporation and use of climate data into adaptation and development practices and strategies
			Number of climate adaptation research studies undertaken for knowledge strengthening under the project				

4.3 National Innovations in Climate Resilient Agriculture

4.3.1 Climate Context for Districts Targeted under the National Innovations in Climate Resilient Agriculture (NICRA) Project

Under the NICRA project, the districts of Khammam and Nalgonda have received assistance to enhance climate-resilient agriculture.[12]

The district of Khammam is located in north Telangana, which receives normal annual rainfall of 1161 mm and is predominantly dominated by black red soils. Drought, heat stress are the primary concerns of the district. The district is important from an agricultural perspective with over 29% of net sown area. The district also has roughly 47% of its area covered by forests. The village of Nacharam (Nacharam and Cluster villages; Gangulanacharam, Colony Nacharam, Ramatanda, Bhadrutanda, Muniya tanda and Bheemlatanda) situated in Enkoor Mandal of Khammam district was selected for implementing the project activities. The village is home to 749 households with a population of 3246. Paddy, cotton, chilli, and sugar cane are the major crops grown in the project village with major irrigation sources of streams and bore wells.[13]

On the contrary, Nalgonda district is located in South Telangana. The district receives a normal annual rainfall of 804 mm and is prone to heat stress and drought. In 2015, the district reported receiving a rainfall of 627 mm only. The soil type in the district is black soil. The villages of Nandyalagudem and Boring Thanda of Atmakoor (S) Mandal were selected for the NICRA. The village has 155 households with approximately 50 ha of the total cropped area. The prominent crops of the village are cotton, pigeon pea, green gram, paddy, and vegetables and the major sources of irrigation include wells and bore wells. Due to heat waves, mango, and sweet orange crops were damaged. Other challenges for agriculture in the village include low seed replacement rate, limited access to quality seeds and farm mechanizations, poor support for livestock farming as well as limited scope for enhanced/ alternate livelihoods.

4.3.2 National Innovations on Climate Resilient Agriculture Project

The 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 is spearheaded and coordinated by Central Research Institute for Dryland Agriculture (CRIDA).

The project was designed to bolster climate-resilient agriculture initiatives in India by means of scientific research and technology demonstration. The project consists of four components: strategic research, technology

[12] Home | Agricultural Technology Application Research Institute | Hyderabad | ICAR, 2022

[13] ICAR- Agricultural Technology Application Research Institute (ATARI), 2016

demonstration, capacity building, and sponsored/competitive grants. The programme has an outlay of Rs350 crore for the XI Five-year Plan[14] and has the following objectives:

- To enhance the resilience of Indian agriculture covering crops, livestock, and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies.
- To demonstrate site-specific technology packages on farmers' fields for adapting to current climate risks.
- To enhance the capacity of scientists and other stakeholders in climate-resilient agricultural research and its application.

Through the programme, the ICAR aims to develop and promote, climate-resilient technologies in agriculture to address the increasing vulnerability of the sector. Programme implementation will help districts and regions to cope with climate extremes. Although the target area of the scheme are all climatically vulnerable regions of the country, small and marginal farmers in rain fed, coastal and hill areas will benefit more in view of the focused attention in these regions[15].

Through the process of strategic research thrust areas of the programme include:[16]

- Identification of most vulnerable districts/regions.
- Devolving crop varieties and management practices for adaptation and mitigation.
- Assessing climate change impacts on livestock, fisheries, and poultry and identifying adaptation strategies.

4.3.3 Key Components

Strategic research on mitigation and adaptation: Focused programmes are taken up on different commodities on adaptation and mitigation such as Natural Resource Management, Crops, Pests and disease dynamics, Livestock, Fisheries and Energy Efficiency. A detailed assessment on vulnerability of different agro-climatic zones of the country is also planned.

Technology demonstration: This component is being implemented in farmer participatory mode in the climatically most vulnerable districts of the country through 121 Krishi Vigyan Kendras (KVKs) spread across the country in 28 states and 1 union territory. Under this component, an integrated package of proven technologies is demonstrated in one village in each district for adaptation and mitigation of the crop and livestock production systems to climate variability based on the available technologies.

The interventions are categorized in four modules, namely, natural resources, crop production, livestock and fisheries, and institutional interventions. According to the need of the specific village based on the detailed exercise of finding climatic vulnerability (drought/floods/heat wave/frost/cyclone) and the available technology

[14] Five-year Plans were initiated in the year 1951, which map out the development priorities and implementation on a five-year basis for the Government of India.

[15] Details available at <http://www.nicra-icar.in/nicrarevised/index.php/home1>

[16] Details available at <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1743354>

options specific interventions are suggested. The interventions are selected from each of the module and an integrated package from all the modules is formulated. This makes most of the farmers covered with one or more of the interventions in order to demonstrate a discernible effect.

Capacity building and knowledge management: Under this component, capacity-building programmes are planned for different stakeholders. For scientists on the latest tools and methodologies of climate change research; capacity building of senior faculty through short- term exposure visits, participation in international symposia; training programmes for extension functionaries of the states, policy makers, NGOs, and farmers to generate awareness on climate change; co-operatives and insurance companies on climate risk assessment and modelling.

Sponsored and competitive grants: Under this component, research proposals are invited from identified institutions/ scientists to fill up critical research gaps. Research proposals addressing critical gaps of national importance not covered in the main project and highly location-specific regional climate variability issues which have a major bearing on the productivity of principal crops in that region are being funded under this component inviting proposals from identified institutions or through an open invitation on competitive basis from institutions/ individuals.

The mentioned interventions include the following four modules:

1. Natural resource management
2. Crop production
3. Livestock and fisheries
4. Institutional interventions

4.3.4 Governance Structure

The project is governed by a multi-tier structure of entities at the national, state, and local levels that are further responsible for conception, funding, execution, and monitoring of the project.

