AFB/PPRC.15/12
25 September 2014

Adaptation Fund Board
Project and Programme Review Committee
Fifteenth meeting
Bonn, Germany, 7-8 October 2014

Agenda Item 6 h)

PROPOSAL FOR INDIA (4)

Background

1. The Operational Policies and Guidelines (OPG) for Parties to Access Resources from the Adaptation Fund (the Fund), adopted by the Adaptation Fund Board (the Board), state in paragraph 45 that regular adaptation project and programme proposals, i.e. those that request funding exceeding US$ 1 million, would undergo either a one-step, or a two-step approval process. In case of the one-step process, the proponent would directly submit a fully-developed project proposal. In the two-step process, the proponent would first submit a brief project concept, which would be reviewed by the Project and Programme Review Committee (PPRC) and would have to receive the endorsement of the Board. In the second step, the fully-developed project/programme document would be reviewed by the PPRC, and would ultimately require the Board's approval.

2. The Templates approved by the Board (OPG, Annex 4) do not include a separate template for project and programme concepts but provide that these are to be submitted using the project and programme proposal template. The section on Adaptation Fund Project Review Criteria states:

> *For regular projects using the two-step approval process, only the first four criteria will be applied when reviewing the 1st step for regular project concept. In addition, the information provided in the 1st step approval process with respect to the review criteria for the regular project concept could be less detailed than the information in the request for approval template submitted at the 2nd step approval process. Furthermore, a final project document is required for regular projects for the 2nd step approval, in addition to the approval template.*

3. The first four criteria mentioned above are:
   1. Country Eligibility,
   2. Project Eligibility,
   3. Resource Availability, and
   4. Eligibility of NIE/MIE.

4. The fifth criterion, applied when reviewing a fully-developed project document, is:
   5. Implementation Arrangements.

5. It is worth noting that since the twenty-second Board meeting, the Environmental and Social (E&S) Policy of the Fund was approved and consequently compliance with the Policy has been included in the review criteria both for concept documents and fully-developed project documents. The proposals template was revised as well, to include sections requesting demonstration of compliance of the project/programme with the E&S Policy.

6. In its seventeenth meeting, the Board decided (Decision B.17/7) to approve "Instructions for preparing a request for project or programme funding from the Adaptation Fund", which further outlines applicable review criteria for both concepts and fully-developed proposals. The latest version of this document was launched in conjunction with the revision of the Operational Policies and Guidelines in November 2013.

7. Based on the Board Decision B.9/2, the first call for project and programme proposals was issued and an invitation letter to eligible Parties to submit project and programme proposals to the Fund was sent out on 8 April 2010.

8. According to the Board Decision B.12/10, a project or programme proposal needs to be received by the secretariat no less than nine weeks before a Board meeting, in order to be considered by the Board in that meeting.

9. The following fully-developed project document titled “Enhancing Adaptive Capacity and Increasing Resilience of Small and Marginal Farmers in Purulia and Bankura Districts of West Bengal” was submitted by the National Bank for Agriculture and Rural Development (NABARD), which is the National Implementing Entity of the Adaptation Fund for India. This is the second submission of the proposal, using the two-step approval process. It was first submitted as a project concept to the twenty-third meeting of the Board, and the Board decided to:

> (a) *Endorse the project concept, as supplemented by the clarification response provided by the National Bank for Agriculture and Rural Development (NABARD) to the request made by the technical review;*
>
> (b) *Request the secretariat to transmit to NABARD the observations in the review sheet annexed to the notification of the Board’s decision, as well as the following issues:*
>
> *(i) The fully-developed project document should clearly explain the specific scope of the proposed activities;*
>
> *(ii) The project document should provide a clear rationale and explanation of the SMS-based weather / crop advice;*
>
> *(iii) The project document should elaborate on the approach to replication and scaling up;*
>
> *(iv) When developing the fully-developed project document, additional screening of potential impacts on marginalized and vulnerable groups should take place and that screening should include consultation with the potentially impacted groups;*
>
> (c) *Approve the Project Formulation Grant of US$ 29,700;*
>
> (d) *Request NABARD to transmit the observations under item (b) to the Government of India; and*
>
> (e) *Encourage the Government of India to submit through NABARD a fully-developed project proposal that would address the observations under item (b).*
>
> *(Decision B. 23/8)*

10. The current submission was received by the secretariat in time to be considered in the twenty-fourth Board meeting. The secretariat carried out a technical review of the project proposal, with the diary number IND/NIE/Agri/2014/1, and completed a review sheet. In accordance with a request to the secretariat made by the Board in its tenth meeting, the secretariat shared this review sheet with NABARD, and offered it the opportunity of providing responses before the review sheet was sent to the PPRC.

11. The secretariat is submitting to the PPRC the summary and, pursuant to Decision B.17/15, the final technical review of the project, both prepared by the secretariat, along with the final submission of the proposal in the following section.

Project Summary

India – Enhancing Adaptive Capacity and Increasing Resilience of Small and Marginal Farmers in Purulia and Bankura Districts of West Bengal

Implementing Entity: *NABARD*
Project/Programme Execution Cost: USD 201,162
Total Project/Programme Cost: USD 2,314,385
Implementing Fee: USD 196,469
Financing Requested: USD 2,510,854

Programme Background and Context:

The proposed project aims at developing climate adaptive and resilient livelihood systems through diversification, technology adoption and natural resource management for rural small and marginal farmers associated with agriculture and allied sector in Lateritic Zone of West Bengal, India. Specifically, it would seek to enhance adaptive capacity of vulnerable farm families in semi-arid regions of Purulia and Bankura districts of West Bengal by introducing measures to tide over the adverse impacts of climate change on their food and livelihood security. The project would focus on 5,000 households covering about 22,596 beneficiaries who belong to vulnerable small and marginal farming communities and communities dependent on natural resources as livelihood option. The project would be executed by Development Research Communication and Services Centre (DRCSC), which has been operating in the semi-arid region of West Bengal for the last 15 years. It would build on earlier work done by DRCSC such as the project "Diversifying livelihood options through integrated production system for climate change adaptation and food & livelihood security of the small and marginal farmers in water logged flood plain of West Bengal (CCA IFS)" supported by GIZ and the Indian Ministry of Environment and Forests, and the project "Collective Action to Reduce Climate Disaster Risks and enhancing Resilience of Vulnerable Coastal Communities around the Sundarbans in Bangladesh and India", supported by the European Union.

Component 1: Preparation of Land & Water use master plan (LUMP & WUMP) (USD 54,165)

In order for the communities to develop protocol for collective management of land and water use through better understanding of climate change related impacts. First, time series maps on ground water situation, land use pattern, forest cover, courses of rivers etc. would be prepared using GIS. Second, participatory rural appraisal (PRA) methodologies would be used to identify the key vulnerabilities of a particular community, to understand how community members perceive risks and threats to their lives and livelihoods, and to analyze the resources (capacities) and strategies available to them to address or reduce these risks. Third, climate trend analysis would be used to validate plans. Fourth, a Spatial Decision Support System (SDSS) with Land and Water Use Master Plan for climate change adaptation would be prepared for three Gram Panchayats (local self-governing unit at the small town level).

Component 2: Reducing climate risks through timely and appropriate early warning in local language (USD 55,401)

This component would establish six automated weather stations and 12 manual weather data collection centers to collect local weather information. Based on the information and in collaboration with an expert group comprising meteorological and agricultural experts, crop advisories would be prepared, and disseminated by Climate Resource Centers (CRC) and weather kiosks using SMS services and climate volunteers.

Component 3: Climate resilient technology transfer for enhancing the adaptive capacity of the community (USD 1,877,373)

This component, representing ca. 90 per cent of the total component budgets, would seek to reduce climate risks on livelihoods and to stabilize annual production through introduction of natural resource based diversified and integrated alternative production systems. A range of methods would be used. These would include soil and water conservation measures through contour bunds, check dams, semi-circular bunds, and trenches/pits and planting of multipurpose trees, cover crops and seasonal drought tolerant crops. Step ponds would be used for water-conserving multi-crop farming. Minor irrigation facilities such as dug wells would be sunk in homesteads for home garden irrigation, and small farm ponds for paddy irrigation. Other activities would include multipurpose village woodlots in common lands, food forests and integrated farming systems. The component would also finance post-harvest activities such as grain banks and seed banks, and non-agricultural activities such as biogas units, energy-efficient ovens and water harvesting facilities and water filters.

Component 4: Learning and Knowledge Management (USD 126,284)

The learning and knowledge management component of the project would aim at improving awareness regarding climate change and its impacts, and at increasing popularity of climate resilience practices in the targeted area. For this purpose, various means would be used, such as developing a dedicated website and printed materials, and arranging environment education classes/events in schools targeting direct beneficiary families and indirect beneficiaries. The component would also build networks and partnerships with relevant organisations for strengthening awareness and ownership of adaptation and climate risk reduction processes at local, state and national levels. At the district level, workshops, seminars, meetings, trainings, etc. would be organised with different stakeholders.

ADAPTATION FUND BOARD SECRETARIAT TECHNICAL REVIEW OF PROJECT/PROGRAMME PROPOSAL

PROJECT/PROGRAMME CATEGORY: Regular-sized Project

Country/Region: **India**
Project Title: **Enhancing Adaptive Capacity and Increasing Resilience of Small and Marginal Farmers in Purulia and Bankura Districts of West Bengal**
AF Project ID: **IND/NIE/Agri/2014/1**
IE Project ID:
Requested Financing from Adaptation Fund (US Dollars): **2,510,854**
Reviewer and contact person: **Mikko Ollikainen**
Co-reviewer(s): **Daouda Ndiaye**
IE Contact Person: **P. Radhakrishnan**

Review Criteria	Questions	Comments on 25 August 2014	Comments on 15 September 2014
Country Eligibility	1. Is the country party to the Kyoto Protocol?	Yes.	
	2. Is the country a developing country particularly vulnerable to the adverse effects of climate change?	Yes.	
Project Eligibility	1. Has the designated government authority for the Adaptation Fund endorsed the project/programme?	Yes (endorsement letter dated 14 August 2014).	

	2. Does the project / programme support concrete adaptation actions to assist the country in addressing adaptive capacity to the adverse effects of climate change and build in climate resilience?	Yes, broadly. However, questions regarding sustainability (CR below) and other aspects remain. Component 3 includes a range of proposed activities many of which are not particularly demanding in technical capacity, such as multipurpose woodlots, integrated farming, sustainable agricultural practices, etc. **CR1**: Please explain for each proposed activity, what have been the barriers for adopting the practices listed under Component 3 in the past, and how the project would seek to overcome those barriers. **CR2:** Please explain for each of the activities under Component 3, whether there is experience of using them in the target area and provide very brief examples highlighting experiences, acceptance by community members and possible problems. For any activities for which there is no local experience in the form that is proposed for the project, please explain why it is believed that the approach would work in the target area, referring to experiences, acceptance by community members and possible problems experienced elsewhere.	**CR1**: Addressed. The proposal includes a table (pp. 51-52) on the barriers and ways to overcome them. **CR2:** Addressed. The proponent has explained experience of using soil erosion control measures, rainwater harvesting (step ponds), multipurpose woodlots, nutrition gardens, mixed cropping, and grain banks. Using check dams is very common.

		Component 3 is also planned to support setting up systems that require management, which the community members may not be familiar with, such as grain banks, seed banks and fodder banks, biogas plants and community-based drinking water supply systems. **CR3:** Please explain how the systems, proposed under Component 3, that require technical or organizational management will be managed during and after the project. Please describe both the planned managing entity/structure and the necessary incentive, if any, needed to ensure motivation.	**CR3:** Addressed. The management of the systems, building on DRCSC's experience of 15 years, has been explained in the revised proposal (pp. 78-79).
	3. Does the project / programme provide economic, social and environmental benefits, particularly to vulnerable communities, including gender considerations, while avoiding or mitigating negative impacts, in compliance with the Environmental and Social Policy of the Fund?	Yes, the proposed has potential to produce these benefits. However, please see CRs above on feasibility.	
	4. Is the project / programme cost effective?	Yes, the project seems to be very cost effective.	

	5. Is the project / programme consistent with national or sub-national sustainable development strategies, national or sub-national development plans, poverty reduction strategies, national communications and adaptation programs of action and other relevant instruments?	Yes, the project is aligned with the priorities of the National Action Plan on Climate Change, the State Action Plan on Climate Change for West Bengal, and the 12th Five Year Plan.	
	6. Does the project / programme meet the relevant national technical standards, where applicable, in compliance with the Environmental and Social Policy of the Fund?	**CR4:** Please explain, whether the activities proposed for the project, such as check dams, would require environmental impact assessments according to Indian law and regulations. If necessary, please include an environmental and social management plan.	**CR4:** Addressed. The revised proposal explains that the proposed interventions will not require environmental impact assessments according to Indian law and regulations.
	7. Is there duplication of project / programme with other funding sources?	There does not appear to be duplication with other funding sources.	
	8. Does the project / programme have a learning and knowledge management component to capture and feedback lessons?	Yes, the project has a dedicated component on knowledge management.	

	9. Has a consultative process taken place, and has it involved all key stakeholders, and vulnerable groups, including gender considerations?	A consultative process has taken place but based on the presented information it is not clear whether the concerns of women and vulnerable groups have been taken specifically into account in the process. **CR5:** Please elaborate how the consultative process involved women and vulnerable groups, and how their views were taken into consideration.	**CR5:** Addressed.
	10. Is the requested financing justified on the basis of full cost of adaptation reasoning?	Yes, in general the investment is justified.	
	11. Is the project / program aligned with AF's results framework?	Yes.	
	12. Has the sustainability of the project/programme outcomes been taken into account when designing the project?	Activities under component 2 would seem to require setting up new bodies to collect and process weather information to advisories to be disseminated to the local level. **CR6:** Please explain how the functioning of the expert group would be financed after the project. The proposal states: "The Climate Resource Centre (CRC) proposed to be set up in the project area can also be merged with Tathyamitra (Information Kiosk) being set up by State Government, thereby complementing the efforts of the Government. The activity will be implemented in close coordination with Panchayats so that after the withdrawal these can be maintained	**CR6:** Addressed.

		and used further by them in order to collect local data and analyse." **CR7:** Please explain whether there is commitment from either the state government or the panchayat to undertake and finance the respective duties after the project. Activity 2.3 is planned to rely on volunteers to be selected among community leaders. **CR8:** Please explain whether and with which kind of results such use of community leaders as volunteers has been done in the past, whether financial incentive is required and if yes, how the financial incentive would be provided after the end of the project.	**CR7:** Addressed. **CR8:** Addressed. Previous examples have been provided.
	13. Does the project / programme provide an overview of environmental and social impacts / risks identified?	The proposal explains (p. 47) that ditches (and possibly dug wells) would be built on lands belonging to individuals but that after that the water stored in those ditches could be used by neighbouring individuals. **CR9:** Please explain how the rights of the landowners would be protected against involuntary relocation of their livelihoods activities. **CR10:** Please explain how equitable access to the outputs produced by the project would be ensured for community members. **CR11:** Please explain whether indigenous people are present in the project implementation area, and if yes, describe how the project will be	**CR9:** Addressed. **CR10:** Addressed. **CR11:** Addressed. There are no indigenous people in the project area. The consent of the vulnerable Scheduled Tribe and Scheduled Caste population in

		consistent with the 2007 UN Declaration on the Rights of Indigenous Peoples, and particularly with regard to Free, Prior, Informed Consent (FPIC) during project design, implementation and expected outcomes related to the impacts affecting the communities of indigenous peoples; please describe the involvement of indigenous peoples in the design and the implementation of the project, and provide detailed outcomes of the consultation process of the indigenous peoples; provide documented evidence of the mutually accepted process between the project and the affected communities and evidence of agreement between the parties as the outcome of the negotiations. **CR12:** Please explain whether the planned check dams would have negative effects on natural streams, and whether those streams represent critical natural habitats. If the streams include critical natural habitats, please provide an analysis on the nature and the extent of the impact including direct, indirect, cumulative or secondary impacts; the severity or significance of the impact; and a demonstration that the impact is consistent with management plans and affected area custodians.	the project villages has been obtained during consultative process with regards to design of project interventions and expected outcomes. These vulnerable groups would also be part of implementation mechanism of the project. **CR12:** Addressed. The check dams are small structures which will be used for small temporary streams caused by the run-off during monsoon. According to the proponent, the practice of erecting such small check dams is very common in the entire red lateritic soil zone, and they will not have any negative effect on natural streams and ecosystem surrounding it. Further, the streams do not include any critical natural habitats.
Resource Availability	1. Is the requested project / programme funding	Yes.	

	within the cap of the country?		
	2. Is the Implementing Entity Management Fee at or below 8.5 per cent of the total project/programme budget before the fee?	No. The management fee is currently at 8.58 percent of the total project budget. **CAR1:** Please revise the IE management fee to remain at or below 8.5 per cent of the total project budget.	**CAR1:** Addressed.
	3. Are the Project/Programme Execution Costs at or below 9.5 per cent of the total project/programme budget (including the fee)?	Yes.	
Eligibility of IE	4. Is the project/programme submitted through an eligible Implementing Entity that has been accredited by the Board?	Yes.	
Implementation Arrangements	1. Is there adequate arrangement for project / programme management?	Yes.	
	2. Are there measures for financial and project/programme risk management?	Yes.	

	3. Are there measures in place for the management of for environmental and social risks, in line with the Environmental and Social Policy of the Fund? Does the proposal describe how the Implementing Entity will ensure that executing entities are fully aware of their responsibilities with regards to the provisions of the Environmental and Social Policy of the Adaptation Fund, including the promotion of human rights, where applicable, and how the executing entities and direct beneficiaries are made aware of the grievance mechanism available in the country and of the complaint handling mechanism of the Fund, in case of non-compliance?	Yes. However, please see the CRs above related to environmental and social risks.	
	4. Is a budget on the Implementing Entity Management Fee use included?	Yes.	

	5. Is an explanation and a breakdown of the execution costs included?	Yes, in annexure VI.	
	6. Is a detailed budget including budget notes included?	Yes.	
	7. Are arrangements for monitoring and evaluation clearly defined, including budgeted M&E plans and sex-disaggregated data, targets and indicators?	Arrangements for monitoring and evaluation are defined. However, data, targets and indicators are not disaggregated by gender. **CR13:** Please include sex-disaggregated data, targets and indicators.	**CR13:** Addressed. Gender considerations have been taken into account in monitoring, including sex-disaggregation of results framework targets.
	8. Does the M&E Framework include a break-down of how implementing entity IE fees will be utilized in the supervision of the M&E function?	Yes.	
	9. Does the project/programme's results framework align with the AF's results framework? Does it include at least one core outcome indicator from the Fund's results framework?	Yes.	

	10. Is a disbursement schedule with time-bound milestones included?	Yes. **CR14:** Please include a disbursement matrix in which the payments are made annually rather than biannually. The Adaptation Fund results based management system is based on annual project performance reports whose clearance by the Adaptation Fund Board releases the subsequent annual tranche.	**CR14:** Addressed.

Technical Summary	The overall goal of this proposed project is to develop climate adaptive and resilient livelihood systems through diversification, technology adoption and natural resource management for small and marginal farmers associated with agriculture and allied sector in the Red and Lateritic Zone of West Bengal. To this end, the project plans to enhance the adaptive capacity of 5,000 vulnerable farm families in semi-arid regions of Purulia and Bankura districts of West Bengal by introducing measures to adapt to the adverse impacts of climate change on their food and livelihood security. More specifically, the project seeks to help communities to adopt land and water use master plans with the help of local government through better understanding of climate change related impacts. The project would also equip farmers to be better prepared for climate resilient agriculture and wastelands development, make their livelihoods less vulnerable to climate change, and achieve higher levels of productivity. The project would also publish various types of materials on processes and techniques, and take measures to scale up the interventions to improve climate resilience in the red and lateritic zone. The initial technical review found that the proposed IE management fee was above the maximum set by the Adaptation Fund Board and needed to be lowered. **CAR1:** Please revise the IE management fee to remain at or below 8.5 per cent of the total project budget. In addition, the initial technical review made a number of clarification requests: **CR1**: Please explain for each proposed activity, what have been the barriers for adopting the practices listed under Component 3 in the past, and how the project would seek to overcome those barriers. **CR2:** Please explain for each of the activities under Component 3, whether there is experience of using them in the target area and provide very brief examples highlighting experiences, acceptance by community members and possible problems. For any activities for which there is no local experience in the form that is proposed for the project, please explain why it is believed that the approach would work in the target area, referring to experiences, acceptance by community members and possible problems experienced elsewhere. **CR3:** Please explain how the systems, proposed under Component 3, that require technical or organizational management will be managed during and after the project. Please describe both the planned managing entity/structure and the necessary incentive, if any, needed to ensure motivation. **CR4:** Please explain, whether the activities proposed for the project, such as check dams, would require

	environmental impact assessments according to Indian law and regulations. If necessary, please include an environmental and social management plan. **CR5:** Please elaborate how the consultative process involved women and vulnerable groups, and how their views were taken into consideration. **CR6:** Please explain how the functioning of the expert group would be financed after the project. **CR7:** Please explain whether there is commitment from either the state government or the panchayat to undertake and finance the respective duties after the project. **CR8:** Please explain whether and with which kind of results such use of community leaders as volunteers has been done in the past, whether financial incentive is required and if yes, how the financial incentive would be provided after the end of the project. **CR9:** Please explain how the rights of the landowners would be protected against involuntary relocation of their livelihoods activities. **CR10:** Please explain how equitable access to the outputs produced by the project would be ensured for community members. **CR11:** Please explain whether indigenous people are present in the project implementation area, and if yes, describe how the project will be consistent with the 2007 UN Declaration on the Rights of Indigenous Peoples, and particularly with regard to Free, Prior, Informed Consent (FPIC) during project design, implementation and expected outcomes related to the impacts affecting the communities of indigenous peoples; please describe the involvement of indigenous peoples in the design and the implementation of the project, and provide detailed outcomes of the consultation process of the indigenous peoples; provide documented evidence of the mutually accepted process between the project and the affected communities and evidence of agreement between the parties as the outcome of the negotiations. **CR12:** Please explain whether the planned check dams would have negative effects on natural streams, and whether those streams represent critical natural habitats. If the streams include critical natural habitats, please provide an analysis on the nature and the extent of the impact including direct, indirect, cumulative or secondary impacts; the severity or significance of the impact; and a demonstration that the impact is consistent with management plans and affected area custodians. **CR13:** Please include sex-disaggregated data, targets and indicators. The final technical review finds that the revised proposal has successfully addressed all clarification requests.
Date:	15 September 2014

REQUEST FOR PROJECT/PROGRAMME FUNDING FROM THE ADAPTATION FUND

ENHANCING ADAPTIVE CAPACITY AND INCREASING RESILIENCE OF SMALL AND MARGINAL FARMERS IN PURULIA AND BANKURA DISTRICTS OF WEST BENGAL

By

Development Research Communication and Services Centre (DRCSC)

Through

NATIONAL BANK FOR AGRICULTURE AND RURAL DEVELOPMENT (NABARD)

REQUEST FOR PROJECT/PROGRAMME FUNDING FROM THE ADAPTATION FUND

The annexed form should be completed and transmitted to the Adaptation Fund Board Secretariat by email or fax.

