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Replicable Model for Climate Proofing and Reducing Vulnerabilities due to Climate Change in different Agro Climatic Zones of Maharashtra

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Abstract: ***Watershed Development projects have been implemented all over to address the soil and water conservation issues and social capital formation since long. However, climate change is impacting the agricultural production, productivity, livelihood and income of the farmers severely due to uncertain and erratic changes in weather parameters especially temperature, humidity and rainfall. Thus, there was need to superimpose climate change mitigation and adaption measures on the completed watersheds so we can climate proof the watersheds. Thus, Climate proofing Programme was initiated by NABARD in 2017 and it was implemented by BAIF Development Research Foundation implemented in 19 villages across various Agro climatic zones in Maharashtra. Over a period of 4 years, a range of interventions were undertaken in different agro climatic zones susceptible to diverse climatic risks. This case study highlights the effective climate interventions that were used to reduce vulnerabilities, along with the methodologies behind them in order to build resilience among different communities in Maharashtra. Further, it explores the need and potential for Replication of such climate interventions to increase the adaptive capacities of communities in different agro climatic zones in line with the climate - specific needs of the region. The case study examines three key aspects in which the project can be replicated. The first is the institutional methodology of Region- specific approach for implementation of climate - proofing interventions. Second, demonstrating effective low - carbon, climate - resilient technologies and systems can facilitate scale - up and replication. Third, it discusses the effectiveness of the bottom - Up Approach for Implementation of climate adaptation and mitigation measures: Fourth, the cluster level approach for Addressing Knowledge Gaps can be recommended in all the climate change projects and programmes in India.***

Keywords: Climate Change, Climate Resilience Replicability, Bottom - Up Approach, Region Specific Approach, Vulnerability Assessment, Adaptation Pathways, Climate Proofing.

1. Introduction

A detailed study of the project area was conducted, analysing the biophysical and Agro - climatic context. Vulnerability of the region to climate change was accessed which included hazard mapping, hazard prioritization, existing adaptive capacities and preparation of Adaptation plans using the CRiSTAL tool. The RAPI index was referred, socio - economic conditions of the villages and the Agro climatic zones were accessed.

Historical analysis of climate data of past 30 years was done. Grided data of Rainfall and Temperature of the villages was obtained from IMD.

Treatment measures and adaptation options were identified and tailored to address specific climate change challenges, integrating them into the implementation plan for the watershed's resilience. Based on the agro - climatic zone and an assessment of climatic hazards, the primary climatic risks in each location were identified, and subsequent activities were planned accordingly.

Identified Climatic Risks and Hazards.

- Delay in Onset of monsoon
- High Intensity of Rainfall
- Temperature Extreme
- Heat stress
- Reduced Rainfall

Region - specific approach for implementation of climate - proofing interventions.

Implementation of Climate Proofing Watershed Project" in four districts of Maharashtra, initiated in 2017 with a particular focus on its impact on climate resilience, livelihood improvement, and sustainable natural resource management in different clusters and district (Fig.1) Collaboration with community members, NGOs, NABARD officers, allied state departments, and experts facilitated the review and prioritization of recommended options. Treatment measures and adaptation options were identified and tailored to address specific climate change challenges, integrating them into the implementation plan for the watershed's resilience. The project was implemented taking into consideration the 4 Agro Climatic zones of Maharashtra viz.,

- Madhya Maharashtra, Western Maharashtra Scarcity Zone (MH - 6), Transition zone II
- Marathwada, Western Maharashtra Scarcity Zone (MH - 6),
- Madhya Maharashtra, Western Maharashtra Scarcity Zone (MH - 6), Sub - Mountain zone/ Transition Agro climatic zone - 1 (MH - 4).
- Central Vidarbha, Agro climatic zone (MH - 8), Hot semi - arid Sub eco region