Governance structure	Entities
Funding agency	Ministry of Finance (MoF) to the Ministry of Agriculture Indian Council of Agricultural Research (ICAR), Ministry of Agriculture and Farmers Welfare, Government of India
Overall review	MoA (Department of Agriculture Research and Education)
Planning, implementation, and coordination	ICAR-CRIDA
Evaluation	ATARI Hyderabad and VCRMC
Capacity building and implementation	KVK
Beneficiaries	Farmers

Key Stakeholders for the Adaptation Intervention: identification of stakeholders, roles, and responsibilities

Stakeholder identification		
Stakeholder	**Stakeholder interest (Low, medium, high)**	**Stakeholder influence on intervention (Low, medium, high)**
Ministry of Finance (MoF)	High (Objective of the entity is to increase channelization of NAFCC funds towards adaptation oriented projects)	Medium (Regulates NAFCC fund disbursement for project implementation)
Ministry of Agriculture (MoA) (Department of Agriculture Research and Education)	High (The Department co-ordinates, guides, and manages research and education in agriculture and allied sectors in India)	High (Conducts routine review of work being implemented under NICRA in coordination with other stakeholders)
ICAR-CRIDA	High (Autonomous body responsible for carrying out the research for improvement of rain-fed areas through resource management)	High (Preparation of implementation plans in coordination with ICAR and management of funds)
ATARI	High (Plan, monitor, and review KVK activities being taken up in the zone)	High (Directly manages the KVK activities and raises concerns faced by the communities to the higher authority)
VCRMC	High (Village committees are representatives of village farm communities, therefore benefit from adaptation interventions implemented at village level)	High (The committee works closely with farmers to mobilise them and build their interest towards adoption of adaptation actions)
KVK	High (To conduct skill development training programmes in agriculture and allied sector)	High (Responsible for conducting capacity-building activities to raise interest of farmers. Also serves as an executing entity at farm level)
Farmers	High (To receive benefits of schemes that intend to make them resilient to the existing and future climate stresses)	High (The planning and uptake of the program is heavily dependent on interest of farmers)

4.3.5 Stakeholder Analysis: relevance and impact

The stakeholder matrix depicts that most of the stakeholders have high interest and high influence on the programme. Stakeholders that plan, monitor, and implement actions at farm level like the KVK's, ATARI, and VCRMC are more influential since they represent the concerns of the farmers with an attempt to increase the uptake of the intervention. The farmers are the most influential since most of the adaptation actions are structured on the needs.

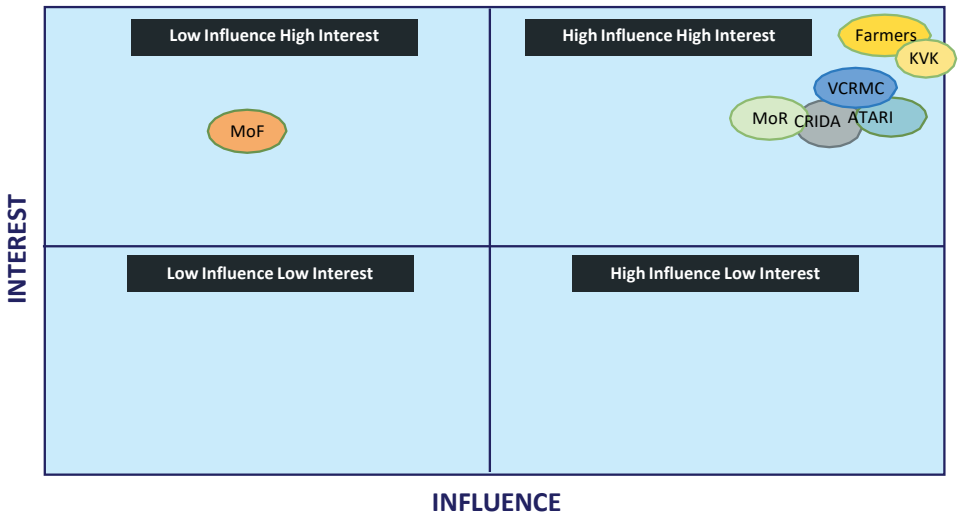

Figure 7 Stakeholder interest and influence matrix for NICRA

Proposed Monitoring, Evaluation, and Learning Framework for the Adaptation Intervention.

Module I: Natural Resources' Management

This module consists of interventions related to *in-situ* moisture conservation, water harvesting and recycling for supplemental irrigation, improved drainage in flood-prone areas, conservation tillage where appropriate, artificial groundwater recharge and water-saving irrigation methods.

National Innovations on Climate Resilient Agriculture (NICRA)			
Module 1: Natural Resources' Management			
Climate risk	**Outcome 1**	**Outcome indicators**	**Unit of measurement**
Increase in temperatures, heat waves, variability in monsoon rainfall, variability in annual rainfall and number of rainy days	Changes in soil moisture content, productivity of soil and groundwater table	Change in soil's water-retention capacity as a result of soil and moisture conservation	Per cent
		Change in groundwater table due to percolation from water-harvesting structures	Metres below ground level (Mbgl)
		Change in AQI due to reduction in crop burning	Per cent
		Change in water-use efficiency as a result of adoption of water-efficient irrigation systems	Per cent
		Change in area under land reclamation	Per cent
	Output 1	**Output indicators**	**Unit of measurement**
	Adoption of measures for improvement in natural resource base	Number of research studies on natural resource management spanning across soil and moisture conservation	Number
		Number of site-specific demonstrations on NRM practices to help farmers to cope with climate variability and change	Number
		Number of farmers aware of sustainable NRM	Number
		Number of farmers practising in-situ soil moisture conservation	Number
		Number of farmers practising bio-mass mulching which improve soil health	Number
		Number of farmers using crop residue for alternate purpose (not practising crop burning)	Number
		Rate of crop residue incorporation in soil	Tonnes per hectare
		Number of structures constructed for water harvesting, recycling for supplemental irrigation	Number
		Number of farmers practising conservation tillage	Number
		Number of farmers practising water-saving irrigation methods such as micro and drip irrigation	Number
		Number of farmers practising in green manuring for reclamation of low fertile and saline soil	Number

National Innovations on Climate Resilient Agriculture (NICRA)			
Module 1: Natural Resources' Management			
	Impact	**Impact indicators**	**Unit of measurement**
	Ecological sustainability and natural resource management	Change in awareness among stakeholders on sustainable natural resource management	Descriptive
		Change in land area covered under soil and water conservation	Per cent
		Change in land area under conservation agriculture	Per cent

Module II: Crop Production

This module consists of introducing drought/temperature-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, community nurseries for delayed monsoon, custom hiring centres for timely planting, location specific intercropping systems with high-sustainable yield index.