Please type in the responses using the template provided. The instructions attached to the form provide guidance to filling out the template.

Please note that a project/programme must be fully prepared (i.e., fully appraised for feasibility) when the request is submitted. The final project/programme document resulting from the appraisal process should be attached to this request for funding.

Complete documentation should be sent to:

The Adaptation Fund Board Secretariat
1818 H Street NW
MSN P4-400
Washington, D.C., 20433
U.S.A
Fax: +1 (202) 522-3240/5
Email: afbsec@adaptation-fund.org

ADAPTATION FUND

PROJECT/PROGRAMME PROPOSAL TO THE ADAPTATION FUND

PART I: PROJECT/PROGRAMME INFORMATION

Project/Programme Category:	REGULAR PROJECT
Country/ies:	INDIA
Title of Project/Programme:	ENHANCING ADAPTIVE CAPACITY AND INCREASING RESILIENCE OF SMALL AND MARGINAL FARMERS IN PURULIA AND BANKURA DISTRICTS OF WEST BENGAL
Type of Implementing Entity:	NIE
Implementing Entity:	National Bank for Agriculture and Rural Development (NABARD)
Executing Entity/ies:	Development Research Communication and Services Centre (DRCSC)
Amount of Financing Requested:	**2,510,854** (in U.S Dollars Equivalent)

Project / Programme Background and Context:

Provide brief information on the problem the proposed project/programme is aiming to solve. Outline the economic social, development and environmental context in which the project would operate.

1. Climate Vulnerability Profile of India

A vast country with multiple agro-ecological and meteorological zones, India supports one sixth of the world's population on only 2% of its landmass. Nearly 59% of India's land area is prone to risks of earthquakes, 12% is prone to floods, about 8% is prone to cyclones and is exposed to tsunamis and storm surges, 2% of land is landslide prone and 68% of India's arable land is affected by droughts. Thus the entire country is significantly impacted by at least one hazard and related mortality. Intensification of these risks or slower onset disasters like land degradation, drought and floods, are predictable impacts of climate change and climate instability in future. Lack of access to technological and financial resources along with high dependence on climate sensitive livelihood sectors like agriculture, fisheries and forestry, makes India highly vulnerable to climate change.

Some current trends and projection of climatic factors[1]

Surface Temperature: At the national level, increase of 0.4^{o} centigrade has been observed in surface air temperature over the last 100 years.

[1]Source of data –National Action Plan on Climate Change (NAPCC)

Rainfall: Long-term rainfall does not show a very significant trend. Marginal increase in monsoon rainfall is expected along the west coast, northern Andhra Pradesh and north-western India (+10~12%). A decreasing trend is observed in eastern and north-eastern India, part of Gujarat and Kerala (-6~8%).
Extreme Weather: Over the last 130 years no large-scale droughts and floods have been recorded. However, there has been an increasing trend in severe storm incidents along the coast at the rate of 0.011 events per year.
Sea level rise: North Indian Ocean is showing a sea level rise of 1.06~1.75 mm per year. Sea level fluctuations have been estimated at 21 °31' 00"N, 88°03' 00"E during 1985-2000, which shows that the relative mean sea level of the Bay of Bengal is rising @ 3.14 mm/year.

Indian Scientists at the Indian Institute for Technology (IIT) Delhi have indicated that that the severity of floods under the projected climate change is likely to intensify (Gosain et al, 2006). The projections by the National Institute of Oceanography (NIO) showed an increased occurrence of cyclones in the Bay of Bengal, particularly in the post-monsoon period, along with increased maximum wind speeds associated with cyclones and a greater number of high surges under climate change (DEFRA/GoI, 2005). Along with floods, India will also suffer from acute water shortage.

Amongst all the disasters mentioned above, though the number of deaths directly attributable to drought during 1963-1992 is quite less (3%) compared to that caused by floods (26%) and tropical cyclones (19%), yet the number of persons affected by drought (33%) is the highest amongst all the natural disasters and the significant damage caused by drought is 22% which is comparable to the corresponding values of floods and tropical cyclones.

Three fourth of India's annual rainfall comes from the summer monsoons that occur between June and September. Major staple crops like rice, maize and some millet are rain-fed and sown during this season. The agricultural sector lies at the core of Indian society employing 60% of the population and contributing approximately one fifth of the country's GDP. Thus the monsoons are one of the most important factors for the country’s growth. The monsoons and other climatic factors also control the well-being and food/nutrition security of the majority of the Indian populace. 43% of the rural population is landless or near landless (<0.2 ha.) and is dependent on seasonal rain-fed farming or collection of small forest produce or work as wage labour. Monsoons are also responsible for recharge of ground water and surface water systems. A water famine is looming on the horizon because of erratic rainfall, longer dry spells between rainy days, increases in temperature, consecutive droughts and over exploitation of ground water. Water levels in North India fell by 4 centimeters per year, between August 2002 and August 2008. Practices like shifting from growing water prudent millets like sorghum which needs 300 mm of water to water intensive crops like sugarcane which needs 2,500 mm of water, contributed to this situation. More than 109 cubic km of ground water disappeared from aquifers during this time.

Red and Lateritic Soil zone of India

Water scarcity, coupled with poor soil quality increases the vulnerability of the area dominated by **Red and Lateritic soil**.

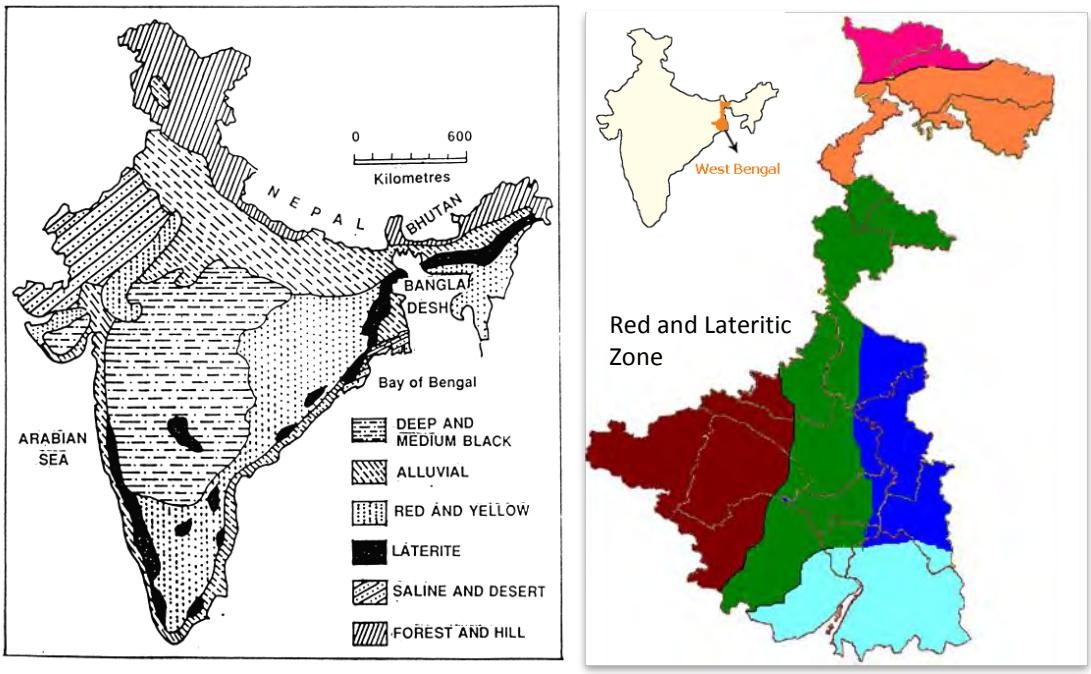


Figure 1: The lateritic zone in India and West Bengal

Red soils are generally red or reddish brown in colour. The colour is due to the coatings of Ferric oxide on the soil particles. Red soil ranges in depth from shallow to very deep, is thin in composition, gravelly in the uplands and deep to very deep in the plains and valleys. The pH varies from generally neutral to slightly alkaline (pH 6.3 to 8.0). Down the slope the pH changes from acidic to neutral (or alkaline). The soil is severely deficient in organic matter, nitrogen, phosphorus and lime but is well supplied with potassium. In some cases, deficiency of calcium and magnesium is also reported.

On the other hand, lateritic soils are deep reddish in colour due to the presence of hematite. These soils are deeply weathered and may extend up to several meters deep. With depth, there is a decreasing intensity of red colour and clay content. The soils are generally well drained and porous. Laterization is intensified with the increase in rainfall. The soils are generally acidic in nature with a pH of 5.5 to 6.5. All lateritic soils are very poor in lime and magnesium and are deficient in nitrogen. Occasionally P_2O_5 may be high, probably being present in the form of iron phosphate, but K_2O is deficient.

Table 1: Red and Lateritic soil areas in India

State names	Area (km^2)	Projected soil zone population
Tamilnadu, Madhya Pradesh, West Bengal, Andhra Pradesh, Kerala, Assam, East Rajasthan, South Karnataka	590,000	416 million (approx.)

Red soil is generally poor in its water holding capacity, which does not permit post rainy season cropping. Such areas face severe problems of soil erosion and are unfit for raising crops. The lateritic soils are also poor in terms of deficiency in phosphate, potassium, calcium, magnesium, zinc and boron content. This pre-condition clubbed with undulating terrain and erratic rainfall has made the target zone for this proposed project more vulnerable. The red/laterite soil zone of India supports some of the worst

rural poverty in the nation. It is also home to approximately 416 million people out of which 53.7 million belong to scheduled Tribes (STs), and Scheduled Castes (SCs) 12.4 million.

A large part of the country's agricultural land has been brought under irrigation but the limited extent of lands owned by the SCs remain almost wholly un-irrigated, forcing even small farmers among the SCs to depend on agricultural wage-labour.

STs, proud masters of their traditional territory, are being progressively deprived of their lands and have, in many cases, been reduced to minorities in their own home-lands. The lands that still remain with them are poorly developed, are rarely irrigated and are unintegrated or poorly integrated with the market, leaving the field open to exploiters and middlemen from outside. Irrigation projects undertaken in the tribal areas, submerged tribal lands, thereby scattering their settlements. As a result an increasing number of STs are forced into agricultural wage labour and the proportion of STs among agricultural wage labourer has increased in recent decades. Traditional symbiotic relationship between tribes and forests has been unilaterally abrogated and abridged.

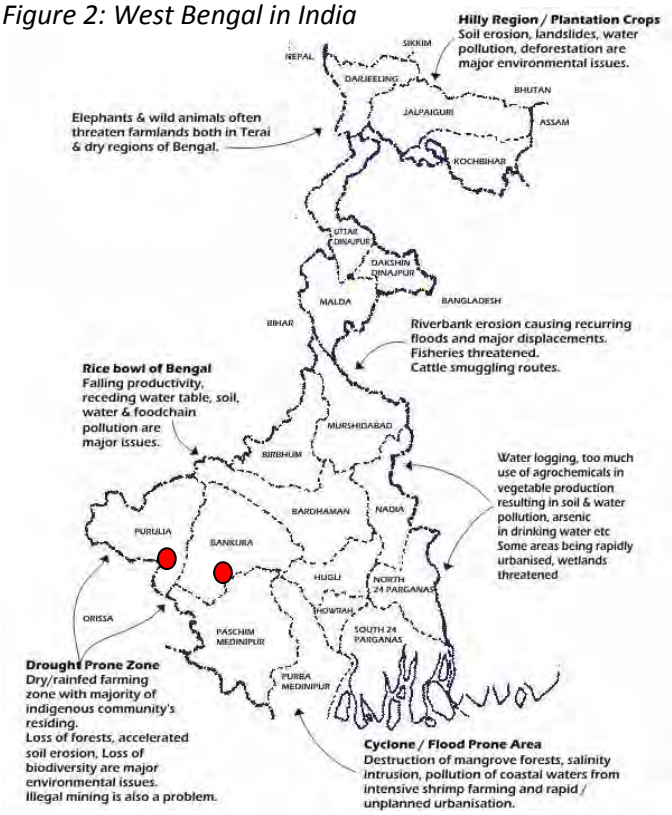
2. West Bengal, the target state profile and position of the districts covered by the project

West Bengal is an eastern state of India. The Net State Domestic Product (NSDP) of West Bengal in respect of climate dependent sectors (agriculture including animal husbandry and horticulture, forestry and fisheries) for the year 2012-13 was 17.4% of the total NSDP at constant 2004-05 prices[2]. Further, 70% of its total population, mainly the rural population, was dependent on these climate sensitive sectors for their livelihood. Of the total rural workers, 19.5% and 19.3% respectively were cultivators and agricultural laborers. According to the Planning Commission, 23% of the total rural population lived below the poverty line in 2011-12 in the state of West Bengal.

Covering only 2.7% of the Indian landmass, West Bengal is home to 12.3% of the nation's flora and fauna. The state has more than 7,000 species of described flora including bacteria, algae, fungi, bryophytes, pteridophytes and angiosperms and more than 10,000 species of described fauna.

[2] Source: Bureau of Applied Economics and Statistics, Govt. of West Bengal

Figure 2: West Bengal in India



West Bengal is also a multi-hazard state with the following agro-ecological zones (Figure 3 left):

- Hill region
- Old Alluvial Zone
- New Alluvial Zone
- Red and Lateritic zone
- Saline Coastal region

Multi-hazard events and the subsequent loss of production and income due to climatic hazards demonstrate that almost the entire state is significantly impacted by at least one hazard and its related vulnerability.

Figure 3: Hazards in different zones of West Bengal

Table 2: Red and Lateritic areas in West Bengal

District names	District Population[3]	Area of the soil zone (km^2)	Estimated soil zone population	Percentage of Households living in poverty[4]	Percentage of Tribal Households[5]
Purulia	2,927,965	6,259	2,898,685	43.6	18.3
Bankura	3,596,292	4,697	1,134,264	42.5	10.4
Birbhum	3,502,387	4,545	2,311,575	44.0	6.7
Paschim Medinipur	5,943,300	7,520	4,280,424	32.9	8.3
Bardhaman	7,723,663	1,821	471,143	26.2	6.4
Total	**23,693,607**	**24,842**	**11,096,091**		
West Bengal	91,347,736	-	-	36.4	5.5

Source: DRCSC estimates compiled from Census data (2011), maps, and state data.

The Red and Lateritic soil zones cover major part of West Bengal and a large proportion of the population lives in this zone (Table 2). The percentage of households living below the poverty line is higher than the state average of 36.4%. The project aims to focus on the **sub-humid west climatic region with Red and Lateritic soil zone in the districts of Bankura and Purulia** to strengthen the

[3]Census of India, 2011

[4]According to a survey done by Govt. of India in 2002. No other survey was done after that and Govt. of India is still undecided about the criteria of Poverty Line.

[5] Census of India 2001

capacity of small and marginal farmers to build resilient livelihood models in line with SAPCC of West Bengal.

Development of successful models can lead to scaling up in similar climatic regions of West Bengal and throughout the other seven states with similar soil conditions in India (Table 1).

3 Characteristics of targeted districts

The chosen areas in Bankura and Purulia share the following characteristics:

- Rainfall is both unpredictable and poorly distributed;
- Rate of soil erosion, deforestation, distress migration, under nutrition and illiteracy is quite high, while farm and forest productivity is low.
- The districts are home for about 2.3 million SC/ST population.

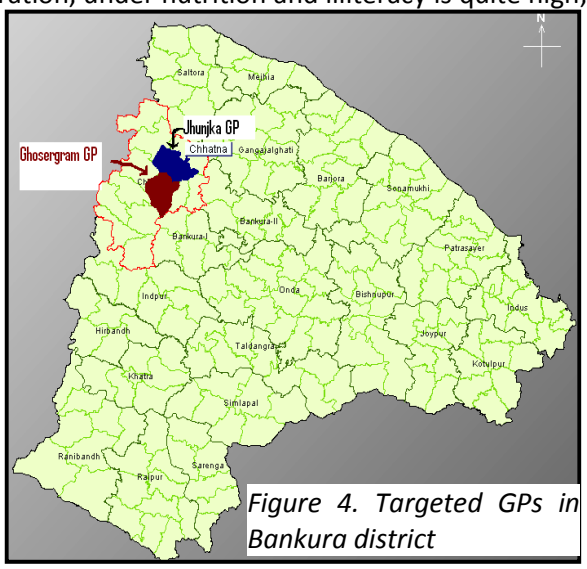


Figure 4. Targeted GPs in Bankura district

The causes of these problems are multidimensional. Undulating terrain and shallow topsoil, high temperature & consequent evaporation loss along with long dry season and periodic dry spells even within the rainy season are part of the problem. In addition to that overgrazing, cultivation of water/chemical intensive crops & adoption of inappropriate cropping/farming system, inadequate investment in developing basic infrastructure as well as lack of community participation in defining developmental priorities are also contributing factors.

Natural forests/water bodies, as a source of fodder-firewood and uncultivated food have decreased – partly due to mining, dams and development projects and partly due to replacement by short or long term mono-species plantations and over harvesting. This combined with restrictions on collection and use of NTFPs has affected the living condition of the landless poor. Rope making, soap making, basket weaving, palm sugar making, mat making and hundreds of other small crafts based on agro waste or forest produces have gradually disappeared as sources of livelihood due to either negligence or lack of support, exploitative monopoly, lack of appropriate technology or a combination of all these.

District profile of Bankura (Physical, Climatic[6] and Demography)

Bankura is situated between 22° 38’ and 23° 38’ north latitude and between 86° 36’ and 87° 46’ east longitude. It has an area of 6,788 km² which is the connecting link between the plains of Bengal on the east and the Chotanagpur plateau to the west. The areas to the east and north-east are low-lying alluvial plains and to the west the surface gradually rises, giving way to undulating topography, interspersed with rocky hillocks. The area consists of two different tracts. The western part of the district has poor, ferruginous soil and hard beds of laterite with scrub jungles and sal (*Shorea robusta*) woods. However,

[6] Prepared as primary research by Dr. Swadesh Mishra, Ex-Agricultural Meteorologist & Rainfall Registration Authority of West Bengal, based on data from Agricultural Meteorology Division, Directorate of Agriculture, Govt. of West Bengal and India Meteorological Department, Govt. of India. With reference from District Statistical Handbook (2005). Bankura and Purulia, Bureau of Applied Economics and Statistics, Govt. of West Bengal.

there is no marked ridge of hills. The rolling downs of the central part gradually merge with the alluvial plains.

Hills and Rivers: The hills of the district consist of outliers of the Chotanagpur plateau and only Biharinath and Susunia are of any great height. Rivers of the area flow from the north-east to the south-west in roughly parallel courses. They are mostly hill streams, originating from the hills in the west. The rivers come down in floods after heavy rains and subside as rapidly as they rise. In summer, their sand beds are almost always dry. Damodar, Sali, Dwarakeswar, Shilabati and Kangsabati are the most important rivers flowing through the district.

Geology: This region is primarily undulating with mounds and valleys and exhibits different grades of the laterisation process in its soil formation. Soils are well drained, susceptible to erosion due to rapid external drainage or run off. Soil reaction ranges from acidic in ridges and near neutral in valleys. Organic carbon content, phosphate and potassium are low. Ground water is not easily and economically accessible. Prevalence of moisture stress on standing monsoon crop in late monsoon period is very common.

Agriculture: Net cultivable area of the district is 430,000 ha and number of cultivators is 447,000. Availability of net sown area per cultivator is approximately 1.0 ha. Due to continuous division and fragmentation of cultivated land, agriculture is becoming less remunerative. About 46% of the net cropped area is under irrigation. The gross cropped area is about 600,000 ha and cropping intensity is 147%. Rice, wheat, oil seeds and vegetables are the principal crops occupying on most of the gross cropped area. Most of the pre-monsoon and monsoon rice are grown in rain-fed condition. Wheat is the second most important cereal crop in the district and it is cultivated only in areas having irrigation facilities. Rape & mustard, and sesame are two important oil seeds grown in this district. Sesame is cultivated in all 3 seasons while rape & mustard is cultivated only in winter. Agriculture is largely dependent on monsoonal rainfall. Drought constitutes a major hazard in the district. Intermittent gaps in precipitation and moisture stress during the monsoon, gives rise to serious setbacks in production.