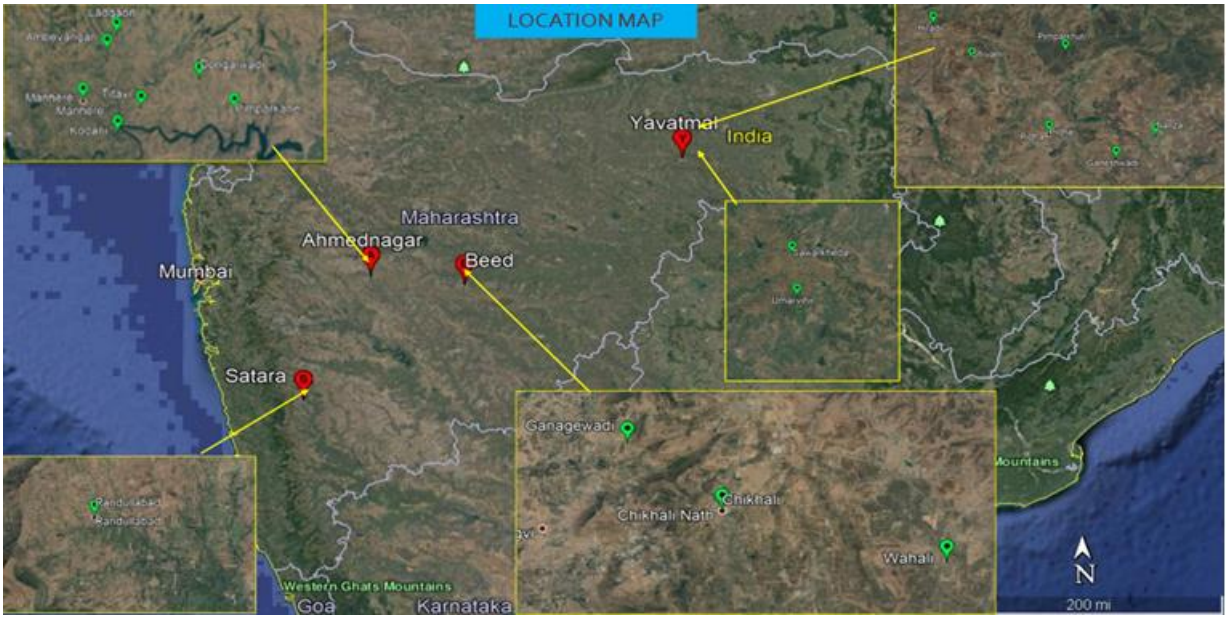

Figure 1: Locations of the project

According to the Agro climatic zones the key climatic risks were identified and interventions were proposed to reduce the vulnerabilities of these climatic risks.

Table 1: Distribution of location according to the Agro Climatic Zone

District	*Agro - climatic zone*	*Taluka*	*Watershed*	*Villages*	*Key Climate Risk*
A	B	C	D	E	F
Ahmednagar	Madhya Maharashtra Western Maharashtra Scarcity Zone (MH - 6) Transition zone II	Akole	Manhere	Manhere, Titvi Kodni, Ladgaon Ambevagan Pimpakarne Dongarwadi	Delayed monsoon Unseasonal rain Temperature extreme (Hot)
Beed	Marathwada Western Maharashtra Scarcity Zone (MH - 6)	Ashti	Gangewadi	Gangewadi	Consecutive drought Hailstorm Temperature extreme (Hot)
		Patode	Wahali	Wahali	
			Chikhali	Chikhali	
Satara	Madhya Maharashtra Western Maharashtra Scarcity Zone (MH - 6) Sub - Mountain zone/ Transition Agro climatic zone - 1 (MH - 4)	Koregaon	Randullabad	Randullabad	Delayed monsoon Hailstorm Temperature extreme (Hot)
Yavatmal	Central Vidarbha Agro climatic zone (MH - 8)	Kalamb	Shivni	Shivani Hiradi	Delayed monsoon Consecutive drought

	Hot semi - arid Sub eco region (6.3)			Ganeshwadi Pimpalkhuti Nanza	Hailstorm Fog Temperature extreme (Hot)
		Ralegaon	Sawarkheda	Sawarkheda Palaskundi Umarvihir	

Climate - resilient technologies and systems can facilitate replication:

According to the Agro climatic zones the Climate - resilient technologies were planned and implemented. Introduction Climate resilient seed Varieties (Local/ Short Duration, Early Maturity, Disease and pest resistant), Crop Diversification, Fodder Cultivation, Water efficiency Measures, IPM, Cattle proof climate sheds were found to be the best adaptive measures which contributed to reduce the vulnerabilities due to climate change.

The preparation of village level contingency plans served as important guides for both government departments and local farmers, offering tailored solutions for a range of unpredictable weather situations. The approach taken to develop these plans was grassroots - oriented, involving district - level scientists from Agricultural Research Stations and Krishi Vigyan Kendras (KVKs), in collaboration with various agricultural organizations like CRIDA, Agricultural Universities, Agriculture Departments, Zonal Agricultural Research Stations (ZARS), KVKs, and farmers themselves. By bringing together experts, local knowledge, and farmer input, these plans were strategically carried out to enhance preparedness and enable timely responses in safeguarding agricultural production. This cooperative approach exemplified a proactive stance in building agricultural resilience. These plans successfully mitigated the negative impacts of uncertain climatic conditions, all the while promoting sustainable farming practices, including the incorporation of indigenous knowledge and the preservation and utilization of local livestock breeds and crop cultivars.