Module 2: Crop Production			
Climate risk	**Outcome 2**	**Outcome indicators**	**Unit of measurement**
Increase in temperatures, heat waves, variability in monsoon rainfall, variability in annual rainfall and number of rainy days	Enhanced preparedness for minimizing the impact of climate variability on Indian agriculture	Change area under intercropping systems	Per cent
		Change in households practising resilient agriculture practices	Per cent
		Change in water-use efficiency due to water saving cultivation methods	Per cent
		Reduction in crop losses due to adjustments in cropping techniques	Per cent
	Output	**Output indicators**	**Unit of measurement**
	Increased uptake of location specific cropping techniques	Number of research studies on enhancing crop productivity under a changing climate	Number
		Number of training workshops to enhance crop productivity	Number
		Number of farmers trained on climate-resilient crop-producing techniques	Number
		Number of farmers using drought/temperature-tolerant crop varieties	Number

Module 2: Crop Production			
		Number of farmers advancing planting dates of Rabi crops in areas with terminal heat stress,	Number
		Number of farmers using water saving paddy cultivation methods (SRI, aerobic, direct seeding)	Number
		Number of community nurseries established in each block	Number
	Impact	**Impact indicators**	**Unit of measurement**
	Improvement of agricultural livelihoods and income security through resilient cropping techniques extension	Change In income from farm activities through diversified livelihoods	Per cent
		Change in crop yield as a result of adoption of varied cropping practices	Per cent

Module III: Livestock and Fisheries

Use of community lands for fodder production during droughts/floods, improved fodder/feed storage methods, preventive vaccination, improved shelters for reducing heat stress in livestock, management of fish ponds/tanks during water scarcity and excess water, etc.

Module 3: Livestock and Fisheries			
Climate risk	**Outcome 3**	**Outcome indicators**	**Unit of measurement**
Increase in temperatures, heat waves, variability in monsoon rainfall, variability in annual rainfall and number of rainy days	Improvement in productivity from animal husbandry and fisheries.	knowledge strengthening on impacts of climate change on livestock and fisheries	Descriptive
		Change in community land being used for fodder production	Per cent
		Change in livestock productivity (milk/eggs / meat, etc.)	Per cent
		Change in fish production from project reservoirs	Per cent
		Change in farmer incomes due to livelihood diversification	Per cent

Module 3: Livestock and Fisheries			
	Output 3	**Output indicators**	**Unit of measurement**
	Livelihood diversification to livestock and fishery management	Number of research studies on impact of climate change on livestock and fisheries	Number
		Identification of useful traits in indigenous breeds of cattle, buffalo, pig and poultry in relation to climate change	Descriptive
		Mapping changes in incidence pattern of livestock diseases	Descriptive
		Number of training workshops to enhance livestock and fishery management	Number
		Number of training workshops on enhanced fodder management	Number
		Number of farmers using improved fodder/feed storage methods	Per cent
		Per cent of livestock population vaccinated	Per cent
		Number of improved shelters for reducing heat stress in livestock	Number
		Identification of breeding strategy for inland fisheries in the context of climate change	Descriptive
		Number of fish ponds being managed for water scarcity/water quality	Number
	Impact	**Impact indicators**	**Unit of measurement**
	Reduction in livelihood vulnerability	Change in farmer incomes due to livelihood diversification	Per cent
		Change in food and nutritional security due to availability of diverse food sources	Per cent

Module IV: Institutional Interventions

This module consist of institutional interventions either by strengthening the existing ones or initiating new ones relating to seed bank, fodder bank, commodity groups, custom hiring centre, collective marketing, introduction of weather index-based insurance and climate literacy through a village-level weather station.

Module 4: Institutional Interventions			
Climate risk	**Outcome 4**	**Outcome indicators**	**Unit of measurement**
Increase in temperatures, heat waves, variability in monsoon rainfall, variability in annual rainfall and number of rainy days	Improved access to CRA technologies and knowledge for farmers	Operational seed bank at village level	Y/N
		Operational fodder bank at village level	Y/N
		Change in quantity of fodder produced as a result of enhanced fodder management	Per cent
		Number of commodity groups established	Number
		Operational custom-hiring centre at village level	Y/N
		Operational/functional weather stations at village level	Y/N
		Number of capacity-building initiatives on fodder and feed management, livestock management, seed banks, fodder banks and integrated livestock Management, etc.	Number
	Output 4	**Output indicators**	**Unit of measurement**
	Institutional capacity building	Number of automatic weather stations installed	Number
		Number of farmers with weather index-based insurance	Number
		Number of farmers receiving weather advisories	Number
		Number of farmers with soil health cards	Number
		Change in use of mechanized farming techniques and farm mechanization	Per cent
		Number of training programmes on fodder and feed management, livestock management, seed banks, fodder banks and integrated livestock Management, etc.	Number
		Improvement of capacities on fodder and feed management, livestock management, seed banks, fodder banks and integrated livestock management, etc. among both male and female farmers	Descriptive
	Impact	**Impact indicators**	**Unit of measurement**
	Enhanced enabling environment for climate-resilient agriculture	Improved institutional capacities (for example, fodder banks, weather stations, seed banks, weather-based insurances, etc.) to support climate-resilient agriculture	Per cent
		Increase awareness about climate-resilient agriculture	Per cent
		Increase uptake of climate-resilient agricultural practices by farmers	Per cent

Table 4 is a compilation of the MEL framework covering all components of the adaptation intervention under the NICRA project.