Weather and Climate[7]: Weather and climate of the district differs slightly between the upland section of the west and north-west and the plains section of the east and south east. However, in general the climate of the district may be called 'tropical sub humid continental'.

- **Rainfall:** It is paradoxical that though Bankura lies in sub-humid zone, it receives total Annual Rainfall of about 1,400 mm[8]. Average annual rainfall of the district is 1,385.9 mm. The amount varies from 1,310.8 mm at Susunia (Chhatna block) to 1575.3 mm at Taldangra which comes between 68.9 and 79.1 rainy days.
- **Temperature**: May is the hottest month when the average daily maximum temperature lies close to 40^0 C and January is the coldest month when average daily minimum temperature remains 11.5^0 C. The difference between the average temperature of the warmest and coldest months is 13^0 C.
- **Relative humidity**: Average morning (at local mean time 07-00 hrs.) and noon (at 14-00 hrs.) humidity varies from 82 – 91 and 49 – 57 per cent respectively.
- **Wind direction and speed**: Due to interior location, average wind speed at Bankura is fairly low.

[7] Detailed information in Annexure 1

[8] Indian Meteorological Department

- **Period of Bright Sunshine Hours**: Bankura records fairly large period of bright sunshine hours per day.
- **Amount of dew**: Dew plays a significant role as a secondary source of moisture during non-rainy period especially in such a dry region. The total amount varies from 41.6 mm to 131.5 mm within the district.
- **Water deficiency and surplus**: An analysis of monthly values of precipitation (P), potential evaporation (PE) of different stations of Bankura shows that there is a period of water deficit lasting for about 8 months and the amount of deficit at different stations varies from 591.7 mm to 873.4 mm. The amount of water surplus is quite encouraging. It varies from 592.3 mm to 808.6 mm although it lasts for 4 months only (June – September).
- **Seasons**
    1. **Cold weather season (December – February)**: Clear sky, bright sunshine, low temperature & humidity and gentle northwesterly or westerly wind are the normal weather features of the season. This is the driest period of the year contributing only 3.1 to 4.4 per cent of the average annual rainfall which varies from 40.8 mm to 69.9 mm in different parts of the district. Rainfall of the season mainly comes in association with the passage of western disturbances and suffers from high variability. The C.V. of rainfall of the season varies between 68 and 81 per cent. Moderate cold wave condition sometimes occurs in the rear of the western disturbances when the minimum temperature drops 6^0 C or more below its normal. The lowest temperature value reached below 5^0 C. January is the coldest month of the season when the mean daily temperature varies between 17.8^0 C and 18.1^0 C and average daily minimum temperature lies close to 11^0 C. Fog sometimes occur in the western disturbances. This season registers very high diurnal range of temperature which varies from 13^0 to 14^0 C.

    2. **Hot weather season (March – May)**: March to May is a period of rapid rise of temperature. Average daily temperature rises from 26^0 C in March to 32^0 C in May. March registers the largest diurnal range of temperature which varies between 14^0 C and 15^0 C and slowly decreases along with the progress of the season. Heat wave condition frequently occurs when the maximum temperature rises even above 47^0 C. Relative humidity of air steadily declines in consequence of rapid rise of temperature and onset of dry continental westerly or northwesterly wind especially during the daylight hours. Southeasterly wind during the evening and night sometimes gives relief after the mid-day heat. During noon in summer, flow of hot dry westerly or northwesterly winds brings down the relative humidity below 5%. Pre-monsoon thunderstorms during the afternoon and evening sometimes bring relief after the mid-day heat. This season contributes 9.0 to 13.8 per cent of the average annual rainfall which varies from 119.8 mm to 191 mm in 8 to 12 rainy days in different parts of the district. The amount of rainfall of the season suffers from the C.V. ranging between 41 and 44 per cent.

    3. **South west monsoon season (June – September)**: South west monsoon is the period of general rain contributing 75 to 80 per cent of the average annual rainfall. The amount varies from 1,014.6 mm to 1,224.6 mm in different parts of the district which comes between 50.2 and 57.9 rainy days. Monsoonal rainfall is more dependable than the rainfall of other seasons and the covariance varies from 17 to 23 per cent in different parts of the district. Monsoon rain usually starts by the end of the second week of June and continues up to the first week of October and characterized by alternately wet and dry spells lasting for 4-5 days to more than 10-15 days. Dry spells are usually longer than the wet spells. Maximum

temperature abruptly drops due to the appearance of monsoon cloud and onset of rain. Minimum temperature does not fall much resulting in a much shorter diurnal range. Both the maximum and diurnal range of temperature suddenly increases during the period of breaks. July and August are the peak monsoon months. From September the amount as well as incidences of rain gradually decreases along with the weakening of monsoon. The region occasionally receives heavy to very heavy rainfall persisting for 2 to 3 days in association with the passage of slow moving low pressure systems or depressions.

4. **Retreating monsoon (October – November)**: Retreating monsoon is the period of transition between the outgoing monsoon and advancing winter. The weather rapidly changes along with the progress of the season. South west monsoon usually withdraws by the second week of October. After its withdrawal, sky becomes gradually clear resulting in steady increase in the period of bright sunshine hours, amount of rainfall decreases and the incidences become few and far between. Minimum temperature begins to drop faster than the maximum temperature causing a gradual increase in the diurnal range. Deposition of dew increases. The season accounts for 6 to 9 per cent of the average annual rainfall amounting from 86.1 mm to 120.4 mm within 4.7 and 7.1 rainy days most of which comes within the first half of October. From October to November the change is more rapid. Amount of rainfall remarkably reduces and the temperature fall becomes more rapid. Cyclonic storms and depressions in the Bay of Bengal sometimes bring spells of cloudy weather, rain and gusty wind during the season.

Reasons for selecting **Chhatna** block for interventions through the project are[9]

- The trend of rainfall over fifteen year is declining.
- The trend in maximum and minimum temperature for the district of Bankura is on the rise.
- The dryness, lack of water, and rainfall aberrations are highest[10]
- Annual rate of water-level fluctuation is maximum in Chhatna, Ranibandh, Raipur, Bishnupur, Joypur, Indus and Kotulpur (4 m to 6 m)
- The dryness, lack of water, and rainfall aberrations are highest[11] (ref. climate data above)
- At Chhatna block, in the long dry season (December -- June) decrease in water level varies between 2 m to 3 m.
- Chhatna has the highest undulation as it has Sushunia hill which is the highest point of Bankura This falls under watershed CD-46, the most degraded one in the district
- Chhatna has the highest scheduled tribes (ST) population in the Bankura Sadar subdivision (Scheduled castes 27.4%, ST 21.8%)[12]
- People below poverty line make up 49.9% of the population, which is the second highest in the district

[9] All data in this paragraph is taken from District Human Development Index 2007 by UNDP
[10] Detailed information in Annexure 1
[11] Detailed information in Annexure 1
[12] The main scheduled tribes residing in the area are santals, oraon, munda

District profile of Purulia (Physical, Climatic[13] and Demography)

Figure 5. Targeted GPs in Purulia district

This district is between 22°42'35" and 23°42'0" north latitude and 85°49'25" and 86°54'37" east longitude. Out of the 2,468 rural inhabited mouzas[14] declared as backward.

Drainage[15]: The main rivers passing through or bordering the district are Kangsabati, Kumari, Darakeswar, Subarnarekha and Damodar. Soil erosion is the most prominent feature of this district resulting in huge deposition of fertile soil in the valley region. As a result, Purulia District is facing crisis due to depletion of fertile top soil and water loss.

Forest: As per Satellite Imagery data 52.5% of total area used for agriculture. 29.7% of the area is under forest coverage and 10.1% is identified as wasteland (14.1% as per Landsat Thematic Mapper/IRS LISS II/III data). The natural forests of the district are mostly of a mixed nature.

Ground Water: The district is a 'White Zone' in respect of ground water status (i.e. 60% of available ground annual recharge is in use). In general, during the rainy season the water table in the wells rises up to 1.00 to 3.50 m below ground level (bgl) till the end of October and gradually falls down to maximum of 6 to 14 m bgl during April-May.

Agriculture: The percentage of net-cropped area to cultivable area is 73.4%. Only 16.53% of the net-cropped area is under multi crop cultivation. 90% of the net-cropped area is under Aman paddy (rainfed) cultivation. Cropping Intensity is 117%. About 60% of the total cultivated land is upland. On the other hand out of the total operational holding, 72.68% belongs to small and marginal farmers (92% of the total number of holdings) having scattered and fragmented small holdings.

Irrigation: As per the Minor Irrigation Census 2001, 17.09% (considering gross cropped area as 391,390 hectare) of the gross cropped area is under irrigation. Contribution of surface flow irrigation source is 88.8%. Out of the total gross irrigated area 74.86% receives irrigation in Monsoon and 21.19% in winter. As per Minor Irrigation Census 2001, total number of Tanks in this district is 26491. Out of which, number of tanks used for irrigation is 18,426 and that for non-irrigation purposes is 8,065. Out of the 32 Medium Irrigation Schemes planned for the district, 23 are completed and 9 are in various stages of execution. There are 135 River Lift Irrigation (RLI) schemes with effective command area. The total irrigation potential created is for 13,500 acres. Irrigation Potential created by the 66 surface flow Minor Irrigation Schemes is 8,193 ha. out of which 6498 ha is in monsoon and 1595 ha in winter-summer. Number of Dug-wells constructed so far is 4218.

[13] Prepared as primary research by Dr. Swadesh Mishra.

[14] A mouza corresponds to a specific land area comprising of settlements in more than one contiguous villages, this is used in land documents for convenience of locating the area in government records

[15] Data of drainage and resources are from www.purulia.zp.in, www.purulia.gov.in

***Weather and Climate**:* Weather and climate of the district is mainly influenced by its continental location, undulating terrain with residual hills, porous soil with very poor moisture retentive capacity and absence of large water bodies or perennial rivers. In a general term the climate of the district may be called 'tropical sub-humid continental with prolonged dry season' (S. Mishra, 1991). The specifications are following.

- **Rainfall:** Purulia is known as the driest district in the state. Pattern of distribution of rainfall in the district is guided by its location with respect to the moisture laden monsoon wind coming from the south and south east and local relief. Average annual rainfall of the district is 1321.9 mm which varies from 1218.8 mm at Burrabazar in the south western part to 1426.6 mm at Bagmundi on the foot of Ajodhya Hill which comes between 66.1 and 74.1 rainy days. Co-efficient of variability of annual rainfall in the district is around 20%.
- **Temperature**: Purulia is one of the warmer districts of the state with high average daily temperature and very high diurnal and annual range of temperature. May is the hottest month when the average daily maximum temperature lies close to 40^0 C and January is the coldest month when average daily minimum temperature lies close to 12^0 C. The difference between the average temperature of the warmest and coldest months is as high as 14.2^0 C.
- **Relative humidity:** Since Purulia is the driest district of the state, the average relative humidity is comparatively low. Average daily morning (at local mean time 07-00 hrs.) and noon (at 14-00 hrs.) relative humidity values of are 79 and 50 respectively.
- **Wind direction and speed:** In Purulia, wind direction is mainly controlled by two principal seasonal pressure pattern of this subcontinent. Southeasterly wind is dominant from May to October, while during the rest part of the year northwesterly and westerly wind becomes important. Winds from other directions are relatively less frequent. Due to interior location, wind speed is low (4.7 km. per hour) which varies from 2.8 in December to 6.7 in May and June.
- **Average Period of Bright Sunshine Hours per day**: Since it is the driest district, the region registers the highest amount of bright sunshine hours per day. The average annual value is as high as 7.4 hrs per day.
- **Amount of dew:** Although not very large in amount but dew plays a significant role as a secondary source of moisture during non-rainy periods. Dew deposition starts from the end of the monsoon season and ceases in April with highest concentration between October and January. Nearly 40 mm of water is received in Purulia in the form of dew.
- **Water deficiency and surplus:** An analysis of monthly values of precipitation (P), potential evaporation (PE) of Purulia shows that there is a period of water deficit lasting for about 8 months and the amount of deficit is 700.2 mm. Although amount of water surplus lasts for 4 months only (June – September), its quantity is substantial -- 617.7 mm.
- **Seasons**
    1. **Cold weather season (December – February)**: Low temperature and humidity, clear sky, bright sunshine, and gentle northwesterly or westerly wind is the normal feature of weather of the season. This is the driest period of the year contributing only 2.9 to 3.8% of the average annual rainfall which varies from 38.8 mm to 53.6 mm in different parts of the district. Rainfall of the season is associated with the passage of western disturbances and the amount is highly variable from one year to the other. Co-efficient of variability of rainfall of the season is the highest and is around 90%. Moderate cold wave condition sometimes occur in the rear of the western disturbances when the minimum temperature drops suddenly 6^0 C or more below normal reaching the lowest value even up to 5^0 C. Average daily temperature of the season varies from 18.9^0 C in January to 21.8^0 C in February while the diurnal range varies from 12.7^0 C to 13.3^0 C.

2. **Hot weather season (March – May)**: March to May is usually a period of rapid rise of temperature and fall of barometric pressure. Average daily temperature rises from 26.9^0 C in March to 33.1^0 C in May with high diurnal range varying from 13.1^0 C to 14.2^0 C. Heat wave condition frequently occurs when the maximum temperature reaches 47^0 C or beyond. Humidity of the air steadily declines in consequence of the rapid rise of temperature and onset of dry westerly or northwesterly continental wind. During summer noon's flow of hot dry westerly and northwesterly wind bring the relative humidity below 5%. This phenomenon is known as 'loo' and is frequent during summer. Pre-monsoon thunderstorms during the afternoon or evening sometimes bring relief after mid-day heat. This season contributes 7.5% to 15% of the total annual rainfall which varies from 95.3 mm to 120.6 mm in 8 to 11 rainy days in different parts of the district. The amount of rainfall of the season, however, suffers from the co-efficient of variability ranging between 37% and 55%.
3. **South west monsoon season (June – September)**: This is the principal rainy season of the year contributing 79% to 83% of the total annual rainfall. The amount of average rainfall of the season varies from 970 mm to 1178 mm in different parts of the district which falls between 50 and 56 rainy days. The amount of monsoon rainfall is more dependable and suffers from low variability ranging between 21% and 25%. Monsoon rain usually starts by the end of the second week of June and continues up to the first week of October and characterized by alternatively wet and dry spells lasting for 4 or 5 days to more than 10 to 15 days. Maximum temperature suddenly drops along with the onset of monsoon rain. July and August are the rainiest months. From September rainfall gradually diminishes along with the weakening of monsoon. In September the region occasionally receives heavy to very heavy rainfall persisting for a couple days in association with the passage of slow moving low pressure systems or depressions.
4. **Retreating monsoon (October – November)**: This is a period of transition between the outgoing monsoon and incoming winter. As a result, the weather rapidly changes along with the progress of the season. South west monsoon usually withdraws from the region by the second week of October. After the withdrawal of monsoon, sky gradually becomes clear resulting in steady increase in the period of bright sunshine hours. Number of incidences of rain gradually decreases. Minimum temperature begins to drop faster than the maximum temperature causing a gradual increase in the diurnal range. Deposition of dew becomes important. The season accounts for 6% to 7% of the average annual precipitation amounting from 78.3 mm to 96.9 mm within 4 and 5 rainy days most of which comes within the first fortnight of October. From October to November the change is more rapid. Amount of rainfall remarkably reduces and the temperature fall is more rapid. Cyclonic storms and depressions in the Bay of Bengal occasionally bring a spell of cloudy sky with rain and gusty wind.

Kashipur block has been selected for the project intervention for the following reasons:

- The dryness, water unavailability, rainfall aberrations are very high[16] (ref. climate data above).
- According to the Rural Household Survey in 2005 to identify the BPL families based on a scoring method that has a 12 point criteria. From block level data we find that 35% of the population in Kashipur is living below the poverty line. Substantial inter-district variation in incidence of poverty is also observed in Kashipur.

[16] Detailed information in Annexure 1

- According to ranking of rural poverty, Kashipur (51.9%) scores 2nd highest poverty among 17 blocks.[17]
- Women's literacy rate is 42% and marginal worker/total worker is 47.8%.[18]
- According to human poverty index, Kashipur ranks 1. Landless agricultural labourers constitute 84.5% of the people living in this block. 42% of the families living in Kashipur do not have any homestead land and live on other's land with or without permission.[19]
- This is adjacent to project location in Bankura.
- Scheduled tribe population of Kashipur block is 54,316 and Scheduled Caste population is 55,024 (Census 2001)
-

1. The climate change Profile

The overall trend and projection as mentioned by State Action Plan on Climate Change (SAPCC) for the state is as follows:

Temperature: It is observed that the maximum temperatures are decreasing across the state the minimum temperatures are increasing. The maximum temperature has become less by 0.5^0C with respect to starting of the observation period (1970s) in the Lateritic zone; whereas, the minimum temperatures are increasing all across the state. In the lateritic zone, the minimum temperature has increased by 0.5^0C.

Precipitation: A recent report of the Indian Meteorological Department (IMD) indicates that there have been distinct changes in observed pattern of rainfall between 1901 and 2003 between the northern and southern regions of West Bengal. In winter and pre-monsoon seasons, rainfall has decreased in the southern region by -14.5 mm and -6.7 mm respectively. In the northern region an increase in rainfall in the pre-monsoon season by +10.5 mm has been observed during the same period, whereas a decrease in rainfall by -1.7 mm in the winter season has been observed over the same period. In the monsoon season the increase in rainfall in the southern region is about 91 mm and in the southern region the increase is approximately 57 mm. Post monsoon season continues to show an increase in rainfall by 25 mm in the southern region, but a decrease in rainfall is observed in the northern region (-5mm). In the monsoon period, the same analysis carried over for 1901-2003 indicates that the June rainfall has decreased by an amount of Precipitation has declined by -3.1% in the northern part of West Bengal and by - 0.9% in the southern part of West Bengal since the 1970s. There is no change observed in the July precipitation in the southern region, but in July there is a perceptible increase in rainfall by 4.5% in the northern region. In August there is an overall decrease of -0.2% and -0.1% in southern and northern parts of West Bengal, respectively. In September, though southern West Bengal shows an increasing trend (+2.5%), the northern part of the state shows a decrease in rain fall by -1.1%. An analysis of total annual rainfall for a recent time slice, between 1990 and 2008, for the 6 agro climatic zones in West Bengal, carried out using the rainfall statistics published in the district handbooks, indicates that there is an overall decrease in the total rain in 2008 with respect to 1990 in the Red and Laterite zone.

Onset of monsoon: Analysis of the dates of the onset of the monsoon for a period of 102 years over Gangetic West Bengal, reveals that the mean date is now 13thJune (previously it was 7th June). However, there has not been any substantial change in the date of withdrawal of the monsoon. These observations, therefore, clearly indicate a gradual reduction in the span of monsoon over this region.

[17] Rural health survey, 2005.

[18] Census 2001

[19] Final Report on "Poverty, Hunger and Public Action": An Empirical Study of on-going Decentralisation Initiatives in West Bengal – Lok Kalyan Parishad and Planning Commission of West Bengal.

Drought-prone: A study of drought for a period of 100 years (1901-2000) indicates that Gangetic West Bengal experienced the phenomena for 7 years during the first 50-year period but the frequency of drought increased by 12% during the second half of the last century.

Observed trend as per SAPCC in Climate in West Bengal

- Between 1969 and 2005, a net warming trend has been established in the annual average temperature
- Minimal decrease in maximum temperatures of the order of -0.25 to -0.5^{o} C in the 37 year period
- Perceptible increase in minimum temperatures has been observed with a range of between +0.25 to +1.5^{o} C within the same period
- Total amount of monsoonal rainfall, which accounts for more than 75% of total annual rainfall over the state, has not changed significantly between 1969-2005
- Tough high variability in inter-annual rainfall in time and space has been observed
- A clear positive trend in post monsoon (Oct-Nov-Dec) rainfall in nearly all the state has been observed during 1969-2005
- The intensity of extreme rainfall events has increased in West Bengal, as concluded by the IMD.

Projections of Climate Change as per SAPCC

Climate projections for the 2050s and 2100 have been derived from PRECIS (Providing Regional Climate for Impact Studies), which is a portable version of the HadRM3 model, developed to run on a PC with a grid resolution of 0.44° x 0.44° driven by the GHG emission scenarios - A1B which assumes a future world of very rapid economic growth, a global population that peaks in mid-century and declines thereafter, and assumes rapid introduction of new and more efficient technologies.