The Village level Contingency Plans cover:
Delay in monsoon onset
Breaks in monsoon leading to early, mid and late-season droughts
Delayed or limited release of water for irrigation
Floods
Unseasonal rains
Extreme weather events: heat wave, cold wave, frost, hailstorm and cyclone

This initiative implemented measures to mitigate climate change risks. Various strategies were enacted to reduce negative impacts from changing climate conditions, enhancing resilience and minimizing vulnerabilities. Weather stations were installed in watershed clusters for real - time monitoring, enabling timely SMS weather advisories to aid farmers' planning. Crop and livestock insurance was introduced to assist recovery from adverse weather losses. These measures effectively safeguarded the community's livelihood and resilience to climate change.

The effectiveness of the bottom - Up Approach for Implementation of climate adaptation and mitigation measures:

Top - down approaches begin by downscaling a few climate model predictions and information from relevant stakeholders to the ground levels. the downscaled climate projections through various models to develop expectations for changes in hydrology, vegetation, social systems, etc are runned. While top - down climate change analyses present a wide range of possible mean future climate conditions, the models do not adequately describe the range of potential future conditions more generally (Stainforth et al.2007b). In addition, top - down analyses provide limited insight into the changes in climate drivers (such as monsoon patterns and atmospheric rivers), and climate extremes (Olsen and Gilroy 2012). As a result, deriving probability distributions is problematic, making it impossible to predict which future is most likely.

Approach:
Bottom-up involving district level scientists of Agricultural Research Stations and KVKs of SAUs

Organizations involved:
CRIDA
Agricultural Universities (SAUs)
Agriculture department
ZARS
KVKs
Farmers

In contrast to top - down approaches, bottom - up climate assessments begin in the vulnerability assessment of the local prevailing conditions. They take important system characteristics and local capacities into account before the sensitivity and robustness of possible adaptation options are tested against climate projections. Bottom - up approaches account for particular intrinsic system characteristics such as exposure, sensitivity, and adaptive capacity as important elements for describing risk (Bouwer 2013). This is in contrast to top - down approaches that use GCM downscaling to “predict, then act” in response to a narrow range of climate variables (Weaver et al.2013).

One of the examples of the bottom - up approach is preparation of Village Level Contingency Plans:

Preparation of local village level contingency plans, Preparation of Detailed project Reports, identifying knowledge gaps existing in the villages and addressing them form the Decision scaling bottom - up approach to integrate

the best current methods for climate risk assessment and robust decision analysis with simple procedures for risk management. This also takes into account the targeted audience and the situations to design targeted solutions.

Addressing Knowledge Gaps: Cluster - Level Approach

Multiple linkages, collaborations and multiple actors are needed to address multiple barriers. For addressing the Knowledge gap that existed at the Grass root level, the existing gaps in the villages were identified and the reasons for the gap were also identified.

Collaboration with community members, NGOs, NABARD officers, allied state departments, and experts facilitated the review and prioritization of recommended options.

Preparing contingency plans, Collaboration with esteemed agricultural research institutions like MPKV ZARS, VNMKV, local KVKs, and Divisional Agriculture Research Station were done.

Awareness campaigns on climate - resilient farming practices empowered farmers with climate - smart techniques.

Exposure visits to research stations and progressive farmers offered field knowledge for adopting optimal crop management.

Crop - specific training on System of Crop Intensification improved productivity and resource efficiency.

Village - level water budgeting implemented for optimized water management and sustainable farming.

Farmers educated about insurance schemes for crop and livestock protection through awareness - building activities, mitigating risks and enhancing financial security.

Facilitated convergence with government schemes and fostered linkages with relevant institutions, ensuring farmers' access to essential resources and support.

Major 3 replications that can be scaled:

1) Water (revival of water bodies) as the prime strategy of climate proofing
2) Bottom - Up Approach (Village level contingency plans) with Partnerships and Linkages.
3) Introduction to Climate resilient seed Varieties (Local/ Short Duration, Early Maturity, Disease and pest resistant), for building resilience against high intensity of rainfall, rainfall irregularities and delay in onset of monsoon Crop Diversification for assured income and income diversification. Agro Weather advisories for early prediction and warnings related to climate, Integrated pest management ensuring losses due to temperature extremes.
4) Cluster level approach to address knowledge gaps which incorporates linkages, partnerships and collaborations can be recommended for replications.