Table 4 Compilation of the MEL framework covering all components of the adaptation intervention

Climate risk	Project components	Outputs	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
Increase in temperatures, heat waves, variability in monsoon rainfall, variability in annual rainfall and number of rainy days	Module 1: Natural Resource Management	Adoption of measures for improvement in natural resource base	Number of research studies on natural resource management spanning across soil and moisture conservation	Changes in soil moisture content, productivity of soil and groundwater table	Change in soil's water- retention capacity as a result of soil and moisture conservation	Ecological sustainability and natural resource management	Change in awareness among stakeholders on sustainable natural resource management
			Number of site-specific demonstrations on NRM practices to help farmers to cope with climate variability and change		Change in groundwater table due to percolation from water harvesting structures		Change in land area covered under soil and water conservation
			Number of farmers aware of sustainable NRM		Change in AQI due to reduction in crop burning		Change in land area under conservation agriculture
			Number of farmers practising in-situ soil moisture conservation		Change in water-use efficiency as a result of adoption of water- efficient irrigation systems		
			Number of farmers practising bio-mass mulching which improve soil health				

Table 4 Compilation of the MEL framework covering all components of the adaptation intervention							
Climate risk	**Project components**	**Outputs**	**Output indicators**	**Outcomes**	**Outcome indicators**	**Impact**	**Impact indicators**
			Number of farmers using crop residue for alternate purpose (not practising crop burning)				
			Rate of crop residue incorporation in soil				
			Number of structures constructed for water harvesting, recycling for supplemental irrigation				
			Number of farmers practising conservation tillage		Change in area under land reclamation		
			Number of farmers practising water saving irrigation methods such as micro and drip irrigation				
			Number of farmers practising in green manuring for reclamation of low fertile and saline soil				

Table 4 Compilation of the MEL framework covering all components of the adaptation intervention

Climate risk	Project components	Outputs	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
Increase in temperatures, heat waves, variability in monsoon rainfall, variability in annual rainfall and number of rainy days	Module 2: Crop Production	Increased uptake of location-specific cropping techniques	Number of research studies on enhancing crop productivity under a changing climate	Enhanced preparedness for minimizing the impact of climate variability on Indian agriculture	Change area under intercropping systems	Improvement of agricultural livelihoods and income security through resilient cropping techniques extension	Change In income from farm activities through diversified livelihoods
			Number of training workshops to enhance crop productivity		Change in households practising resilient agriculture practices		Change in crop yield as a result of adoption of varied cropping practices
			Number of farmers trained on climate resilient crop producing techniques		Change in water-use efficiency due to water saving cultivation methods		
			Number of farmers using drought/ temperature-tolerant crop varieties		Reduction in crop losses due to adjustments in cropping techniques		

Table 4 Compilation of the MEL framework covering all components of the adaptation intervention							
Climate risk	**Project components**	**Outputs**	**Output indicators**	**Outcomes**	**Outcome indicators**	**Impact**	**Impact indicators**
			Number of farmers advancing planting dates of Rabi crops in areas with terminal heat stress				
			Number of farmers using water-saving paddy cultivation methods (SRI, aerobic, direct seeding)				
			Number of community nurseries established in each block				
Increase in temperatures, heat waves, variability in monsoon rainfall, variability in annual rainfall and number of rainy days	Module 3: Livestock and Fisheries	Livelihood diversification to livestock and fishery management	Number of research studies on impact of climate change on livestock and fisheries		Knowledge strengthening on impacts of climate change on livestock and fisheries	Reduction in livelihood vulnerability	Change in farmer incomes due to livelihood diversification

Table 4 Compilation of the MEL framework covering all components of the adaptation intervention

Climate risk	Project components	Outputs	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
			Identification of useful traits in indigenous breeds of cattle, buffalo, pig and poultry in relation to climate change		Change in community land being used for fodder production		
			Mapping changes in incidence pattern of livestock diseases		Change in livestock productivity (milk/ eggs /meat, etc.)		
			Number of training workshops to enhance livestock and fishery management		Change in fish production from project reservoirs		
			Number of training workshops on enhanced fodder management		Change in farmer incomes due to livelihood diversification Knowledge strengthening on impacts of climate change on livestock and fisheries		
			Number of farmers using improved fodder/feed storage methods				Change in food and nutritional security due to availability of diverse food sources

Table 4 Compilation of the MEL framework covering all components of the adaptation intervention							
Climate risk	**Project components**	**Outputs**	**Output indicators**	**Outcomes**	**Outcome indicators**	**Impact**	**Impact indicators**
			Per cent of livestock population vaccinated				
			Number of improved shelters for reducing heat stress in livestock				
			Identification of breeding strategy for inland fisheries in the context of climate change				
			Number of fish ponds being managed for water scarcity/ water quality				
Increase in temperatures, heat waves, variability in monsoon rainfall, variability in annual rainfall and number of rainy days	Module 4: Institutional Interventions	Institutional capacity building	Number of automatic weather stations installed	Improved access to CRA technologies and knowledge for farmers	Operational seed bank at village level	Enhanced enabling environment for climate-resilient agriculture	Improved institutional capacities (for example, fodder banks, weather stations, seed banks, weather-based insurances, etc.) to support climate-resilient agriculture

Table 4 Compilation of the MEL framework covering all components of the adaptation intervention

Climate risk	Project components	Outputs	Output indicators	Outcomes	Outcome indicators	Impact	Impact indicators
			Number of farmers with weather index- based insurance		Operational fodder bank at village level		Increase awareness about climate-resilient agriculture
			Number of farmers receiving weather advisories		Change in quantity of fodder produced as a result of enhanced fodder management		Increase uptake of climate-resilient agricultural practices by farmers
			Number of farmers with soil health cards		Number of commodity groups established		
			Change in use of mechanized farming techniques and farm mechanization		Operational custom- hiring centre at village level		
			Number of training programmes on fodder and feed management, livestock management, seed banks, fodder banks and integrated livestock Management, etc.		Operational/ functional weather stations at village level		

Table 4 Compilation of the MEL framework covering all components of the adaptation intervention							
Climate risk	**Project components**	**Outputs**	**Output indicators**	**Outcomes**	**Outcome indicators**	**Impact**	**Impact indicators**
			Number of beneficiaries trained on fodder and feed management, livestock management, seed banks, fodder banks and integrated livestock Management, etc. (males and females)		Improvement of capacities on fodder and feed management, livestock management, seed banks, fodder banks and integrated livestock management, etc. among both male and female farmers		

The framework aims to capture both the quantitative and qualitative impact of the project. Indicators are developed so as to reflect the measurable impact and capture the progress and achievements of the project over a long time period.

An effective project management approach is one which requires the participation of all stakeholders, establishes partnerships, and prevents the marginalization of groups and water resource users. Water management itself involves various complexities, given the changing climate, growing conflicts and governance issues. For better assessment and improving the contribution of stakeholders, indicators have to be designed to integrate environmental, economic and social aspects. With particular reference to water, data that captures the social dimension will aid in the promotion of equity in water access. Environmental data will aid in ensuring the sustainability of water resources and the economic dimension data will contribute to the goal of improving water-use efficiency.