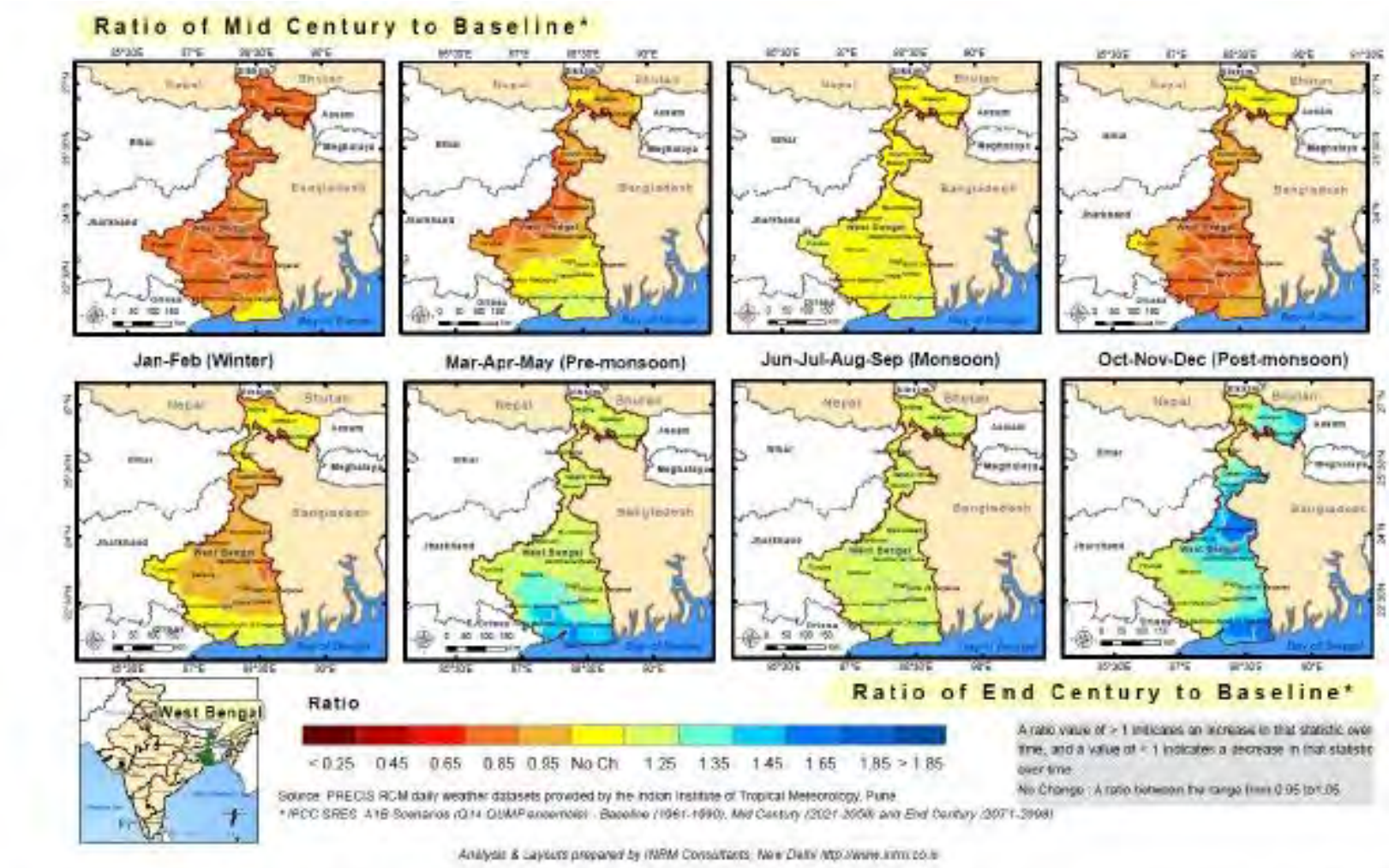


Figure 6. Projected changes in average rainfall during winter, pre-monsoon, monsoon and post-monsoon seasons in West Bengal in the 2050s (upper panel) and in 2100 (lower panel)

Rainfall: Projections of rain fall in West Bengal for midcentury i.e. 2050s (Figure 6, upper panel) indicates that there is no change in monsoon (June-July-August-September) rainfall in the entire West Bengal region in the midcentury, except for an increase that is indicated in the southern Sundarbans region of South 24 Parganas and in eastern part of Purulia. In the winters (October-November-December), however, the scenario changes, the rainfall decreases in most parts of southern Bengal, no change is seen in eastern parts of Purulia and in Coochbehar and Jalpaiguri. A slight increase in rainfall is projected for the northern tip of Darjeeling during the same period. Projections for January and February show an overall decrease in rain fall in entire West Bengal, except in the Sundarbans region where it is projected that there will be no change in rainfall. In summers, the rainfall is likely to decrease northwards in WB starting from Bankura, Purulia, Bardhaman, with no change in Paschim Medinipur, Hoogly, Howrah, and North 24 Parganas, and an increase in summer rainfall in the south 24 Parganas and Uttar Medinipur. However, rainfall will increase in the entire WB region by the end of the century, except in January-February period, when it is likely to decrease in the entire alluvial region from Dakshin Dinajpur in the North to Bankura, Howrah, Kolkata, and northern parts of North 24 Parganas and Paschim Dinajpur in the South.

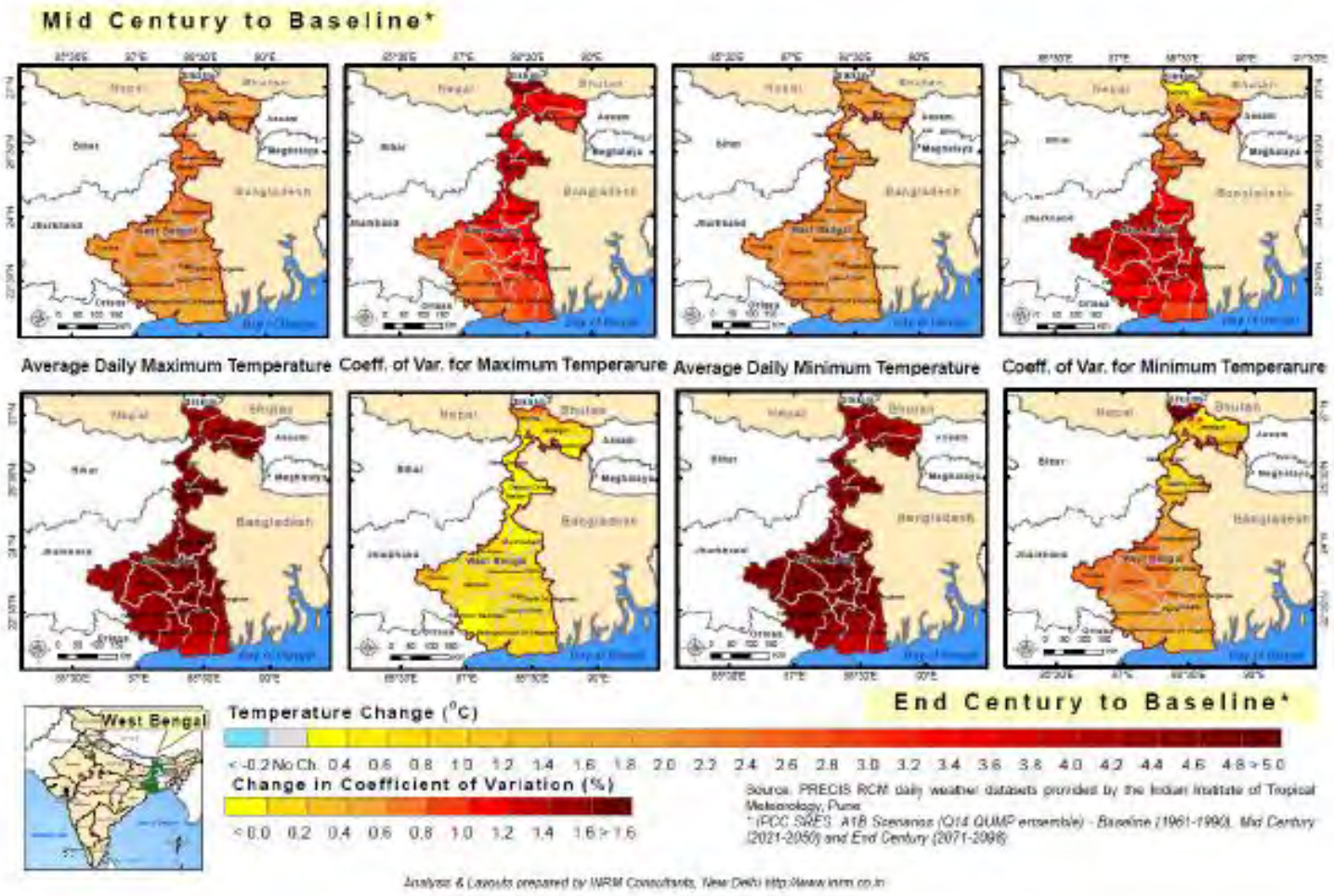


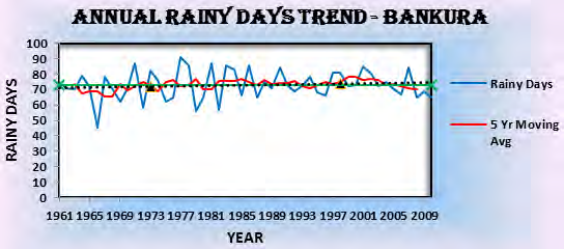
Figure 7. Projected changes in temperature in West Bengal in 2050s (upper panel) and in 2100 (lower panel)

Temperature: As regards temperature, in the 2050s, the average daily maximum and minimum temperatures are both projected to rise by 2.2°C in 2050s and by 2100, the temperatures are likely to rise by 3.6 to more than 5°C with respect to the base line i.e. 1960-1990 (see above Figure).

Location specific analysis for the selected districts and block[20]

Salient features of the long term trend[21]

Rainfall (1961-2010): An analysis of rainfall data of last 50 years using the technique of semi average trend shows the following facts:



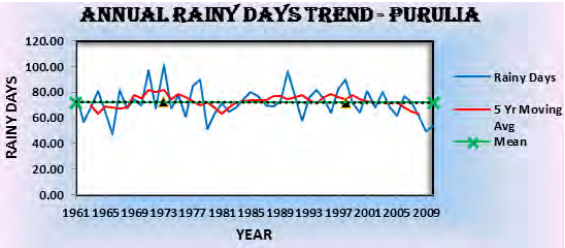
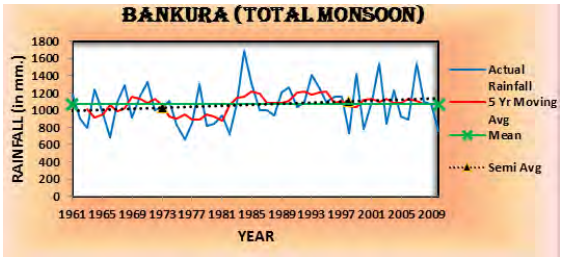


Table 3: Annual number of rainy days

Station	1961-2010 (X)	1961-1985 (X_1)	1986-2010 (X_2)	X_1-X_2	X_1-X_2 as % to X
Bankura	73.0	72.0	73.9	1.9	2.6
Purulia	72.2	72.4	72.0	-0.4	-

Monsoon rainfall trend (Jun-Sept)



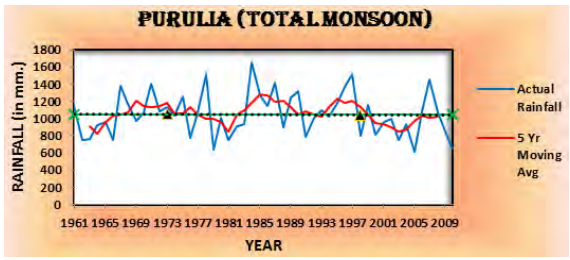
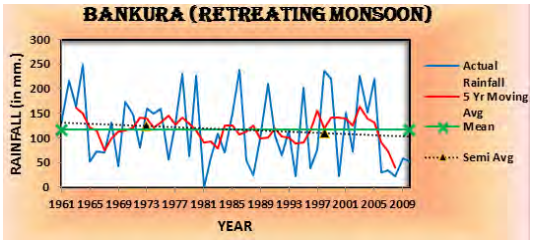
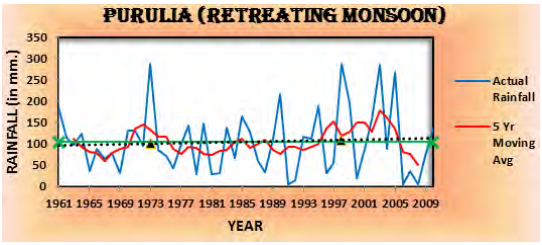


Table 4: Monsoon Rainfall

Station	1961-2010 (X)	1961-1985 (X_1)	1986-2010 (X_2)	X_1-X_2	X_1-X_2 as % to X	Remarks
Bankura	1065.8	1029.7	1101.9	72.2	6.8	Marginal increase
Purulia	1048.8	1052.7	1044.9	-7.8	-0.7	No appreciable change

Post monsoon rainfall trend (Oct-Nov)





[20]Prepared as primary research by Dr. Swadesh Mishra, Ex-Agricultural Meteorologist & Rainfall Registration Authority of West Bengal, based on data from Agricultural Meteorology Division, Directorate of Agriculture Govt. of West Bengal and India Meteorological Department, Govt. of India.

[21] See Annexure 1 for more detailed analysis

Table 5: Post Monsoon Rainfall

Station	1961-2010 (X)	1961-1985 (X_1)	1986-2010 (X_2)	X_1-X_2	X_1-X_2 as % to X	Remarks
Bankura	116.8	123.7	109.8	-13.9	-11.9	Moderate decrease
Purulia	104.2	100.2	108.3	8.1	7.8	Marginal increase

Temperature: Analysis of different components of temperature shows that average daily temperature is increasing almost everywhere. Average daily minimum temperature is rising faster than the average daily maximum temperature causing a reduction in the diurnal range. After 1970, increasing trend is well marked and more marked since the beginning of the present century.

Onset and withdrawal of monsoon (1905-2010): Normal date of onset of monsoon over Gangetic West Bengal now stands as on 13th instead of the 7th June. So the date of onset has been delayed by about a week, but the date of its withdrawal remains almost unchanged i.e., by 10th October causing a general reduction in the span or duration of monsoon in this part. However in recent years, delayed withdrawal is noticed.

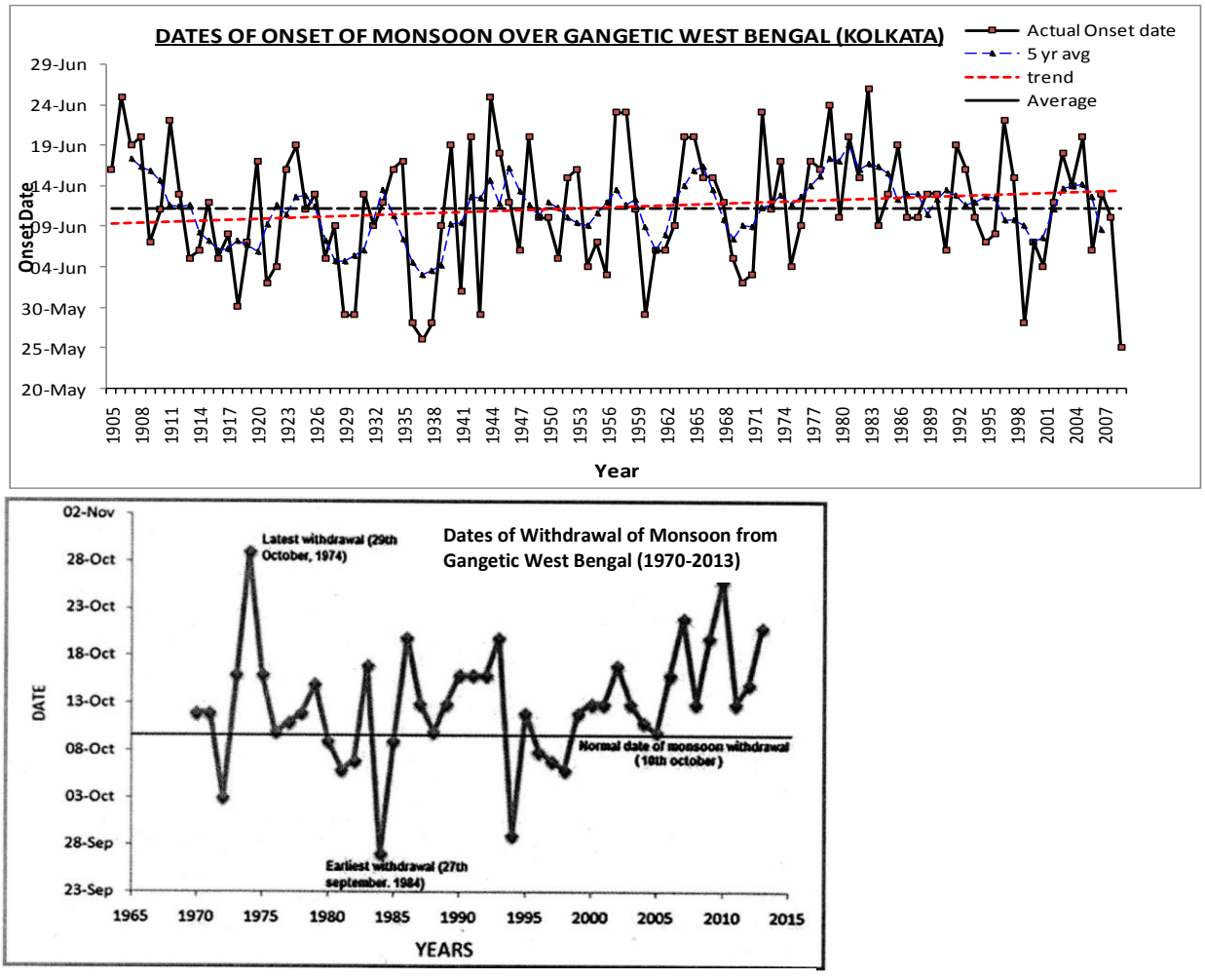


Figure 8: Charts showing Onset and Withdrawal of Monsoon

Incidences of Drought during monsoon (1961-2010): Although the area is well marked as 'drought prone' but the dryness is more due to poor moisture holding capacity of the soil rather than poor rainfall. However, the tendency of occurrence of drought during different phases of monsoon is shown in the following table.

Table 6: *Percentage number of years with drought during different phases of monsoon*

Station	1st half of monsoon (Jun-Jul)	Mid-monsoon (Jul-Aug)	2nd half of monsoon (Aug-Sep)	Total monsoon (Jun-Sept)
Bankura	20	22	32	14
Purulia	24	26	26	20

Recent or on-going trend of weather and climate in the target districts and blocks

In phase two, the study of recent changing trend of weather and climate has been made for a period of the last three and a half decade. The salient features are listed as follows:

- Deposition of dew is decreasing.
- Erratic nature in weather behavior is increasing.
- Typical seasonal character of weather is disappearing.
- Exceptional incidences are becoming the usual ones.
- In general winters are becoming shorter, warmer and drier.
- Summers are becoming longer.
- Post monsoon weather is becoming too uncertain and variable. In recent years wet spells are becoming longer even after withdrawal of monsoon.

Changes in winter weather

- Span of winter has reduced up to 7 days.
- Intensity of winter has decreased.
- Average daily minimum temperature is rising faster than the daily maximum temperature.
- January temperature has slightly decreased while average temperature of all other months is rising.
- In general average winter temperature is rising everywhere varying from 0.1^0 C to 0.5^0 C per one and a half decade.
- During winter intervention of warm spells have increased. On the contrary frequencies of cold spells are few and far between. Warm spells are usually longer than the cold spells.
- Winter rainfall is decreasing everywhere although not at the same rate.
- Completely dry winter seasons have become more frequent during the last 15 years compared to the previous period of the same span.
- Number of rainy days is also decreasing everywhere.

Monsoons are becoming more variable

- Onset of monsoon is being delayed while the withdrawal remaining almost the same causes a reduction in the span of monsoon.
- Variability of rainfall of the monsoon months has increased without causing much change in the total quantity of the season.
- Incidences of partial break in one region and heavy rainfall in the other causing partial drought and flood is on the rise.

Projected changes in climatic environment in the target districts and blocks

By 2050 the probable change of the climatic environment of these two western districts – Bankura and Purulia, will be as follows:

- Bankura will register a marginal increase in the amount of rainfall. The projected amount of average annual rainfall is likely to be around 1425 mm and will be characterized by large fluctuations from one year to the other
- In case of Purulia, the projected figure of average annual rainfall does not show any appreciable change and the annual rainfall value will remain around 1,340 mm
- Variability of rainfall will increase and the agriculturists will have to face more incidences of weather aberrations
- Frequency of drought will increase up to 30%
- Both the districts will register a rise in temperature
- Average daily maximum temperature will increase up to 0.7^0 C and the minimum temperature will rise up to 1.3^0 C from the present value
- Span of winter will be reduced up to two weeks
- Delayed withdrawal of monsoon will be more frequent

The perspective of the community on climate change, and its impact [22]

Based on the Participatory Vulnerability Assessment conducted by DRCSC some of the **sensitivity/preconditions identified**, which adds on to the vulnerability are

- Agriculture is mainly rain fed. Soil is poor in nutrient content
- Lack of technical knowledge of farmers due to loss of traditional knowledge for being overpowered by modern technology
- Deforestation and degradation of natural forest along with plantation of inappropriate plant species
- Undulating terrain, leading to soil erosion
- Ignorance about natural resources and common property
- No job opportunities locally, hence migration seen as a coping strategy
- Landlessness.
- Lack of quality seeds while seedbed is damaged due to untimely rainfall
- Poor access to credit society
- Pressure of money lenders

Participatory Vulnerability and Capacity Assessment

PVCA is a package of PRA tools, which practiced with the community to get to understand the perception of the community on Climate Change, its impact, coping mechanism and suggested adaptation. The tools used are the following:

1. Hazard Ranking – Matrix ranking of hazards
2. Time line of climatic changes - The 'time line' reflects a period of last 20 years starting from current year.
3. Climate Variability Factors – FGD to understand the climate variability factors, its magnitude and Impact on livelihood.
4. Climate Trend Analysis – FGD to understand the indicators of change, magnitude of change and impact.
5. Seasonal Livelihood Analysis – 'Seasonal calendar on scarcity' illustrates the scarcity of basic primary needs for livelihood sustaining

[22] Participatory Vulnerability and Capacity assessment done by DRCSC, see Annexure 2 for the report.

- No or little awareness about 'nutrition'
- Lack of awareness about their rights
- Poor or no linkage with local Govt.
- Less exposure to outer world
- No agricultural advice based on weather pattern.

The following areas of **concerns relating to climate change** have been identified.

- Rainfall is inherently scanty and is declining further, especially during last 5-6 years
- Temperature, both maximum and minimum, is rising
- Rainy days decreased
- Uncertainty of rainfall
- Summer prolonged
- Winters have shortened
- Foggy weather has increased
- Incidence of hail storms increased.

Impact of these

- The forest cover is vanishing gradually. Many food items that were previously collected are no longer grown in the forest. This zone is dominated by tribal people who are generally more dependent on non-timber forest products (NTFP).
- Lack of fodder and degradation of grazing land
- Water sources (wells, tube wells, ponds) are getting dried up quickly during summer causing acute scarcity of drinking water for both humans and cattle
- Winter crops, especially wheat are getting affected
- Soil moisture has reduced leading to more erosion and nutrient loss
- Fallow season and fallow lands have increased
- Surface water bodies drying up
- Major problem is 'uncertainty'. Now it is very difficult for farmers to anticipate the rains by calendar days /months (which they could do earlier). Earlier, for each seed variety, the farmers knew the dates of sowing, transplanting etc. Farmers say this has become 'a guessing game' affecting output
- Both total time period and intensity of fog have increased creating lot of damage to different crops (mainly vegetables and fruits).

2. Socio-Economic Context

Socio-economic profile of the select location based on sample survey is given in Table 7.

Table 7: Socio-economic profile of the selected location on the basis of a 10% sample[23]

	Chhatna, Bankura	Kashipur, Purulia
Demography and Literacy	The average household size: 5.68. The sex ratio: 778 (for age group 0-6 years - *alarming*), 993 (51-70 years) Literacy: 58 for females and 73 for males	The average household size: 5.56 Sex Ratio : 998 Literacy: 60.89 for female and 75.96 for male

[23] See annexure 3 for the detailed socio-economic study.

Livelihoods	1st three primary occupations are Labour - 51%, Farming - 33%, Service - 5% 1st three secondary occupations are Labour - 40%, Self-employment - 19.5%, MGNREGA - 19%	1st three primary occupations are Farming - 68%, Labour - 63%, Self-employed - 13% 1st two secondary occupations are Labour - 37%, MGNREGA - 49%
Infrastructure	Household: 72% Permanent katcha (mud walled thatched) structured houses, 19% pucca (brick-walled & concrete roofed) houses. Toilet: 91.3% belong to no toilet category. Electricity: 49.5% Electricity, 21% Kerosene Oven: 94% traditional chullah Fuel: 54% use firewood as fuel The 1st three sources of drinking water are: Tube-well - 84%, Tap - 9% and Well -7%. 37% faced scarcity of drinking water.	Household: 82% Permanent katcha structured houses. Toilet: 94% belongs to no toilet category. Electricity: 44.92%, 12.83% kerosene Oven: 97.33% traditional chullah Fuel: 96% use firewood as fuel The source of drinking water used by maximum people is Tube-well - 92%. 26% faced scarcity of drinking water.
Agriculture	20% have 'Patta' (registered ownership deed) for their land 17% are share croppers. Majority of land is medium high and upland. Major crops grown are: Paddy in Monsoon; Mustard, Vegetable, Potato in Winter and very few vegetables in pre-Monsoon. 50% sell their produce either to middleman or to outside the village. 88% use chemical fertilizers (DAP, Urea, 10:26:26). Organic manures are being used by 73% by only 87 kg/acre.	88% sell their produce either to middlemen or to people living in other villages.
Income	Monthly average income of Rs. 6,064/-. The average monthly expenses of households is observed to be Rs. 4,946/-. 27% said, they faced scarcity of food. 7% reported fodder scarcity. 21% reported to work outside to meet the shortage. 45% have worked outside for 50~90 days. 64% had worked as daily labour. 36% has taken loan, 60% of the loan in for agriculture.	Monthly average income of Rs. 5784/-. The average monthly expenses of households is observed to be Rs. 4507.44/-. 31% reported to work outside to meet the shortage. 16% faced food scarcity of 77 days on an average. 48% loan has been taken for agriculture.
Dependence on Natural Resources	The weighted average of dependence on natural resources are Food 39.23%, Fuel 74.71%, fodder 54.52%, income 17.45.	The weighted average of dependence on natural resources are Food 15%, Fuel 94%, fodder 60%.

Proposed Location and Beneficiaries[24]

The geographical focus will be 40 villages from Kashipur block of Purulia and Chhatna block of Bankura district[25]. These 2 blocks are representative of the red and lateritic soil semi-arid region of West Bengal. The project will focus on 5,000 households covering about 22,596[26] beneficiaries who belong to vulnerable small and marginal farming communities and communities dependent on natural resources as livelihood option. These households were selected on the basis of preliminary participatory rural appraisal and are the poorest inhabitants of the villages.

The demographic details[17] show that 49.6% of the targeted population belong to scheduled tribes, 31.6% to the scheduled castes and 5% belong to OBC and the minority communities. In so far as the economic status of these families are concerned, they form the most marginalized section of the country (66.26% live below poverty line; the rest 33.74% marked as APL have only the food to sustain them through the year) who are likely to be the most affected due to the impacts of climate change. Within the poor households the women happen to suffer the most although they take part in all kind of agricultural and other livelihood activities doing the household chores at the same time. Naturally they form the most vulnerable section in so far as climate change impacts are concerned.

Before formulation of the project, Participatory Vulnerability and Capacity Assessment (PVCA) was done with the project beneficiaries, whose composition, as detailed in the earlier paragraph, shows that it consists mostly of marginalized people (Scheduled Tribes & Castes and other backward communities). All the interventions were designed to address their problems as articulated by them in the PVCA exercise. (Please refer to PVCA Report in DPR, Annexure 3)

Primary consent from the community was taken for doing the interventions in the area. As all the interventions proposed will be controlled by groups and DRCSC will play the role of the facilitator only, all decisions have to be taken at the group level which will be ratified by the members of the beneficiary group, practically there is no possibility of their rights getting violated; because, DRCSC has been making the people conscious about their rights throughout its activities in the area.

DRCSC has been active in this area for over 15 years and working mainly with the tribal people ensuring that the rights of these people are safeguarded.

About 52% households have their own land[17]. Average land holding is little high in Purulia and landlessness is also low. As more areas are under double and triple crop, pond ownership and field well is also high in number, Purulia happens to be a bit improved in agriculture; whereas, Bankura is predominantly a mono-cropped situation. Paddy is the major crop that people grow during Monsoon, with very less vegetable, wheat and mustard are grown during Ravi.

Bankura, even if it is poor in agriculture, is more dependent on livestock with all families having cow, most of them having poultry and goat or ship. From the income pattern[17] of the beneficiaries, it is quite clear that people in Bankura have less faith on agriculture as a livelihood option and depend more on daily labour. Average income from daily wages is also more than agriculture. But in Purulia, people are more inclined to doing agriculture, which actually gives less income as compared to migration or labour. Livestock plays a poor role in the income pattern.

[24] The details are based on sample survey (10%) done in the project area, for details see Annexure 2
[25] Refer section 1b.1 and 1b.2
[26] Based on the household survey of beneficiaries done by DRCSC

5. Summary of problems and proposed strategies

As mentioned in the section **1, 2, 3, 4**, the summary of impacts are as follows

Issues which affect livelihood of small and marginal farmers	Economic Impact	Impact on Ecosystem	Social Impact	Impact on Development
Water availability	Falling of production and productivity due to water scarcity, lack of water for livestock and poultry	Loss of Biodiversity, Falling Ground water, lack of soil moisture	Inequitable distribution of irrigation water. Land becomes unproductive leading towards poverty. Increasing drudgery of women for bringing water	Lack of drinking water and water for household use and home garden, Water borne diseases in waterlogged area
Drought, long rain break	Falling of production and productive Land remains fallow	Loss of agro biodiversity	Migration, increasing scarcity of food, fodder, firewood and cash	Food and nutrition insecurity, malnutrition
Depleting Natural Resources	Loss of NTFP based livelihood, lack of fodder	Low productivity. Loss of buffer. Loss of diversity. Depletion of ground water.	Migration of landless.	Nutrition insecurity especially during stress period.
Uncertain climatic pattern	Uncertainty in production.	Loss of biodiversity, Pest and disease attack on crops and livestock.	More stress on women for livelihood related work.	More investments on relief rather than development.

Coping and adaptation strategies shared by the community[27]

Adaptation to climate change refers to adjustments in natural or human systems in response to actual or expected climatic effects. The adaptation process includes three essential stages (1) vulnerability assessment; 2) capacity building; and 3) implementation of adaptation measures.

The main implications for reducing the risk to livelihoods through adaptation measures are as follows:

[27]Annexure 2

- The crop-weather advisories will help to reduce the risks and damages caused by climate change. It will capacitate the farmers to take more effective decisions regarding farm management.
- The introduction of sustainable agriculture practices instead of the conventional chemical agriculture will impact the environment positively in terms of climate change. Integrated farming systems will help in reducing climate risk and cost of agriculture which will increase the adaptive capacity of the households.
- Rainwater harvesting measures will enhance the storage capacity to provide irrigation to the rainfed crop in spite of rainfall aberrations as well as the long dry periods and will help to extend the growing season beyond monsoon.
- Introduction of mixed cropping of heat tolerant and low water demanding crops will help to adapt to the rainfall variability and give a more or less sustainable production.
- The other livelihood option of livestock rearing, fishery, sericulture, horticulture etc will shift the over dependence on rainfed agriculture.
- Soil and water conservation measures will ensure ground water recharge which in turn will improve soil health, increase vegetative cover, check soil erosion.
- Grain and seed reserves will equip the community to adapt climate induced disasters.
- Appropriate technologies introduced will reduce the drudgery of women, atmospheric pollution, overdependence on natural assets like forests and fuel costs.

Coping and adaptation strategies shared by the community are given below:

- Rice varieties for the future - *Roghusal, Bhutmuri, Chadrakanta, Puja, Lalgutka, IR-36, LalSwarna, Lalat, Gorya -1, Manikkalma, Asanlaya, Talmari, Chandrakanta, Kashiful, Baiddhula(most are local)*
- Harvesting of rain water by excavation and renovation of ponds.
- Land shaping considering topography.
- Introduction of short duration paddy variety.
- Re-introduction of drought tolerant crops like bajra, jower, kodo, arhar etc.
- Cover crop to protect soil erosion.
- Formation of village youth group to protect and preserve natural resources.
- Use of organic soil nutrient management to increase moisture retention
- Exposure to options and alternatives
- Agri-advisory services.

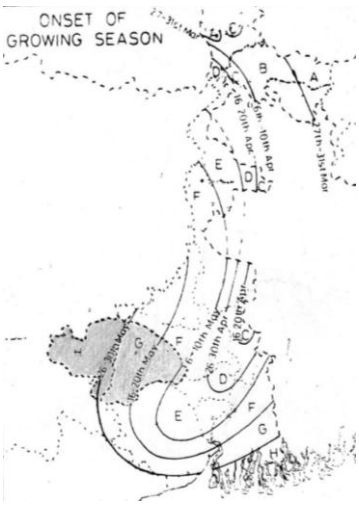
Adaptation strategies mentioned in SAPCC recommendations

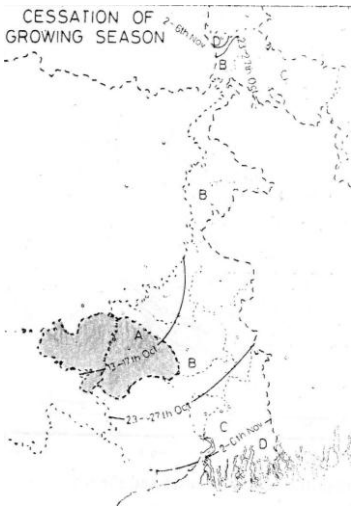
- Undertake special afforestation programmes to increase the run off infiltration ratio through joint forest management practices in identified regions
- Undertake extensive rain water harvesting through dug up pits or directing rain water to the recharge zones in the undulating slopes of the hills to increase the percolation of rain water and thus result in the recharge of ground water, reduce sediment load, and rejuvenate moribund rivers. Create small reservoir schemes such as check dams that intercept rivulets, Nalas, with canal system in this region.

- Encourage surface water schemes, through rain water conservation in ponds/dighis as hard rocks in the area do not provide access to deep aquifers which are free from fluoride.

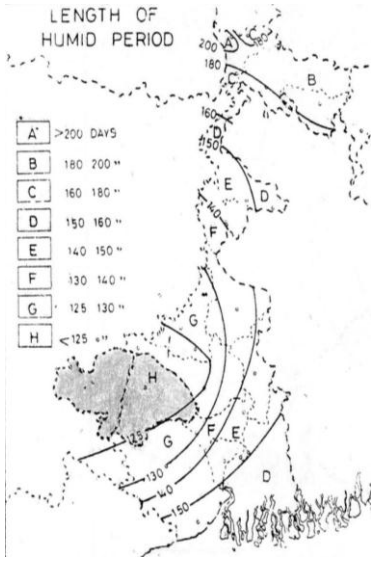
Adaptation to recent climate and climate variability according to climate trend[28]

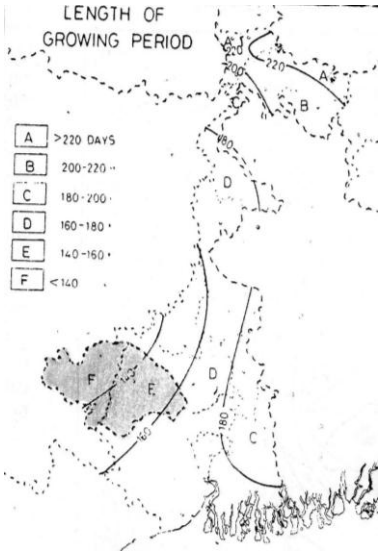
Rain fed agriculture should be limited within the growing period when the rainfall satisfies crop need. In Purulia the length of growing season is a little less than 135 days and in Bankura it varies from about 135 days to more than 160 days.





Purulia has a window of growing season between 26/30th May to 13/17th October. The project location of Bankura has a window of 16/20th May to 13/17th October, with a roughly 140 to 160 days in Bankura and less than 140 days in Purulia and less than 125 days of humid period.





[28] Annexure 1

Table 8: Mean Rainfall (MR) and Assured Rainfall (AR%) Values (mm) of Bankura and Purulia

Stations			Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
BANKURA	MR		15.1	24.4	27.4	33.9	82.4	233.1	313.9	303.3	216.2	98.1	15.2	3.3
	AR	50%	3.6	15.5	17.5	21.1	68.8	190.8	303.5	285.8	190.6	80.5	1.0	0.0
		60%	1.8	9.4	9.4	17.5	57.8	171.7	272.4	252.8	176.0	61.7	0.0	0.0
		70%	0.0	3.8	3.8	10.2	44.2	154.2	239.0	240.0	152.7	51.6	0.0	0.0
PURULIA	MR		16.9	28.2	23.6	26.8	58.1	208.3	310.1	321.1	239.2	88.9	17.6	3.4
	AR	50%	10.2	15.0	9.9	21.2	49.0	180.1	297.4	286.8	218.5	63.5	0.8	0.0
		60%	4.0	10.7	6.4	16.0	40.1	158.8	283.7	271.2	203.5	58.0	0.0	0.0
		70%	0.4	8.5	2.8	9.8	33.2	142.8	264.6	258.6	158.8	38.8	0.0	0.0

At least 60% assured rainfall values should be utilized for agricultural or crop planning in place of mean rainfall because its reliability is much less compared to the 60% assured rainfall values. Climate adaptation also involves rescheduling of crop calendar and crop combination of three main agriculture seasons utilizing.

The proposed strategies in light of the expected impacts and suggestions[29]

Expected Impacts	**Proposed Intervention**
Productivity of temperature-sensitive crops, especially Winter crop is decreasing. Incidences of crop failure are increasing.	Introduction of drought tolerant/resistant crop like millets, crops having less water requirement, local and traditional varieties of rice seeds keeping the humid period, actual rainfall capacity and crops suggested.
Water scarcity is increasing especially during summer and winter season. The rainy season rice fails because of delayed rain.	Rain Water Harvesting through pond excavation, ditch digging, dug well, Roof Top Rain Water Harvesting, River lift irrigation, check dam construction. Increasing soil moisture by application of organic carbon. Weather specific agro-advisory services.
Incidences of pests, diseases and weed are increasing.	Use of Bio pest-repellents, Integrated Pest Management, Mechanical instruments, management practice, mixed cropping etc.
Decomposition of organic material and fertilizer are becoming faster, also decomposition of roots is being noticed.	Mulching, improvement of drainage system, application of *Tricoderma viridi*. This also can be used for positive sense for quicker decomposition of composting material.
Length of growing season of summer crops is increasing due to late monsoon at the cost of the Winter season.	Development of irrigation structures for increasing area under irrigation, adoption of soil and water conservation techniques. Introduction of drought tolerant short duration crops with the window of growing season.
The forest cover and associated biodiversity is vanishing gradually. The collected food items are no longer grown in the forest. This zone is dominated by tribals, who are generally more dependent on non-timber forest products.	Development of social forestry. Plantation of horticulture plants, introduction of Sericulture in plants like *Ber, Arjuna*, sustainable land & water treatment measures.
Lack of fodder and degradation of grazing land.	Emphasis on fodder cultivation, selection and promotion of trees plantation for fodder purpose.
Increasing drudgery of women for bringing water and firewood.	Installation of biogas units, energy efficient ovens, roof top water harvesting etc.

[29] Refer Section 2

Increased migration and loss of livelihood assets.	Introducing allied agriculture activity, creation of opportunity for employment in the project villages to create non-climate dependent livelihood opportunities. improving Farm productivity through Integrated Farming System
Nutrition insecurity increases, especially during stress period.	Nutrition garden, animal husbandry, fishery, promotion of organic farming, grain bank.

Project / Programme Objectives:

List the main objectives of the project/programme.

Overall goal

Developing climate adaptive and resilient livelihood systems through diversification, technology adoption and natural resource management for small and marginal farmers associated with agriculture and allied sector in the Red and Lateritic Zone of West Bengal.

Specific Objectives

To enhance adaptive capacity of 5,000 vulnerable farm families in semi-arid regions of Purulia and Bankura districts of West Bengal by introducing measures to adapt to the adverse impacts of climate change on their food and livelihood security.

Main Outcomes

1. Communities adopt land and water use master plans with the help of Panchayats through better understanding of climate change related impact.
2. Farmers are better prepared for climate resilient agriculture and wastelands development
3. Livelihoods have become less vulnerable to climate change and achieve higher levels of productivity
4. Various types of materials on processes and techniques are published and measures are taken to upscale the interventions to improve climate resilience in the red and lateritic zone

Project / Programme Components and Financing:

Project/Programme Components	Expected Concrete Outputs	Expected Outcomes	Amount (US$)
1. Land & Water use master plan (LUP & WUMP)	Five Gram Panchayat -wise Land and Water use Master Plans are prepared	Communities adopt land and water use master plans with the help of Panchayats through better understanding of climate change related impacts	54,165
2. Reducing climate risks through timely and appropriate weather specific crop/agro-advisory services in local language (Bengali)	***2.1*** Automated Weather stations (AWS) at 6 locations (covering 10 sq.km each), 12 manual data collection centres (MDC) for collection of weather information ***2.2*** The expert group comprising of weather expert and agri experts analyzes the data collected through AWS and MDC and prepares the 5-days crop-weather advisories ***2.3*** A Climate Resource Centre	Farmers are better prepared for climate resilient agriculture and wastelands development	18,360 27,888 9,153

Project/Programme Components	Expected Concrete Outputs	Expected Outcomes	Amount (US$)
	located at the centre of the project area and 40 weather kiosks managed by climate volunteers for collection and dissemination of crop-weather advisories		
3. Climate resilient technology transfer for enhancing the adaptive capacity of the community	*3.1* Sustainable soil and water conservation measures (e.g. semi-circular bunds, check dams, gully plugs, infiltration ditches and agro forestry plantations) for various ecosystems introduced for improvement of agricultural productivity and environmental sustainability *3.2* Multilevel cropping systems & integrated farming practices are introduced mainly through popularizing a combination of drought tolerant field crops, fast growing & multipurpose perennials and small livestock *3.3* Disaster-coping mechanisms like community grain banks, local crop & trees seed banks, fodder banks developed in targeted villages *3.4* Climate resilient appropriate technologies like energy efficient cook stoves, bio-gas, low cost water filters and community based drinking water facility are promoted.	Livelihoods have become less vulnerable to climate change and achieve higher levels of productivity	745,390 901,813 28,330 201,840
4. Learning and Knowledge Management	*4.1* Production of technical and financial data analysis on processes to improve the resilience of the livelihood in red and lateritic zones of West Bengal	Various types of materials on processes and techniques are published and measures are taken to upscale the interventions to improve climate resilience in the	10,000

Project/Programme Components	Expected Concrete Outputs	Expected Outcomes	Amount (US$)
	4.2 Improved access to learnings from the project activities to be ensured through short films, dedicated website and other printed materials *4.3* Advocacy with National / State / Local Government and others (NGOs, CBOs, International organizations, climate activists/experts) on processes and practices adopted under the project	red and lateritic zone	64,084 52,200
5. Project / Programme Execution cost			**2,113,223**
Project Execution Cost			**201,162**
Project / Programme Cycle Management			**1,96,469**
Amount of Financing Requested			**2,510,854**

Projected Calendar:

Indicate the dates of the following milestones for the proposed project/programme

Milestones	Expected Dates
Start of Project/Programme Implementation	October 2014
Mid-term Review (if planned)	September 2016
Project/Programme Closing	September, 2018
Terminal Evaluation	June 2018

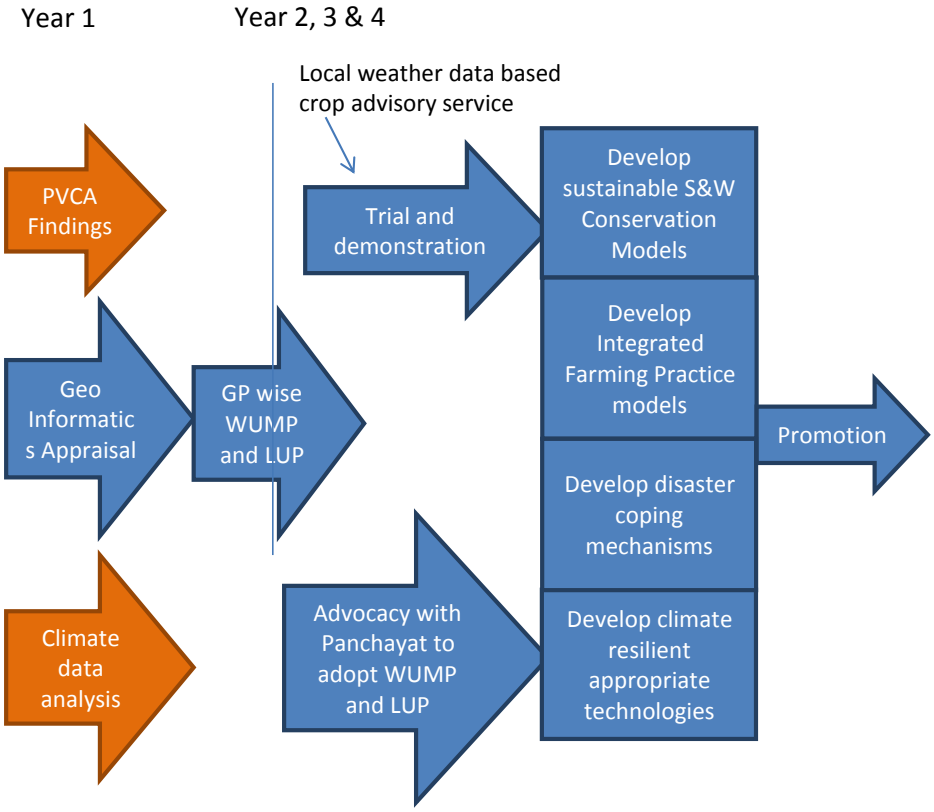
PART II: PROJECT / PROGRAMME JUSTIFICATION

A. Describe the project / programme components, particularly focusing on the concrete adaptation activities of the project, and how these activities contribute to climate resilience. For the case of a programme, show how the combination of individual projects will contribute to the overall increase in resilience.