The relevance of indicators depends on its ability to provide a representative image and its

utility to the decision-makers and managers. Further, a shared vision of the future of water resources among the stakeholders, adequate finance, consensus among stakeholders on integration of various water-related issues, strengthening institutional capacity for improved water management and promotion of decision making at the local level are fundamental to achieving the desired impact of project interventions.

5. Suggested Evaluation Approaches

Evaluation of climate adaptation projects and programmes has been recognized critical for assessing the overall relevance, coherence, efficiency, effectiveness, sustainability, and impact. The Organization for Economic Cooperation and Development (OECD) defines evaluation as "The systematic and objective assessment of an on-going or completed project, programme or policy, its design, implementation, and results. The aim is to determine the relevance and fulfilment of objectives, development efficiency, effectiveness, impact, and sustainability. An evaluation should provide information that is credible and useful, enabling the incorporation of lessons learned into the decision-making process of both recipients and donors"[17]

Likewise, in a paper by Gregorowski and Bours, the authors build on the OECD definition (Development Assistance Committee Working Party on Aid Evaluation, 2002), and define evaluation as the process which can be used to determine the exact worth or contribution of a policy programme or institution—adopting a systematic and objective analysis of development interventions.

Evaluation is conducted to measure the overall progress of the interventions through outcome/result indicators.

Indicators that identify the continuous progress achieved in terms of the goals and objectives of the adaptation intervention are evaluated through Ladder based approach. These can be qualitative or quantitative. These indicators tend to be iterative in nature, and periodic evaluation processes seek to understand if these indicators show positive progress over time. They also help us identify challenges and shocks to the project, by assessing if certain indicators are not progressing as anticipated, and enable us to carry out course correction actions to ensure the success of the project.

Evaluation of more permanent changes from the impacts of the project, such as behavioural or landscape changes, may be qualitative or quantitative. For instance, a quantitative method may involve the number of people adopting a certain type of behaviour. This may also be measured using a scorecard which helps in mapping the result as 'Yes,' 'No' or 'Partial' and may be represented using '2', '1' or '0' for evaluation purpose and may be analysed using a weightage. On the contrary, qualitative techniques for mapping behavioural change would involve use of expert judgement/narratives or use of pre and post surveys. In case of narratives, scoring for each sub-indicator is aggregated to produce an overall score for each outcome indicator. This method then provides a quantitative interpretation of the score. Such a scorecard approach enables us to understand the impact of the project, and whether the outcomes envisaged by the theory of change have been achieved by the project. Scorecard approaches can also help in course-corrections or for expanding the scope of the project, by identifying barriers, co-benefits, and opportunities during the project.

Other tools and techniques of evaluation would include economic assessments such as a cost benefit analysis, social evaluation methods like surveys as well as other technical methods such as geo-tagging or photo verifications of achieved targets. Economic assessments would also help in prioritization of adaptation options, whereas other methods help drive accountability and course correction regarding the achieved targets of the projects. Social evaluation methods can similarly assess the impact of the project on local stakeholders, establishing if positive impacts have been felt by the local communities and helping drive tangible change at the grassroots level.

In case of narratives method, scoring for each sub-indicator is aggregated to produce an overall score for each outcome indicator. This method provides a quantitative understanding of reasoning behind the score.

a) Rain-fed Area Development (RAD) Programme			
Project components	**Outcome**	**Outcome indicators**	**Evaluation method/ approach**
Component 1: Promoting integrated farming system (IFS) emphasizing multi-cropping, inter-cropping, and mixed cropping practices	Increased returns from the farms through sustainable livelihood options which help in reducing the impacts of increase in temperature, drought and other extreme weather events	Per cent of land under multi-cropping to minimize livelihood risks from climate-induced crop failure	Ladder based
		Change in cropping intensity as a result of integrated farming practices	Ladder based
		Change in crop diversification due adoption of various cropping techniques	Ladder based
		Change in area under horticulture as a result of increase cultivation of horticulture crops	Ladder based
		Change in area under silvi-pasture to support livestock activities	Ladder based
		Number of farmers practising livestock rearing for livelihood diversification	Ladder based

a) Rain-fed Area Development (RAD) Programme			
Project components	**Outcome**	**Outcome indicators**	**Evaluation method/ approach**
		Number of farmers practising fisheries to supplement incomes from agriculture to minimize climate risks	Ladder based
		Change in agricultural yield and productivity due to adoption of diverse cropping practices	Ladder based
Component 2: Encouraging value addition and farm development activities	Enhancing climate adaptation through value adaptation and farm development	Change in farm income due to uptake of apiculture	Ladder based
		Change in availability of green fodder and improvement in livestock production as a result of farm development	Ladder based
		Change in crop production due to increase in number of greenhouse structures	Ladder based
		(a) Change in groundwater table due soil and water conservation measures	Ladder based
		(b) Change in area under irrigation due to uptake of water conservation measures	Ladder based
		(c) Change in availability of water for agricultural water use as a result of increase in number of water harvesting structures	Ladder based
		Change in land area under NRM conservation through in-situ moisture conservation, vegetative nitrogen fixing, crop protection, contour bunding, gully and control bunds and spill ways	Ladder based
		(a) Change in production of vermi-compost through increase in number of vermi-composting pits	Ladder based
		(b) Change in production of organic input and green manure for improved soil nutrition	Ladder based
		Change in post-harvest and storage/value addition of NTFP	Ladder based

a) Rain-fed Area Development (RAD) Programme			
Project components	**Outcome**	**Outcome indicators**	**Evaluation method/ approach**
		Change in quantity of processed and packaged food by food-processing units	Ladder based
		Number of farmer producer organizations functional with better access agricultural support infrastructure and facilities	Ladder based
		Area under soil treatment	Ladder based
		Area of fallow/wasteland reclaimed which can be used for agriculture	Ladder based
		Number of farmers aware of integrated farming, climate change adaptation, good agriculture practices on soil, water and crop management which can help in reducing risks during droughts and floods	

b) Evaluation methods for resilient agricultural households			
Project components	**Outcome**	**Outcome indicators**	**Evaluation method/ approach**
Component 1: Understanding household-level adaptation interventions (baseline households survey, finalization and communication of adaptation interventions for each target community and household)	Updated climatic vulnerability and scenarios of the targeted region	Identification of vulnerable households from baseline survey for targeted interventions	Ladder based
		Availability of climate vulnerability scenarios of the targeted region	Ladder based
		Identification of suitable adaptation strategies for vulnerable households (agronomic, soil and water management, integrated farming and value chain interventions) which can help in minimizing climate risks	Ladder based
		Development of technical and operational guidelines for implementation of adaptation measures	Ladder based
		Publication and dissemination of technical and operational guidelines to nodal agencies at block and village levels	Ladder based

b) Evaluation methods for resilient agricultural households			
Project components	**Outcome**	**Outcome indicators**	**Evaluation method/ approach**
Component 2: Developing and implementing Information System for 'seasonal climate forecast' and 'weather-based agro advisories'	Farm planning and operational decisions based on the climate forecast.	Per cent of farmers utilizing weather and agro-based advisories and adopting preventive measures for averting crop losses from climate risks	Ladder based
	Reduction of crop losses due to climatic factors	Economic losses prevented due to cropping system adjustments based on climate forecast and weather-based agro advisories	Ladder based
Component 3: Enhancing capacities of stakeholders for developing and implementing climate change adaptation strategies	State government officials and farmers will be trained to implement climate change adaptation measures.	Number of farmers in project villages trained to implement climate adaptation measures	Ladder based
		Total line department staff capacitated to implement climate adaptation measures.	Ladder based
Component 4: Implementation of the suitable portfolio of adaptation strategies to climate change in the target villages and farm households	Increased crop productivity, Increase in money savings from use of micro-irrigation	Enhancement of crop yield in micro-irrigation areas	Ladder based
		Average money savings due to adoption of micro-irrigation	Ladder based
	Increase in crop water availability	Increase in amount of water available for crop production due to construction of farm ponds and water storage structures	Ladder based
		Increase in water-use efficiency as a result of micro-irrigation systems	Ladder based
	Water availability increases due to groundwater recharge	Change in groundwater level through recharge of bore well	Ladder based
	Growth of drought- resistant crops like pulses/ oilseeds	Change in the net sown area of pulses with improved access to water	Ladder based
		Change in the net sown area of oilseeds with improved access to water	Ladder based

b) Evaluation methods for resilient agricultural households			
Project components	**Outcome**	**Outcome indicators**	**Evaluation method/ approach**
		Change in the net sown area of other drought- resilient crops as a result of increase in water availability	Ladder based
	Livelihood diversification through backyard poultry	Change in poultry production	Ladder based
		Increase in the income of farmers due to sale of poultry products	Ladder based
	Reduce dependency on crops by exploring alternate source of livelihood	Change in quantity of meat products due to rearing of small ruminants	Ladder based
		Increase in income generated from rearing small ruminants	Ladder based
		Increase in income generated from production of fodder crops	Ladder based
	Increase in the productivity of soil	Amount of worm biomass produced from adoption of vermi-composting practices	Ladder based
		Change in soil's water retention capacity from improvements in soil health management practices	Ladder based
	Adoption of weather-based crop insurance products	Number of farmers taking up weather-based crop insurance	Ladder based
Component 5: Knowledge management and mainstreaming of adaptation strategies	Convergence of policies in programmes to promote adaptation practices among farmers	Consolidation of a policy framework integrating all adaptation programmes	Scorecard/Narratives
	Open access to knowledge-sharing platforms (portals, repository)	Stakeholders in study region use the knowledge sharing platforms for climate risk management	Scorecard/Narratives

c) National Innovations in Climate Resilient Agriculture			
Project components	**Outcome**	**Outcome indicators**	**Evaluation method/ approach**
Module 1: Natural resource management	Changes in soil moisture content, productivity of soil and groundwater table	Change in soil's water retention capacity as a result of soil and moisture conservation	Ladder based
		Change in groundwater table due to percolation from water harvesting structures	Ladder based
		Change in AQI due to reduction in crop burning	Ladder based
		Change in water-use efficiency as a result of adoption of water-efficient irrigation systems	Ladder based
		Change in area under land reclamation	Ladder based
Module 2: Crop production	Enhanced preparedness for minimizing the impact of climate variability on Indian agriculture	Change area under intercropping systems	Ladder based
		Change in households practising resilient agriculture practices	Ladder based
		Change in water-use efficiency due to water-saving cultivation methods	Ladder based
		Reduction in crop losses due to adjustments in cropping techniques	Ladder based
Module 3: Livestock and fisheries		Knowledge strengthening on impacts of climate change on livestock and fisheries	Narratives
		Change in community land being used for fodder production	Ladder based
		Change in livestock productivity (milk/eggs /meat, etc.)	Ladder based
		Change in fish production from project reservoirs	Ladder based
		Change in farmer incomes due to livelihood diversification	Ladder based
		Knowledge strengthening on impacts of climate change on livestock and fisheries	

c) National Innovations in Climate Resilient Agriculture			
Project components	**Outcome**	**Outcome indicators**	**Evaluation method/ approach**
Module 4: Institutional interventions	Improved access to CRA technologies and knowledge for farmers	Operational seed bank at village level	Scorecard
		Operational fodder bank at village level	Scorecard
		Change in quantity of fodder produced as a result of enhanced fodder management	Ladder based
		Number of commodity groups established	Ladder based
		Operational custom- hiring centre at village level	Scorecard
		Operational/functional weather stations at village level	Scorecard
		Improvement of capacities on fodder and feed management, livestock management, seed banks, fodder banks and integrated livestock management, etc. among both male and female farmers	Scorecard/narrative

6. Conclusion and Way Forward

Heavy dependence on rain-fed agriculture is a major feature of agricultural systems in Telangana. Roughly 54% of the cultivated area in the state is classified as 'dry land', with high dependence on water-intensive crops. Prominent crops such as rice and cotton occupy roughly 60% of the cultivated area and are water-intensive crops. To address the complex challenges in the climate system and its impact on agriculture, there is a need to strengthen policy decisions and bring about behavioural changes at grassroots levels.

Furthermore, to ensure that the MEL is robust, it must be developed with active participation from stakeholders and followed by conducting capacity-building and training programmes for departments, communities, agricultural research institutions, and all prominent stakeholders involved in the agriculture sector of the state.