The overall project plan

The components detailed below have been designed to provide an integrated solution to manage expected climate change risks and uncertainties in the red and lateritic soil zones under two districts of West Bengal. The components constitute a series of interlinked activities, which ultimately leads to enhance community's participation in the climate sensitive natural resource management plan and carrying out actions according to that. It will be supported by modern methods of GIS appraisal, local weather based crop advisory services and already practiced improved models. The community will also be assisted to share the learning outcomes with the larger communities. Models developed as part of the project will have the scope of getting up scaled in red and lateritic zones of the country through advocacy with appropriate authorities in the government at state and central levels for inclusion in state and national policies.

As a process, the entire project envisages a paradigm shift of existing top-down large scale planning process to a bottom up planning and action with support from benefits of science and technology. The entire project is described by the following process diagram, where the process box in orange indicates the processes that are already initiated.



Component 1: Land & Water Use Master Plan (LUMP & WUMP)

This Component proposes drawing of Land Use Plan and Water Use Master Plan considering the Geo-informatics appraisal, community perspective (PVCA report)[30] and climate data analysis[31].

Climate Change is envisaged to exacerbate the water stress in the western arid districts of Bankura & Purulia of West Bengal. In order to assess the vulnerability and the project activity impact with respect to water availability in this region, a holistic research involving **Geo-informatics Appraisal** and micro level planning in a GIS platform is necessary. This would be useful in developing a "Spatial Decision Support System" to reduce the risk to the vulnerable population and to assist in climate change adaptation in the proposed area and to check the efficacy of the planned activities.

Activity 1.1.1: GIS Mapping

To assess the decadal changes in Land Use, Forest and Vegetation Cover, Population GIS Mapping, Socio Economy, Spatial Shifting Pattern of Rainfall and Land Surface Temperature, Subsurface Water Availability and Uses, Water Stress, assessment of Agricultural Drought, identification of Water Bodies perennial and seasonal, shifting of Drainage Network, Elevation, Slope, Aspect Analysis, Catchment, Basin, Watershed Analysis etc

For conducting Geo-informatics Appraisal **School of Oceanographic Studies, Jadavpur University** has agreed to provide technical support to the project.

Till date the plans that the government has tried to implement to address the issue of climate change have been according to the plans done by NAPCC & SAPCC. So far involvement of the community has been limited. As a consequence, a sense of allienation has hindered the community from adopting these plans in their life and livelihoods. The project proposes to introduce a bottom up approach whereby the Land and Water Use Master Plans prepared on the basis ofgeo informatic appraisal, climate trend analysis and community perspective will be owned by the community.

Activity 1.1.2: Gram Panchayat level WUMP and LUP

The Geo-informatics Appraisal will be the guide to draw LUP and WUMPs in each of the targeted Gram Panchayats. Community perspective and community ownership of these plans will be ensured by usingParticipatory Rural Appraisal tools e.g. Village Transect, Social Maping, Resource Mapping, Wealth Ranking, Weather Trend, Instituional Analysis, Time Trend Analysis andSocial Decision Matrix.

The Land and Water Use Master Plans will also be validated with the 50 years' climate data[32]. The Climate Trend Analysis done during the project development phase has been conducted by an expert and the detailed report contains recommendations which will be taken into account during the preparation of the LUP & WUMP. Judicious use of all components like land, soil, water and weather and their proper manipulation and management will be ensured for obtaining optimum and sustainable return from land through agriculture. Variability in weather cycle due to Climate Change will be synchronized with the normal weather requirement of crop during different stages of its cycle in order

[30] Annexure 2 and 3
[31] Annexure 1
[32] Annexure 1

to get full advantage of the changes in weather and climate. Recommendation for crop selection will be made according to where and when it is best suited.

Land use and land cover maps with vegetation and agricultural changes of the study area will also be prepared with the help of multispectral and multi temporal satellite data. Surface water bodies and existing river/ canal network will be mapped with limited ground checking. Elevation data and ground water potential would be combined with the satellite data to arrive at a micro watershed analysis. Drought assessment will be undertaken with high spectral resolution data.

Finally, using all the available results, a Spatial Decision Support System (SDSS) with Land and Water Use Master Plan for climate change adaptation will be prepared. The GP-wise Land and Water Use Master Plans will be shared with the Panchayats. Advocacy will be done at the district, block and Panchayat levels for adaptation of these plans while drawing the Village Development Plans.

Evaluation at the end of Year 4 on all aspects mentioned in activity 2 will be done to validate the efficacy of the interventions done on the basis of LUP and WUMP.

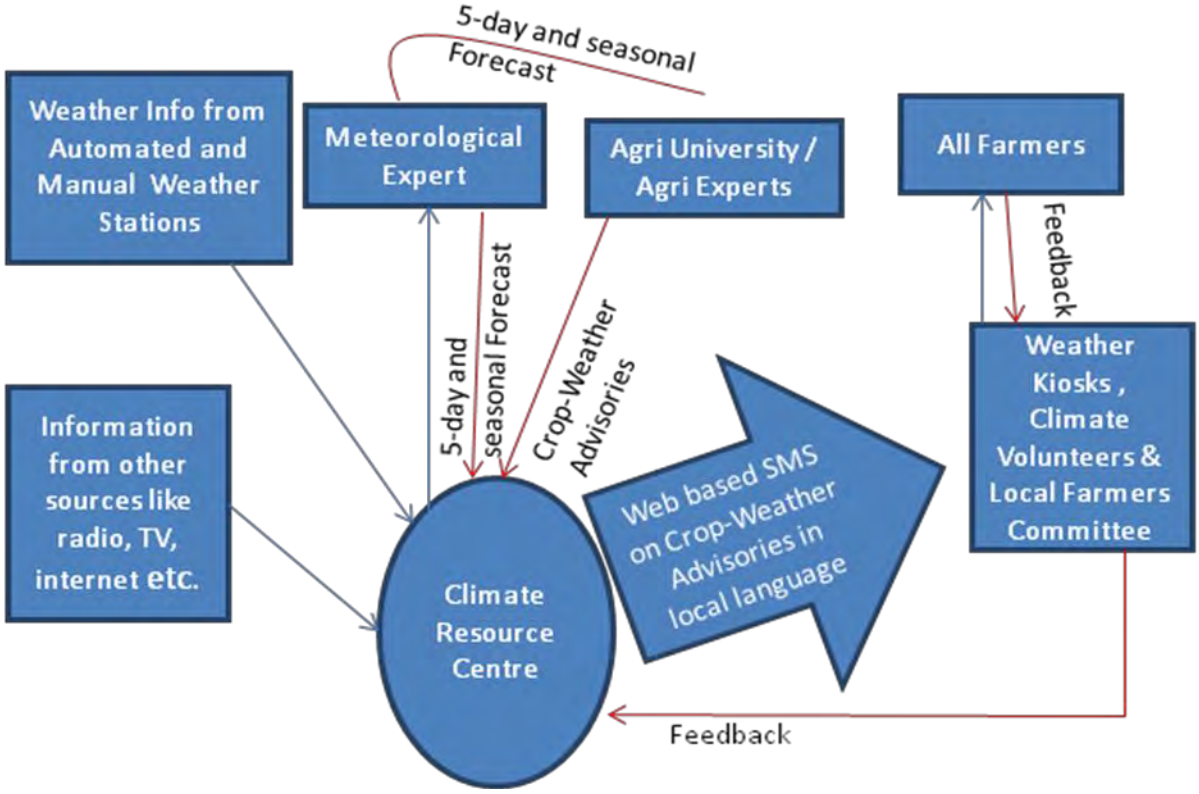
Component 2. Reducing climate risks through timely and appropriate weather specific crop/agro-advisory services in local language (Bengali)

Apart from extreme weather and climate events such as severe droughts, subtle changes like rainfall variability and temperature variations often shock the farming community, particularly in red and lateritic soil zones, leading to decline in agricultural production. In addition, farmers are expected to manage the more insidious effects of long term climate change that may now be occurring at an unprecedented rate. These existing pressures demand the development and implementation of appropriate methods to address issues of vulnerability to weather and climate. Timely Crop-Weather Advisories will assist farmers to develop their adaptive capacity further that will help them to make improved planning and better management decisions. Awareness of targeted farmer groups will be increased by adapting a participatory and cross-disciplinary approach to deliver climate and weather information.

Broad Spectrum of Crop-Weather Advisories

1. Sowing/ transplanting of monsoon crops based on onset of monsoon
2. Sowing of winter crops using residual soil moisture
3. Fertilizer application based on wind condition
4. Delay in fertilizer application based on intensity of rain
5. Prediction of occurrence of pest and disease based on weather
6. Prophylactic measures at appropriate time to eradicate pest and diseases
7. Weeding/Thinning at regular interval for better growth and development of crop
8. Irrigation at critical stage of the crop
9. Quantum and timing of irrigation using meteorological threshold
10. Advisories for timely harvest of crops

The overall plan of this component is explained through the following diagram



Activity 2.1: Installation of AWS and MDC

6 Automated Weather Stations (AWS), 12 Manual Weather Data Collection Centres (MDC) will be set up in various locations within the proposed project area to collect local weather data.

Activity 2.2: Preparation of Crop Advisories

Weather information collected from the AWS and MDC stationed in different points in the project area will be collected by Climate Resource Centre Manager. Then the data will be sent to an Expert Group comprising of Meteorological and Agricultural Experts. The Meteorological Expert will analyze the data with reference to a 30-year weather model (WRP 30 developed by National Centre Atmosphere, USA) of the area, Indian Meteorological Department data and global data. On the basis of the forecasts made Agricultural Experts will prepare crop advisories. The crop advisories SMS will be provided to the CRC for dissemination. The location specific and crop specific farm level advisories (short term and seasonal) containing description of prevailing weather, soil & crop condition and suggestions for taking appropriate measures is expected to minimize the loss of farmers and also optimize input and thereby its costs in the form of irrigation, seed, fertilizer or pesticides. The advisories will also serve as an early warning alerting producers regarding implications of various weather events such as extreme temperatures, heavy rains and strong winds.

The crop advisory services would require involvement of experts like meteorologist, agricultural experts, even after the project period. It is envisaged that the entire intervention of issuing crop advisory services

and associated costs including cost of expert group will be taken over by the local Panchayat. Towards this, discussion were held with the Panchayat officials and Block level officials were held during the consultative process and they were in principle in agreement with this arrangement. During the course of implementation it is proposed to obtain a commitment from the respective Panchayats in this regards.

Activity 2.3: Establishment Climate Resource Centre and Weather KIOSKs

One central level Climate Resource Centre (CRC) and 40 weather kiosks will be established in project villages. The community leaders from each group will be selected as the climate volunteers and their capacity building programmes will be undertaken. The CRC Manager will be responsible to translate the advisories in local language and disseminate to Climate Volunteers stationed in each of the targeted villages and also to the Weather Kiosks through SMS-based mobile services who, in turn, will spread the message to all farmers (targeted and beyond) through farmer groups and display boards in common places. The CRC will also share the advisories with the registered mobile numbers with it beyond our target beneficiaries. The climate volunteers will be responsible for disseminating Crop Weather Advisories, maintaining display boards in Weather Kiosks, physical monitoring and collecting feedbacks so as to know the number of farmers who have actually made changes in their farming activity according to the crop advisory provided and for quality control of the SMS provided. Regular awareness sessions will be organized so that all farmers groups in target areas can understand the implication of the terms used in crop advisories and have the tools to develop local adaptive strategies to safeguard livelihood assets.

DRCSC has motivated beneficiaries under many of the projects for such voluntary actions in the past. A few examples of such action undertaken are given below:

- Plantation on more than 100 km of common property was done with the voluntary participation of the community. The groups involved took the responsibility of protecting the trees and sharing the fruits, fodder and firewood equally among themselves.
- In at least 25 community-based plantation sites covering more than 75 hectares (in 3 villages of Paschim Medinipur, 16 villages of Purulia, 1 village of Bankura, 25 villages of Birbhum), the community leaders along with group members have undertaken the responsibility of protection and intercultural operations voluntarily which does not involve any remuneration or incentive.
- Throughout DRCSC operational area, there have been ample instances of donating personal land for building community assets like Community Training Centre, Common Facility Centre, Area Resource Training Centre and so on. (Saldiha in Purulia, Beriathol in Bankura, Rajnagar, Rautara and Maheshpur in Birbhum, Patharpratima in South 24 Parganas)
- Weather Data like rainfall, maximum-minimum temperature, relative humidity etc. is regularly maintained by volunteers at the village level in Patharpratima, South 24 Parganas.
- Bio-Diversity Registers of 46 villages of North & South 24 Parganas, East Medinipur, Nadia were produced by student volunteers.

The volunteers for this project will be members of beneficiary groups who will be deriving direct benefit out of the project interventions which will act as a motivation for them.

Component 3: Climate resilient technology transfer for enhancing the adaptive capacity of the community

Capitalizing on Component 1 that generates the land and water use plans, Component 3 focuses on transferring the sustainable technologies to the community for increasing their adaptive capacity. In accordance to the plan,

a) **Sustainable soil and water conservation measures** will be taken up with the utmost community participation in order to achieve sustainable management in the long run.
b) The community will be assisted in **diversifying their livelihood activities** away from only climate sensitive practices such as rain-fed agricultural production. The production system will be diversified by integrating various subsystems (crop, tree, aquatic flora-fauna, livestock) so that the produce is distributed over various seasons and space to make the system become more resilient.
c) **Disaster Coping Mechanisms** will be introduced to make the community more prepared to handle the climatic exposures.
d) Introduction of **climate appropriate technologies** will lead to increased resilience at household and community level.

The generic overall plan for the terrain would be like the following diagram, which will be more specified during LUP and WUMP preparation.

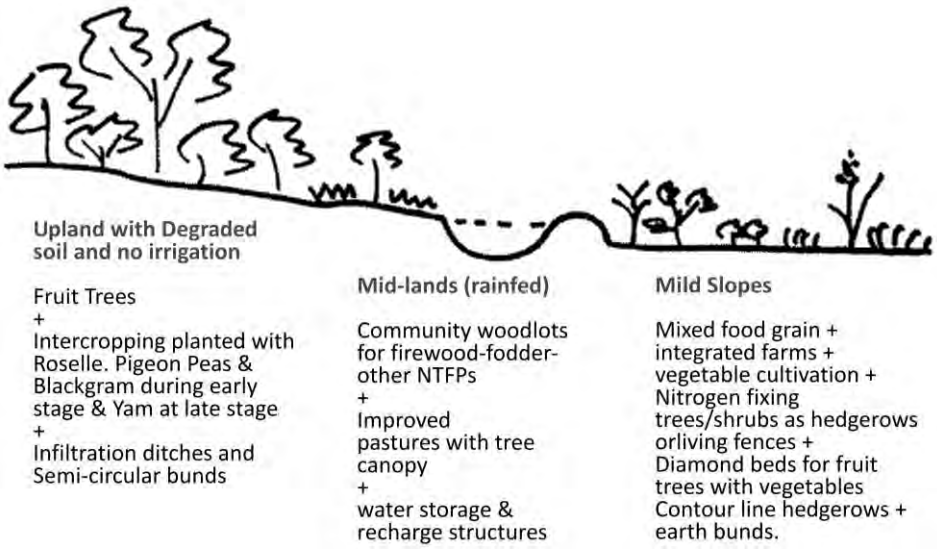


Figure 9: Generic plan for different lands along the gradient

In the red and lateritic soil districts of West Bengal, water availability is the single most important production and livelihood constraint. The PVCA done in the project villages suggest that there is a clearly articulated need to counteract the negative impacts of climate change on water resource-reliant development and livelihoods. It is also necessary to look at the efficiency of water use. Likewise the ability to cope with droughts is necessary in order to protect people, livelihoods and development.

Climate change is expected to have an impact on agricultural production by increasing pressure on water resources. With minimum irrigation facilities, agriculture in Purulia and Bankura is predominantly rain-fed. Maximum rainfall is received between June and September and soil moisture surplus is only found during these months. Both the onset and the cessation of the rains are irregular and the temporal and spatial variability is high.

Both the PVCA Report reflecting community experience and knowledge and Climate Data Analysis (Annexure 1) done by an expert suggest that in both the districts of Purulia and Bankura, a sizeable water surplus is generated after use of rainwater for monsoon crops (mostly paddy). Only a small portion of it gets stored in the surface water storage structures like ponds and ditches; part of it gets recharged in the underground aquifers (recharge is low due to high gradient without vegetative cover rendering low water-holding capacity of the soil and the impenetrability of the rocky layers) and the maximum amount flows down as run off carrying the valuable top soil along with it. High surface runoff rates during the rainy months result in silting up of water storage facilities, such as small dams and community dug-outs. High evaporation rates in the dry and hot season, and siltation driven by erosion and land clearing contributes to reduced water holding capacity, and rapid drying up of these dugouts.

A significant proportion of fallow land has soils with poor physical properties and low content of organic matter. Relatively good soils can be found only in lowland (*shole*). Soils from the top of the mound (*tnar*) to medium upland (*baid*) are highly susceptible to erosion because of the thin vegetative cover and torrential nature of poorly distributed rainfall. There is limited use of soil management practices (e.g. use of organic fertilizers, water management, mulching). This has resulted in low productivity in both crops and livestock.

In order to ensure a sustainable livelihood for the community with an aim to increase their adaptive capacity to withstand the vagaries of nature like erratic nature of rainfall and drought, the project proposes to undertake measures for collecting at least some portion of this water surplus generated during the monsoon and to check soil erosion in order to ensure the rain-fed crop, to increase growing season, to ensure better recharge of underground aquifers and to bring large area of barren land under vegetative cover. Geo informatics appraisal will guide us (ref. Component 1) to determine the ideal places for installing these structures, which will be chosen in consultation with the community that suits the nature of the terrain. After studying the PVCA Report and the suggestions forwarded by the expert through the Climate Data Analysis, the project proposes to install the following soil and water conservation structures in the project area. The implementing agency has a fairly large experience of installing similar structures with very positive results which have been described in the case studies annexed. Each structure has been explained below and justifications provided for making such structures which ultimately leads to building up the resilience and adaptive capacity of the community.