Additionally, learnings from stakeholder consultations and capacity-building workshops can be implemented at departmental levels of the nodal agencies of the state to be incorporated into all projects and activities in the state. By having a robust and inclusive MEL framework in place, that can be tailored to fit all requisite projects and activities, the state can ensure that the impacts of various interventions and policies are properly monitored; along with providing key learnings about any further requirements to ensure inclusive and complete development across the agriculture sector in Telangana.

The proposed M&E framework is grounded in the local context, it recognizes the heterogeneity of needs and maintains the local relevance. Lessons will be drawn from this exercise form the foundation for the development of the sector-level M&E at the national scale, with the framing of a more generalized framework that is flexible enough to take into account the contextual needs of individual states.

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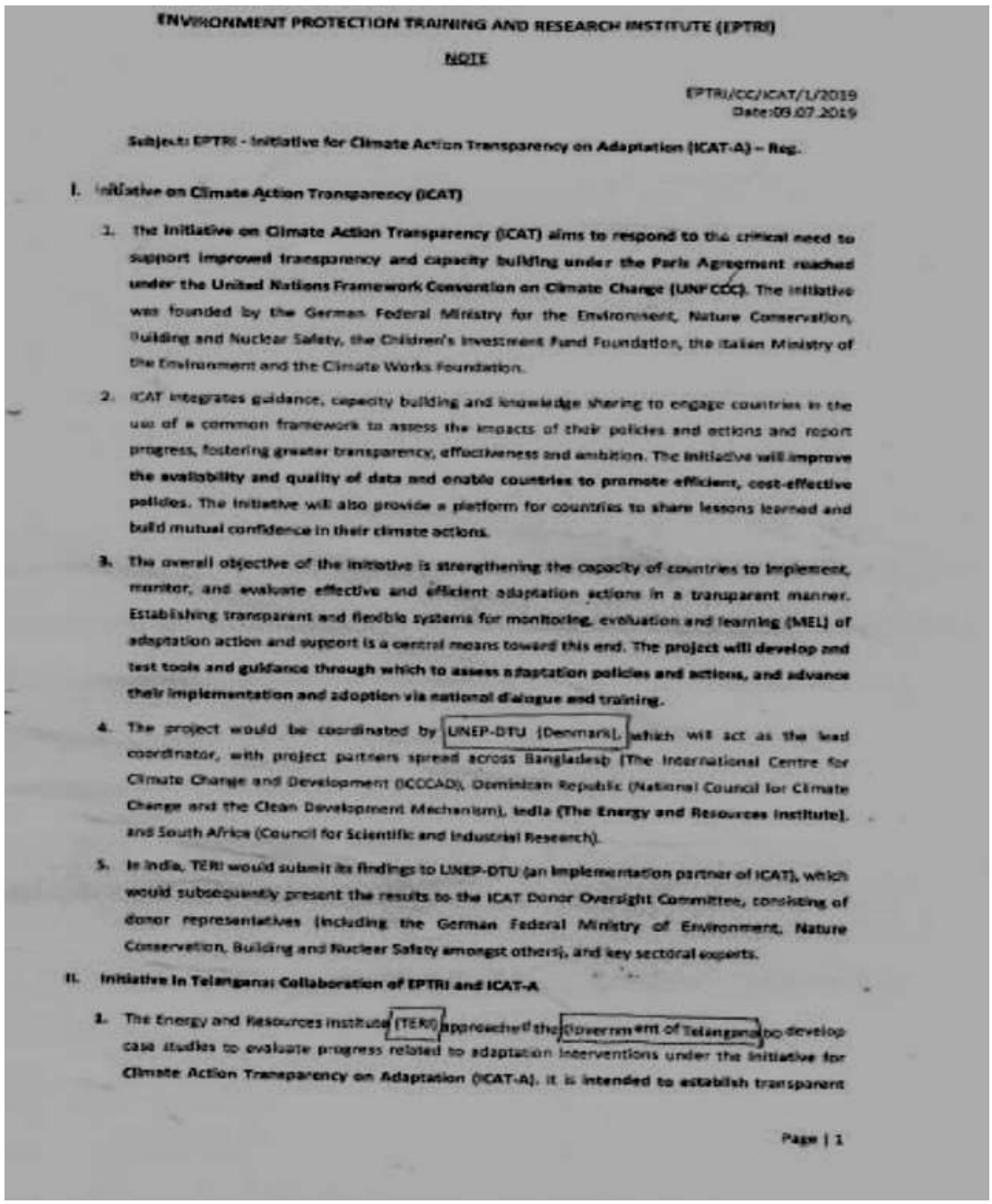
Annexure

No Objection Certificate from the Government of Telangana



ENVIRONMENT PROTECTION TRAINING AND RESEARCH INSTITUTE (EPTRI)

NOTE

EPTRI/CC/ICAT/L/2019
Date:09.07.2019

Subject: EPTRI - Initiative for Climate Action Transparency on Adaptation (ICAT-A) – Reg.

I. Initiative on Climate Action Transparency (ICAT)

1. The Initiative on Climate Action Transparency (ICAT) aims to respond to the critical need to support improved transparency and capacity building under the Paris Agreement reached under the United Nations Framework Convention on Climate Change (UNFCCC). The initiative was founded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, the Children's Investment Fund Foundation, the Italian Ministry of the Environment and the Climate Works Foundation.

2. ICAT integrates guidance, capacity building and knowledge sharing to engage countries in the use of a common framework to assess the impacts of their policies and actions and report progress, fostering greater transparency, effectiveness and ambition. The initiative will improve the availability and quality of data and enable countries to promote efficient, cost-effective policies. The initiative will also provide a platform for countries to share lessons learned and build mutual confidence in their climate actions.

3. The overall objective of the initiative is strengthening the capacity of countries to implement, monitor, and evaluate effective and efficient adaptation actions in a transparent manner. Establishing transparent and flexible systems for monitoring, evaluation and learning (MEL) of adaptation action and support is a central means toward this end. The project will develop and test tools and guidance through which to assess adaptation policies and actions, and advance their implementation and adoption via national dialogue and training.

4. The project would be coordinated by UNEP-DTU (Denmark), which will act as the lead coordinator, with project partners spread across Bangladesh (The International Centre for Climate Change and Development (ICCCAD), Dominican Republic (National Council for Climate Change and the Clean Development Mechanism), India (The Energy and Resources Institute), and South Africa (Council for Scientific and Industrial Research).

5. In India, TERI would submit its findings to UNEP-DTU (an implementation partner of ICAT), which would subsequently present the results to the ICAT Donor Oversight Committee, consisting of donor representatives (including the German Federal Ministry of Environment, Nature Conservation, Building and Nuclear Safety amongst others), and key sectoral experts.

II. Initiative in Telangana: Collaboration of EPTRI and ICAT-A

1. The Energy and Resources Institute (TERI) approached the Government of Telangana to develop case studies to evaluate progress related to adaptation interventions under the Initiative for Climate Action Transparency on Adaptation (ICAT-A). It is intended to establish transparent

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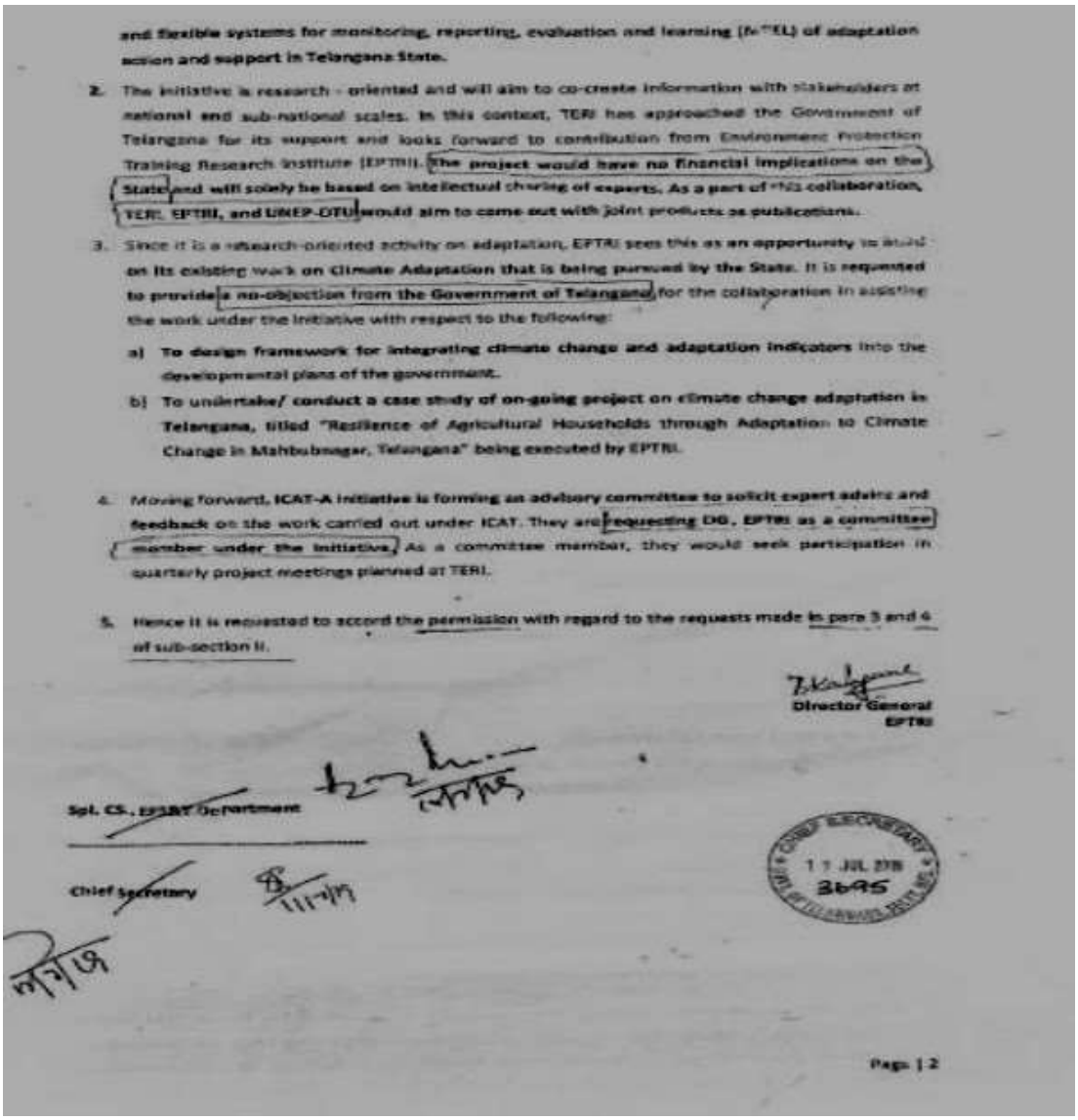

and flexible systems for monitoring, reporting, evaluation and learning (M&E&L) of adaptation action and support in Telangana State.

2. The initiative is research - oriented and will aim to co-create information with stakeholders at national and sub-national scales. In this context, TERI has approached the Government of Telangana for its support and looks forward to contribution from Environment Protection Training Research Institute (EPTRI). **The project would have no financial implications on the State and will solely be based on intellectual sharing of experts. As a part of this collaboration, TERI, EPTRI, and UNEP-DTU would aim to come out with joint products as publications.**

3. Since it is a research-oriented activity on adaptation, EPTRI sees this as **an opportunity to build on its existing work on Climate Adaptation that is being pursued by the State. It is requested to provide a no-objection from the Government of Telangana** for the collaboration in assisting the work under the initiative with respect to the following:

   a) **To design framework for integrating climate change and adaptation indicators** into the developmental plans of the government.

   b) **To undertake/ conduct a case study of on-going project on climate change adaptation in Telangana, titled "Resilience of Agricultural Households through Adaptation to Climate Change in Mahbubnagar, Telangana" being executed by EPTRI.**

4. Moving forward, **ICAT-A initiative is forming an advisory committee to solicit expert advice and feedback** on the work carried out under ICAT. They are **requesting DG, EPTRI as a committee member under the initiative.** As a committee member, they would seek participation in quarterly project meetings planned at TERI.

5. **Hence it is requested to accord the permission with regard to the requests made in para 3 and 4 of sub-section II.**

Director General
EPTRI

Spl. CS., EF&T Department

Chief Secretary

11 JUL 2018
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