Activity 3.1.1: Step Pond

Small and marginal farmers will be organized into groups and motivated to excavate new **step ponds** and re-excavate old ones. The ponds will be excavated on the medium upland instead of upland where the runoff will be stored. The ponds will have a three to four tier design. Three to four broad steps will be made on all four sides to

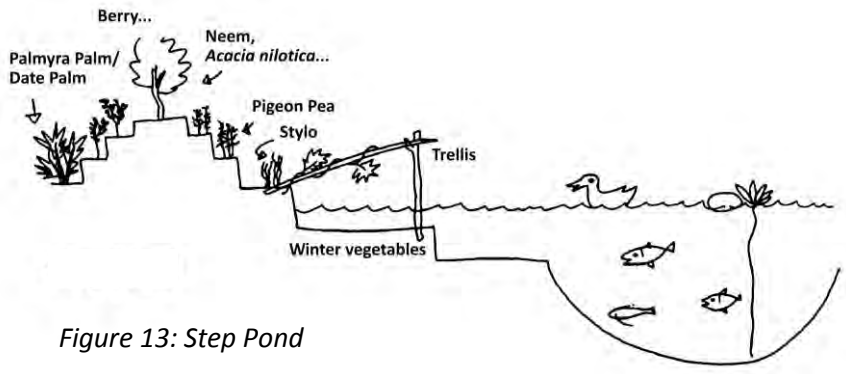


Figure 13: Step Pond

reach the centre. These steps will remain submerged during the rains. After the rainy season when the water level will recede, the residual moisture of the steps will be used to cultivate vegetables which again will add to the total production of the ecosystem. Apart from the rainwater directly falling in the pond, trenches will also be made to channel the run-off from the adjacent plots to the pond. From the bank on all four sides, trellis will be made hanging over the pond for supporting creepers yielding vegetables like pumpkin, bottle gourd, bitter gourd etc. The pond bank will be utilized for growing different vegetables, pulse crops like pigeon pea and seasonal, semi-perennial, perennial and multi-purpose trees. Pond water will be used for fish cultivation for additional income. It will also be utilized for irrigating fallows on both sides of it for growing a wide variety of vegetables in winter. The water may also be used for providing critical irrigation to a matured crop of paddy to counter erratic nature of rainfall. After assessing the total need of the group, yields from the pond, pond bank and newly cultivated fallows will be equally shared among the members of the group. In such step pond excavation, beneficiaries will be motivated to make the depth higher so that after rainy season water remains collected for more number of days, evaporation and seepage is less. 40 such ponds are being proposed.

Activity 3.1.2: Soil & Water Conservation Facilities[33]

Measures like **contour bunds, check dams, semi-circular bunds, and trenches/pits** are being proposed to resist run-off. Multi-purpose trees, cover crop and seasonal drought tolerant crops e.g. Roselle,

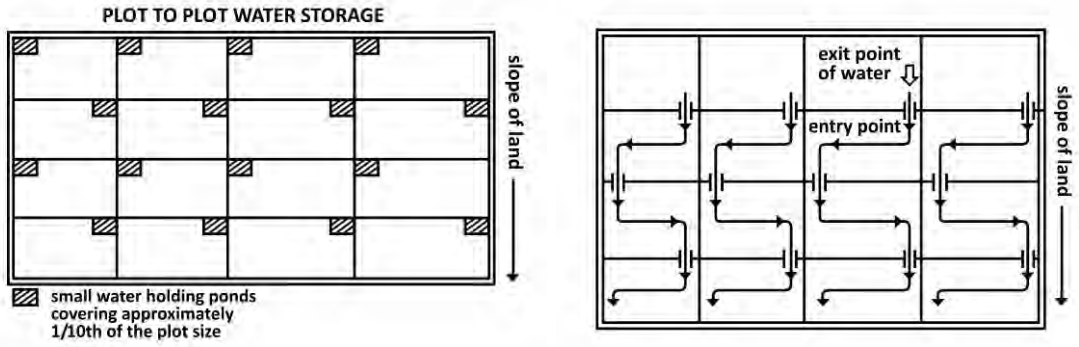


Figure10: Plot to Plot Water Storage

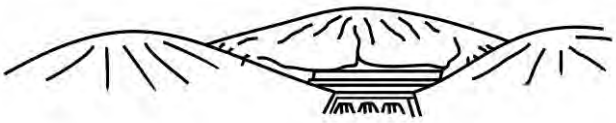


Figure 11: Check Dam

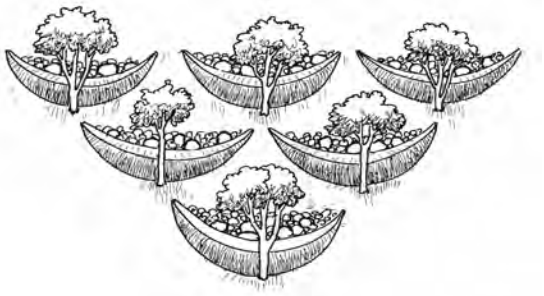


Figure 12: Semi circular bunds

Cowpea, Pigeon pea etc. will be grown to improve soil condition and supplementary income. On the unfertile barren lands, **Water Absorption Trenches** (WAT) would be constructed with dimensions of 3 m

[33] See Annexure 4 for the case studies of such models applied elsewhere

X 1 m X 0.67 m (depth). About 90 such WATs will be constructed per hectare with inter-space of 0.67 m. Stone bunding will be made where there will be a gully. Some semi-circular bunds will be constructed across the slopes. These bunds are arranged just like scales of fish so that the flow of water can be checked to facilitate recharge. Permanent plants (12-15 varieties) like Butter tree (*Madhuca indica*), Minjiri (*Cassia siamea*), Sisoo (*Dalbergia sisso*), Arjun (*Terminalia arjuna*), Subabul (*Leucaena sp*.), Wood apple (*Aegle marmelos*), Indian laburnum (*Cassia fistula*), Indian jujube (*Zizyphus mauritiana*), Margosa (*Azadiracta indica*) etc. will be planted at the back side of the bund. Some fruit trees, like Mango, Guava, Cashew nut, Lemon will also be planted. Water harvested through the bunds is generally utilized to raise the permanent plant, which is planted at the backside of the bund. Efforts will be made to cultivate 5-6 different drought-tolerant crops during the first 3-4 years after planting (when the trees have not grown to cast shade). Soil and Water Conservation measures will be introduced in about 300 hectares of the project area. It is envisaged that the barren land over which these structures will be made will help to make it productive in the long run thereby enhancing the capacity of the community to face climate exposures.

Activity 3.1.3: Plantation (Multipurpose village woodlots in common lands)

As a natural propensity of the tribals, the community residing in the project villages culturally tends to procure a good amount of their food, fodder, fuel and other livelihoods from the wild. With the shrinking of forest cover and degradation of commons, the families have lost their last cushioning option to fall back upon. The so-called 'social forests' created under government schemes encourage only the plantation of one or two types of non-browsable species such as Eucalyptus, Australian Acacia etc which are not at all suitable for meeting the livelihood needs of the people. With the onset of climate change the agricultural scenario has also become quite uncertain for them.

In view of the situation the project proposes to assist the community living in the project area to form groups and locate an unutilized common property (like fallow land, water bodies, river and pond banks, embankments of irrigation canals, roads and railway tracks etc). The groups (with 20-25 members) will be facilitated to make a 20-25 years lease agreement with the landowner (govt. or private), draw up a list of the assorted locally suitable plant varieties preferred by them.

The community will be motivated to select plant varieties as regular source of fodder, firewood and herbs. It may also include multipurpose perennial and semi perennial food and fruit trees, strategic crops etc. Fast growing, nitrogen-fixing and multipurpose trees will be planted to act as carbon sink, produce more fodder and consequently more green manure for preparing vermin-compost etc. which will reduce the need of chemical fertilizers that produce NO gases contributing to global warming.

The groups will be facilitated to raise seedlings and plant them on the land. It is expected that at least 12-15 varieties of trees & 6-8 types of shrubs/herbs will be planted. Some seasonal crops will be grown in the inter-space between trees to get some short term return in the early years of the initiative.

Members will ensure protection of the plantation & share the NTFPs harvested. In the long run, as 8-10 year old trees will be felled, 25-40% of the sale proceeds will be given to the village council/land owner and the rest will be shared equally among members. In the initial 2 years, each family is expected to get some return from the short term crop, fodder grass, firewood etc. The harvest of fodder and firewood is expected to increase gradually from year 3. Sericulture and fruit orchard options will also be tried.

These woodlots will help to increase the greenery, check soil erosion and act as a carbon sink. The biomass generated will help to improve soil fertility as well as water retention capacity of the soil. Livelihood options will be created and biodiversity will increase. The project will support such plantation on 250 hectares of land.

Activity 3.1.4: Check Dam

Many uncontrolled streams intersect this region. 4 check dams will be constructed on the way of these streams to collect the water which will be pumped to the neighbouring fields through a piped channel.

The irrigation facilities will help to reduce the dependence on only rainfed crop and will assure the 2nd and in some cases the 3rd crop also. This activity will directly help to increase the adaptive capacity of the households.

The soil and water conservation measures like step ponds, contour bunds, check dams, semi-circular bunds, plantation, trenches/pits will be done in fallow lands owned by the tribal community. The structures will be designed by qualified engineers as per the technical standards and approval for the same would be obtained from local Panchayat. These structures are small and will not involve any eviction of human settlements. Construction of these low cost structures like check dams does not require environmental impact assessment according to Indian law and regulations.

Activity 3.2.1: Capacity Building

The project proposes to build capacities of the community in reducing their dependence on rain-fed agriculture as their only means of subsistence by diversifying their livelihood activities. Beneficiaries will undergo training on locally suited practices that are not climate sensitive in order to replace rain-fed agricultural production. Farmers will be capacitated to design their production systems by diversifying and integrating various subsystems (crop, tree, aquatic flora-fauna, livestock) so that the produce is distributed over various seasons and space to make the system become more resilient. They will also be given training on basic issues like group building and sustainable agriculture techniques.

Activity 3.2.2: Model Integrated Farming Practices

The integrated farms that will be developed are based upon the first principle of ecology that all the components of nature, biotic and abiotic are interrelated. It is an established principle in ecology now that stability of a system is enhanced by higher connectivity among different biotic elements of a system. A stable system has:

i. Maximum resilience capacity
ii. Optimum productivity with maximum input use efficiency
iii. Higher sustainability

This has been illustrated amply by a number of experimental validations during the last two and a half decades. The basic principles to follow are

- Reduced tillage, biological tillage, mulch farming and other zero tillage systems to reduce the need of heavy machinery and consumption of petrochemicals.
- Mixed cropping of plants with different root depths& structures, resulting in optimal utilization of water & nutrient and higher resilience against environmental stress. Multi-storey agro-forestry extend growing season and reduce soil erosion, while enhancing carbon sequestration. Use of locally adapted plants, animals etc. reduce the need for high external inputs (water, synthetic feed, petrochemical by-products etc.)
- Biological soil inputs, which enhance capacity of soil to store water, carbon & nutrients reducing need for synthetic chemicals / soil nutrients.

- Soil & moisture conservation steps that improve stress tolerance, reduce soil erosion & siltation of water bodies and less groundwater pumping ensuring less petrochemical burning.
- Use of renewable energy resources for irrigation, crop drying, threshing etc. that reduces the need for petrochemicals.
- Varietal diversification of the major crops grown in the project area will be promoted. Traditional technologies which are beneficial in the present day context with respect to climate change adaptation will be emphasized.
- Seed production of major crops will be emphasized in order to make the project villages self-sufficient in seed supply.

Adaptation strategies/hypothesis for IFS:

a. **Time Management** to tackle erratic rainfall, longer dry spell and untimely rain
   - Preponing/postponing crops as preparedness and preventive activity.
   - Postponing crops as rehabilitative activity. Crops like lablab bean, mustard, coriander etc.

b. **Space Management** to introduce multiple production components and increasing diversity so the dependency on one component is reduced
   - By introducing ditch/canal/pond in the low land to drain out the water, and making the low land cultivable. The water can be used for aquatic system.
   - By adopting agro-forestry system to have tree-crop combinations together in the same space.

c. **Diversifying livelihood and production system by integrating various subsystems** (crop, tree, aquatic flora/fauna, livestock, poultry (preferably local variety poultry birds).So the produces are distributed over various seasons and space so that if one is lost due to disaster, others can support the livelihood. It is based on locally adopted crops and breeds, so adaptability and tolerance is high.

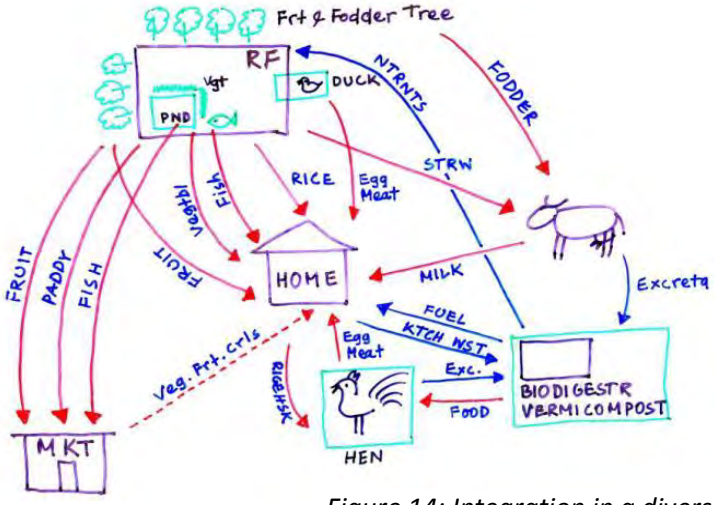


Figure 14: Integration in a diversified farming system

d. As the system is integrated, output of one subsystem is used as input of others, the cost of production is reduced – which in turn means more cash in the hands of beneficiaries.

i. Crops planted at a time, but harvested separately at different points of time by mixing companion crops of different families, root depth, height and fruiting time. Rain fed agriculture should be limited within the growing period when the rainfall satisfies crop need. In Purulia the length of growing season is a little less than 135 days and in Bankura it varies from about 135 days to more than 160 days.

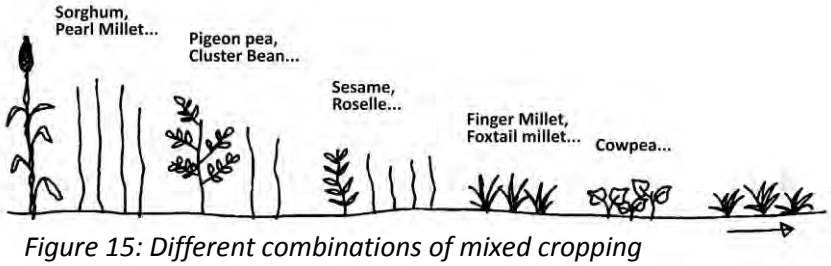


Figure 15: Different combinations of mixed cropping

ii. Season-wise planning with proper crop rotation so that moisture is properly used and soil health is maintained. Outside the rainy season, focus will be more on cultivating heat-tolerant, less water-demanding crops

	Rainy	Winter	Summer
Water stressed Land	Paddy + Black Gram or Maize + Soybean or Roselle + Pigeon Pea	Wheat + mustard + Chickpea or Chick pea + Linseed + Sesame or Grass-pea + Safflower + Linseed	Cluster Bean or Cassava + Groundnut
Low land	Jew's mallow or Water Spinach Bean + Radish Taro/Ginger	Pea or Field Bean or French Bean	Lady's Finger +Cluster Bean or Amaranth + Cowpea Elephant foot yam

iii. Focus more on local breeds of small animals and birds (rabbit, pig, chicken, duck, goat and sheep) for livestock integrated with fodder cultivation to reduce stress on agriculture and water

Integrated Farming Systems will equip farmers to have increased adaptive capacity to absorb shocks induced by climatic stress. Output of one subsystem will act as the input for the other which will ultimately reduce the dependency on market and hence will reduce the cost. Biodiversity and scope for collection of uncultivated food will increase.

Nutrition Garden[34]

In the project villages, each and every household will be encouraged to have their own small nutrition gardens on the homestead land area of about 40 m^2. At present, the families are in the practice of growing 2-3 types of crops in a scattered manner during the rainy season. Through interventions planned in this project, the beneficiaries will be able to harvest nutritious vegetables (leaves, fruits, roots, tubers, legumes etc.) for more than 9-10 months. There are number of edible weeds, unconventional fruits, unknown leafy vegetables which will also be conserved in the gardens. Tuber crops like elephant yam, cassava, *Diaschorea esculanta* etc. which, if not harvested, can be stored live under the soil. These can supply carbohydrate during and after stress period. The project will encourage

conserving these varieties in the nutrition gardens. This activity will be mostly done by the women and it is expected to reduce their nutritional deficiency.

3.2.3: Promotion of Sustainable Agriculture practices

Now it has been proved beyond doubt that irresponsible use of chemicals has over the years increased the compaction of land, reduced permeability and the fertility of soil[35]. The implementing agency's experience of working in the area suggests that climate change has impacted chemical farmers much more than the handful of organic farmers developed through years of intensive work done by the agency in the area.

The project proposes to introduce sustainable agriculture practices through training and motivation of farmers. They will be trained to produce **organic fertilizers and pest repellents at home** by recycling of organic wastes and also to make use of **Integrated Pest Management (IPM)** techniques. The following systems and techniques will be promoted to reduce the cost of agriculture, to increase the adaptive capacity of the farmers and to diminish the loss of soil fertility.

Cultivation without irrigation/zero tillage: A week or two before the rain-fed rice/main crop is harvested, seeds of drought-tolerant varieties of legumes/pulses/oil seeds e.g. linseed, lathyrus, lentil, mustard are broadcasted in the field. Residual moisture in the soil helps the second crop to germinate. Apart from the benefit that the farmer gets to have a second crop almost without any investment, the legumes fix nitrogen in the soil, thereby increasing its fertility. It also acts as a cover crop in the post-harvest days to retain soil moisture and reduces soil erosion.

System of Rice Intensification (SRI): Erratic nature of rainfall creates a situation for the farmers in the red and lateritic soil region, when they have a tendency of planting a bunch of aged saplings out of desperation to get more production which never happens. SRI is an alternative technique of sowing single rice sapling under controlled irrigation. The yield increases by 1.5 to 2 times and seed cost reduction is 80%. The project proposes to introduce this technique in the project area characterized by an undulated terrain, where the land is demarcated by its placement on the slope. The project aims to introduce this system in the medium uplands (*baid*) and medium lowlands (*kanali*) where the flow of rainwater can be controlled to an extent.

The regular **crop advisory service** will add an extra advantage as the farming community will have regular advisories regarding what to plant, when to harvest, when to irrigate etc.

The activity will help to extend the growing season and increase the availability of nutritious food and fodder round the year notwithstanding the vagaries of nature.

Activity 3.2.4: Irrigation Facilities

Ditches and Dug wells: Ditches will be constructed especially in medium lowlands and low lands to act as a harvesting structure during the monsoons which will also help to recycle sub-surface flow locally in the post-monsoon months. Lowland ditches will be made in a series so that the initial monsoon rains are better harvested and the sub-surface flow can be arrested and recycled better in the post-monsoon months. Erratic rainfall has serious impacts on cultivation of paddy which happens to be the main crop

[35]http://www.navdanya.org/climate-change/agriculture

of the area. Life saving irrigation with the stored rainwater can ultimately save an almost mature crop of paddy. Even if the ditches thus made is owned by an individual, at least 4-5 owners of adjacent lands who are also members of the group will have the right to make use of the water stored in the ditch to cultivate low water-demanding crops like mustard, linseed, wheat and vegetables in the winter. In case of scanty or no rainfall after fruiting stage, any one will be able to make use of this water from the ditch for saving his rainfed paddy. Size of the ditch will vary according to the extent of land. The project will support making 650 such ditches (9.1 mX 7.6 m X 3 m) and 150 dug wells (7.6 m depth X1.8 m dia).

There is no possibility of involuntary relocation of livelihood activities of the landowners since cultivation will, in no way, be disturbed by the project interventions. Activities like ditches (*hapa*), dug wells, etc., are small structures, requiring very less land area.

The check dams are small structures and will have dimensions of 20 m wide X 1.5 m high with a cost of INR 500,000/- i.e. US$ 8333. These will be erected on the course of small temporary streams caused by the run-off during monsoon. These structures will not have any negative effect on natural streams and ecosystem surrounding it. These streams do not include any critical natural habitats. In the entire red lateritic soil zone, the practice of erecting such small check dams is very common.

Lift Irrigation: A number of sub-soil rivers flow through this region. It is very difficult to access the river water as a source of irrigation for the lands situated at a higher point in the gradient. These lands are often left fallow or cultivated only during the monsoon. The project proposes to install River Lift Irrigation Systems (RLI) by constructing a well on the riverbed to collect river water which is then pumped up and distributed to the fields through piped channels. 5 such RLI systems will be installed as part of project intervention.

Activity 3.2.5: Animal Husbandry and Fishery

Livestock rearing is a normal practice for people living in the project area as this can be done with least investment because the animals can be reared by free grazing. With the diminishing of vegetative cover on fallows aggravated by the effects of climate change, this practice is also getting disturbed. The people in general have the tendency of rearing cattle for more benefits. In absence of a regular source of fodder, vaccination and other necessary measures for scientific animal rearing, the people are incurring regular losses.

The project will support and capacitate the women beneficiaries in rearing small animals e.g. sheep, goat (*Black Bengal*), rabbit, pig and small birds e.g. duck (*Pati Hansh*, *China Hansh*), chicken (*Mayur puccho*) etc. Local breeds will be chosen which have more tolerance. Beneficiaries will be trained in adapting scientific animal rearing practices like vaccination etc. Natural resource based feed production will also be undertaken. The livestock will be supported to 2750 households. Group based fish cultivation (Indian Carp and Mudfish) will be encouraged in the newly constructed water bodies for 500 beneficiaries.

The activity will diversify the income sources for the beneficiary families and will also act as a supplementary income to agriculture; thereby their adaptive capacity will increase.

Activity 3.3: Disaster-coping measures

Grain Bank: In view of the erratic nature of rainfall and the long drought spells over the area, the agricultural production is not secured. Most of the villages in the area do not have agricultural work during September-November and March- May. Naturally, hunger looms large over the poor families who earn their bread by working as agricultural labourers. In many cases they have to migrate to neighboring districts in search of work or have to take loans at a high rate of interest from local money lenders.

To combat this situation, community managed grain banks will be introduced at community level to save a portion of their produce for lean periods of agriculture caused by climate induced changes. The arrangements can be so done that the individuals will be able to take loan from the banks at the time of their need and return back the same with an agreed amount of interest after the next harvest. 40 grain banks will be established with project support.

Seed Bank: Farmers have become mostly dependent on markets for high yielding and/or hybrid seeds. These seeds show less tolerance to the effects of climate change. These seeds are usually not available at the right time and in sufficient quantities. Moreover the farmers cannot save these seeds for future use. Efforts will be made at the grass root level for collection and preservation of indigenous seeds which are more resistant to climatic stress. The groups will be motivated to maintain stock of native variety seeds (crops, trees etc) suitable for the area. Due to erratic nature of rain, crop damage is a common phenomenon. Conservation of indigenous seeds at the community level will help the farmers to overcome such situations. 5 community managed seed banks will be established through project support.

Fodder Bank: In FGDs done as part of the PVCA, it was revealed that availability of fodder has become very low in the region. The people in the project area show gross negligence towards fodder cultivation. The scope for collection of fodder from the wild has reduced with diminishing of forest cover caused by erratic rainfall, deforestation, longer summers, low soil moisture etc. Natural forests are being replaced by commercial plantations in the name of social forestry which do not allow sufficient vegetative growth on the forest floor.

In view of the above problem, the project will encourage plantation of fodder trees, so that in lean season, beneficiaries are able to feed green leaves to the livestock. Facilities for storing the agricultural wastes of the village will be made. Crop based fodder cultivation will also be promoted at individual household level. 5 fodder banks will be supported as part of the project.

The activity will act as a cushion to withstand climate stress and provide round the year supply of food for both humans and livestock without succumbing to the vicious cycle dominated by the money lenders etc. Market dependence of the farmers for inputs like seeds will be reduced which in turn will help them to become self-reliant and meet the challenges posed by the climate stress.

Activity 3.4: Introduction of Appropriate Technologies

Women spend much of their time sourcing basic resources for the household, such as firewood, water and fodder for animals. Their technical capacity and skill levels remain low. Within homes they also have to work in unventilated, smoke filled rooms. Lack of water within easy reach (10-15 minutes' walk from the home) and indoor smoke pollution increases drudgery and reduces quality of life. Sanitation remains poor due to lack of adequate water supply and facilities for bathing and washing.

This activity will introduce renewable energy systems to ease the burden on women and improve their socio-economic status. This includes providing tried and tested models of fuel efficient cooking stoves, biogas and rainwater harvesting structures.

These measures will have a positive impact on women's workload, due to a decrease in time currently spent in firewood gathering and fetching water from long distance. The activities will also reduce children's workload to support household chores and will contribute to increase the time children spend in schools. The saved time will be used for increasing the adaptive capacity of the households.

Energy efficient ovens: The households of the project area mainly use open stove (*chullah*) for regular cooking purpose. This increases the firewood consumption, and also has adverse effects on the health of women. To reduce the consumption of fuel and drudgery, the improved *chullah* will be installed at individual family level. The *energy efficient cook stoves* will have a hot water storage tank with the capacity of producing about 12 ltr of hot water besides cooking, using the same firewood. The experience has shown that the improved chullah will help to save at least 3 kg of firewood (on an average) per day. This will also help in reducing carbon emission (5.4 kg per family per day on an average). This may also be an opportunity for increasing their income through sale of saved firewood. The project proposes to cover 2400 poor families with this intervention.

Biogas: Poor and marginal families in the villages meet their fuel need by gathering firewood from the wild. But their sources of collecting firewood, dry leaves etc. are gradually getting limited due to a fast disappearing forest cover. As a result, they are compelled to make use of sun-dried dung cakes directly as fuel. On the other hand, cow dung is stacked in large pits on the ground which is kept in the open to dry and rot. This rotting mass produces methane gas and invites environmental problems. This sun-dried cow dung is less effective as a fertilizer. Bio-gas plants can be a solution for all these, installed with joint initiative of govt., implementing agency and the beneficiary concerned. Instead of using dung cakes directly as fuel, the dung produced in the cowshed is used as input for the bio-gas plant to generate the gas used for cooking and illumination. The bio-gas slurry is used as fertilizer in agriculture field, fishery etc. 250 bio-gas plants of 2 m^3capacity proposed to be installed under the project.

The promotion of biogas and energy efficient stoves will reduce the firewood consumption leading to reduced pressure and protection of common land as a buffer especially for food/fodder need during stress period. This will also help in reducing the drudgery of women and the saved time can be used for some alternative activities to enhance their adaptive capacity.

Adaptation benefit is derived from improvement of the quality of life of women in vulnerable households, and within the community. The social dimensions of adaptive capacity include status, health and mobility of women in a community. Increased income, use of clean energy will lead to increased resilience at household and community levels. Higher resilience will improve their ability to face climatic stresses and weather-related disasters.

Low cost water filter and community based drinking water facility

As PVCA report depicts, crisis of drinking water reaches the peak during periods of climate stress. During the longer dry spells, underground water levels are so low that the hand pumps or tube wells are unable to lift any water. People have to depend on ponds as the only source of drinking water. This results in a

spate of water-borne diseases e.g. amoebiosis, cholera, diarrhoea, e-coli, giardiasis, hepatitis A, dysentery etc. Moreover, the project area in Bankura belongs to Fluoride contaminated zone.

Use of Low-cost Water Filters for filtering water collected from tube wells and ponds will help in reducing these diseases during climate stress period. At the same time, 5 Community-based Drinking Water Supply Systems will be installed. The water supply will be ensured mainly during the stress period. Low-cost Water Filters will be distributed to 2500 families.
The supply of safe drinking water will help to check the water borne diseases among the community especially in dry season.

Barriers to be overcome by project interventions

Barriers for adopting the practices listed under the above component in the past, and how the project would seek to overcome those barriers are briefly discussed in the below given table:

Project Outputs	**Barriers to improving ecosystem management for climate change adaptation**	**Project activities and interventions**
3.1 Sustainable soil and water conservation measures (e.g. semi-circular bunds, check dams, gully plugs, infiltration ditches and agro forestry plantations) for various ecosystems introduced for improvement of agricultural productivity and environmental sustainability	• Ignorance about soil erosion and fertility loss of the soil • Lack of technical knowledge on soil and water conservation measures and absence of knowledge regarding groundwater recharge, runoff water storage and their associated benefits • Initial high cost of investments which are beyond means of the poor households in the project area • Inadequate support from Government in the proposed area • Non-organisation of farmers into groups for undertaking common activities. • Non-availability of institutional support for undertaking such activities	• Organize farmers in to common interest groups • Training to build the capacity of the project beneficiaries on soil & water conservation activities • Motivate beneficiaries by involving them in site selection for step pond, location of unutilised common properties for check dams/gully plugs, selection of appropriate species for agro-forestry etc. • Incentivise the poor farmers through financial support for the feasible investments
3.2 Multilevel cropping systems & integrated farming practices are introduced mainly through popularizing a combination of drought tolerant field crops, fast growing & multipurpose	• Traditional practice of mono-cropping that too for only one season (rainy). • Lack of awareness on the improved cropping systems • Non-availability of adequate water • Lack of knowledge on alternate irrigation facilities like ditch, RLI, dug well etc. • Out migration in the absence of suitable agri based activities for 4-5	• Capacity building on group formation, natural resource management and sustainable agriculture techniques covering organic farming, integrated farming system, integrated pest management, etc. • Developing alternate irrigation facilities (Ditch, RLI, dug well etc.) • Incentives for adoption through

perennials and small livestock	months in a year • Lack of capacity and resources for undertaking diversified activities .	financial support for inputs (seeds, biofertilisers, vermicompost etc), livestock , aquaculture etc • Development of model Integrated Farming practices
3.3 Disaster-coping mechanisms like community grain banks, local crop & trees seed banks, fodder banks developed in targeted villages	• Too much focus on Hybrid and HYV seeds which replaced the local and traditional varieties of seeds • Non-availability of traditional varieties of seeds with majority of the farmers • Lack of knowledge and appreciation of disaster coping capacities of suggested measures • Improper facilities for storage of grain and seeds • Subsistence nature of farming by poor households without much saving of surplus grains	• Supporting local drought resistant varieties of seeds • Capacity building and hand holdings of the farmers for production and storage of traditional seeds • Support for community based seed banks, grain banks and fodder banks with storage facilities stored at a central place
3.4 Climate resilient appropriate technologies like energy efficient cook stoves, bio-gas, low cost water filters and community based drinking water facility are promoted	• Lack of awareness on appropriate technologies • Non- availability of technical personnel for proper guidance • Lack of capacity of poor household to invest • Non availability of low cost water filters	• Project support for demonstrative models of technologies like energy efficient cook stoves, biogas, low cost water filter etc • Facilitate technical support from the Government agency • Training of beneficiaries on maintenance of these structures • Demonstrate the use of Community based safe drinking water supply facility

Component 4: Learning and Knowledge Management

Activity 4.1: Publications for Advocacy

Technical documents along with economic analysis will be produced on the successful interventions made as part of the project for sharing with development agencies particularly those working in the red and lateritic soil zones, scientific communities particularly those engaged in researches on climate change interventions, local level policy-makers and govt. authorities at village, block, district, state and national levels. 5 such documents will be produced and shared in course of the project.

One Policy Brief will be produced for advocating the models developed through the project to state and national governments for adoption in state and national policies.

Activity 4.2: Campaign & Awareness

Access to learning outcomes in the targeted villages as well as in public domain will be ensured through a dedicated website, printed materials (case studies, reports, scientific papers) and farmer meets. Mass awareness programs e.g. rallies, village fairs, graffiti, programs in schools and village camps will be organized and 5 short films will be produced in local language for creating awareness among illiterate or neo-literate community living in the project area.

Activity 4.3: Policy Advocacy

The red and lateritic soil zone covers 17.9% of the total geographical area of the country. This area has been found to be drought-prone with degraded soil structure. Vulnerability of the people living in this area is aggravated further by the impacts induced by climate change. The project will venture to advocate the successful models created to appropriate government authorities for adoption in state and national level policies so that they are upscaled to cover the entire red and lateritic soil zone.

The Policy Brief prepared as part of Activity 1 of this component will be one of the tools for advocacy. Two 30 min. films will be produced in English. For influencing policy decisions, 8 local level (Panchayat, Block, District), 3 state level and one national level workshops attended by PRI members, Block Development Officers, District Magistrates, Secretaries and Ministers in charge of government departments, POs, CBOs and climate activists/experts will be organized.

B. Describe how the project / programme provides economic, social and environmental benefits, with particular reference to the most vulnerable communities, and vulnerable groups within communities, including gender considerations. Describe how the project / programme will avoid or mitigate negative impacts, in compliance with the Environmental and Social Policy of the Adaptation Fund.

The project will target climate vulnerable and at-risk groups of people in two semi-arid districts, Purulia and Bankura. It will promote interventions that will help create better living opportunities for the small and marginal farming communities and communities dependent on natural resources. It is expected to deliver the interlinked economic, social and environmental benefits as well as serve as a model for future replication throughout the country.

The groups of people who are expected to be benefited from the project include:

Small and Marginal farmers and landless agricultural labourers

Rural families, who depend mainly on agriculture and natural resources for their livelihood, constitute the principal target group of this project. 49.6% of the targeted population belong to scheduled tribes in the proposed districts. The global phenomenon of climate change has affected the livelihood of these

beneficiaries more adversely. The interventions will help to create diverse income sources so that they have an alternative option to fall back upon.

Women

Among the rural households, women members happen to suffer the most although they take part in all kinds of agricultural and other livelihood activities doing the household chores at the same time. Their contribution to household economy is never taken into account. They form the most vulnerable section in so far as climate change impacts are concerned. The project proposes interventions that will help to reduce the drudgery of women and the saved time will be used for other livelihood activities that will help them improve their status in the family. Coming together to form groups will give them social identity and they are expected to gain in decision-making powers both within the family and outside.

The collection of fodder, firewood etc for livestock rearing and cooking remains the main responsibility for the women. With the decreasing forest covers the women have to travel far for collecting these materials. The soil and water conservation measures will help to increase the biomass production. There will be plantation of multipurpose trees from where women members can easily collect the firewood and the fodders and thus their productive time will be saved, the drudgery will be reduced. The women members will have the opportunity to use their saved time for income generating activities and thus the adaptive capacity will have social forestry and will also increase. The scope for alternative income generation activities will also be created like a grass will become available which can used for making brooms, sal leaves may become available so that sal leaf plates can be made which have a greater market also.

The water crisis also remains for 5-6 months in our project area. Women members have to go far to collect drinking water etc. The excavation of Step Pond will reduce the time spent. The vegetable cultivation on the steps and embankments will increase the availability of vegetables into their daily diet which in turn meet their nutritional need.

Normally the women members grow vegetables at the homestead and rear small animals and birds. Project support towards proper management and design of these gardens will help them to grow some surplus after meeting their daily needs. All the women beneficiaries will have year round production from their gardens. The rearing of livestocks will help 2750 women to earn additional income for the families.

The grain banks will directly benefit at least 1000 women beneficiaries.

The smokeless chullah and biogas will help to reduce the use of firewood. The health hazards of the women will be reduced. About 33% firewood use will be reduced per day per family. 2400 women will be benefited directly by using smokeless ovens and 250 women by using biogas.

The project will support for low cost water filters among 2500 families and will also demonstrate five community based drinking water facility so that they can have access to safe drinking water and the drudgery of the women can get reduced.

PRI Members

In spite of the SAPCC recommendations drafted at State level to address climate change impacts, PRI members need more sensitivity, awareness and capacity to link the activities with the schemes at local level. Inadequate micro-planning leads to results unachieved. The project will create a scope of making

micro plans with the Panchayats, so that economic, social and environmental benefits can be achieved at optimum level.

Children

Awareness about the climate change issue is lacking at community level. The project has a scope to create awareness among the children in schools so that the future generation can equip themselves to adopt climate change impacts.

Benefit Areas	Key benefits	Baseline scenario
Social	Small and marginal farmers face stagnant or irregular production due to erratic rainfall condition and drought like situation. The diverse income opportunities will help to create options for them so that in case failure in one, they can fall back upon the benefits from other livelihood options. This will **reduce migration and poverty.**	Small and marginal farmers are forced to migrate to other districts in search of work.
	The project will deliver both 'soft' support in terms of **awareness, planning capacity and technology transfer** and 'hard' or concrete adaptation actions that are expected to transform lives of communities at risk. Activities implemented through community participation will make certain of providing increased availability of livelihood resources and increase production, ensuring income and **food security** in the longer term.	Community planning and participation is lacking and people only come together for observing festivals.
	The project will create additional **livelihood assets owned by the community** like social forestry, community ponds, community farming etc. The largest share of investment will be in water management to improve water storage and maximize utilization in a variable rainfall regime. Improved irrigation will ensure that farmers have adequate water for cultivation in two / three cropping seasons in a year.	Vast tracts of land remain unutilised, and the water harvesting structures are not created considering the gradient of land resulting in dried up ponds and wells. No sense of ownership exists among the people for community assets.
	The project interventions will create scope for promoting **appropriate technologies to reduce the drudgery of women**.	Women and children bear the burden of collecting firewood, fodder, drinking water – the sources of which are rapidly diminishing.
Economic	Target beneficiaries will enjoy increased investment in agricultural production and farm diversification. The larger share of investment in water management, creation of water harvesting structures in common lands, farms and homes will **improve water storage and maximize utilization** in a variable rainfall	Unsecured and poor income of the small & marginal farmers and agricultural labourers due to climate variability.

Benefit Areas	Key benefits	Baseline scenario
	regime. Emphasis will also be given on using micro irrigation techniques and selection of water efficient crops so that cropping intensity increases. Intercropping and mixed cropping will also add to the **increase in cropping intensity**.	
	Changes in **income/earning of the small fish farmers** from fisheries is being addressed by developing a package of financial instruments comprising of **saving, credit and insurance** that will enable the farmer to cope with financial losses arising out of vulnerability from climate change	Poor insurance coverage and credit access to meet the required capital and recurring expenses.
	The project will focus more on rearing traditional breeds of small animals and birds rather than large animals so that **household income** does not have to depend only on agriculture and **may sustainably increase**.	Driven by the myth of getting more earning, people tend to rear foreign breeds of cattle and often have an income lower than their expectation because of high cost of feed and other management necessities. In case of sudden death of the animal, they fall into a debt trap.
	Market dependency of the farmers will be **reduced** with improved capacity of making organic composts and by saving local and traditional varieties of seeds.	Chemical intensive farming forces the farmer to depend more and more on market forces.
	Investment in disaster proofing measures and storage (buffer stock) of grain, seeds, fodder etc. will provide the beneficiary families with **income and food during lean agricultural seasons** also.	No such measures exist at present.
Environmental	Project interventions will contribute to increased water availability and irrigation potential through **ground water recharge and water harvesting**; **improved forest cover** through community forestry and agro-forestry; **improved soil and slope stability** through conservation techniques such as check dams, trenches, live fences and **improved biodiversity** in terms of plant, animal and microbial life in home gardens and community forests, pond ecosystems etc. These environmental benefits will improve the **integrity of the ecosystem** services that support community livelihoods.	Low moisture retention capacity of the soil and absence of vegetative cover cause the valuable top soil to flow down with the runoff resulting barrenness of the uplands and midlands.
	Heat tolerant, low water-demanding crop/animal species will be introduced that can	The survival rate of species in extreme weather conditions is

Benefit Areas	Key benefits	Baseline scenario
	adapt to climatic variability and yield optimally. This will **reduce vulnerability** and **improve adaptive capacity** of the farmer. The storage of indigenous seeds will regenerate the use of local seeds and will not impact the environment adversely. Protection and recovery of biodiversity with the use of native and adapted species.	reducing drastically.
	The promotion of organic farming, biopest repellents will help to **regain soil health** and **adapt to climate variability**.	Chemical farming is impacting soil health adversely.

The following table depicts component-wise social, economic and environmental benefits.

Activities	Key benefits (Direct)		
	Social	Economic	Environmental
Component 1: Land and Water Use Master Plan			
Geo informatics appraisal & Gram Panchayat wise planning	Micro planning involving scientists, community, Panchayat helps in building the ownership and realisation of the plan	Judicious use of natural resources, increased productivity, increased income	Assessment of existing resources, Water harvesting, improved use of seasonal and permanent fallows, adaptability to climate variability, increased surface water utilisation
Component 2: Reducing climate risks through timely and appropriate weather specific crop/agro-advisory services in local language (Bengali)			
Localised weather data collection, analysis and dissemination of crop weather advisories	Ensured crops will help the farmers to keep social commitments.	Reduced loss due to climate variability and hence increased income	Optimal use of available resources, input loss minimised
	Understanding and awareness of farmers about crop advisories and its relationship to weather will increase.		
Component 3: Climate resilient technology transfer for enhancing the adaptive capacity of the community			
Soil & water conservation work	Better management of land & water, vegetative cover increases, work opportunity created for the landless	Increased opportunity of income by increasing the cropping intensity by 200%	Soil erosion restricted, ground water getting recharged, plantations will also act as carbon sink
Capacity Building	Improved management skill and better understanding of adaptive	Dependence of farmers on market for procuring inputs reduced	

Activities	Key benefits (Direct)		
	Social	Economic	Environmental
	measures in natural resource management		
Construction of irrigation facilities	Rainwater harvesting structures increases the availability of water	Return from rain-fed agriculture assured, double even in some cases triple cropping made possible	Harvesting rain water minimises the use of ground water
Integrated farming models & promotion of organic farming	Sources of income diversified, employment opportunity created, engagement of women in home gardens and livestock rearing increases their contribution in the family thereby increasing their social status and decision-making power.	Risks and cost recovery will be distributed over various sub-systems, whereby the wastes of one will be used as input for the other. Total production of the farm will increase.	Methane emission from unprocessed manure is reduced through bio-digesters like bio-gas and vermi-compost pits. Vermi-compost and biogas slurry improves soil health.
Promotion of grain bank, seed bank, fodder bank	Opportunity created to conserve indigenous varieties of seeds that gives them the power to control agriculture.	Community reserves for lean periods increase. They do not have to pay exorbitant rates of interest to local moneylenders. Scope for enhancing group income through processing of grains is unleashed.	Free grazing will be reduced, thereby reducing the perennial problem of common lands getting denuded of vegetation inviting soil erosion.
Appropriate technology promotion	Reduction in drudgery of women promising better working atmosphere. Saved time can be used for other livelihood activities, hence vulnerability will get reduced.	Women members of the family increase their contribution in the family income.	Reduction in use of fossil fuel, timbers etc. will save the forests and the environment.
Component 4: Knowledge Generation and Management			
Preparation of financial and technical papers	Adaptation policies and plans recognise the social imperatives of the small and marginal farmers	Identification of areas of investment that will enable expansion of productive practices to other areas	Green practices identified and cases for replication developed
Mass awareness generation about climate change	Rural community, children, PRI members are better prepared about the climate change impacts Access to project learnings		Best practices of sustainable natural resource management identified for replication and scaling up.

Activities	Key benefits (Direct)		
	Social	Economic	Environmental
	are assured.		
Knowledge generation and dissemination	Recognition of the community as a key stakeholder in policy development for climate adaptation	Priority areas for economic investments identified	Contributes to the development of sustainable natural resource management practices and policies

From the very onset of the project, DRCSC will closely monitor all activities and outputs so that equitable sharing of all the project outputs is ensured.

Sharing of water: Ditch and dug wells will be constructed on the lands of individuals, but, apart from the landowner, the group members, as well as farmers in the vicinity, will have the right to use the water for providing life-saving irrigation to their crop in case of erratic rainfall, and also for extending growing season. The principle of sharing will remain the same in case of utilization of water from the step pond, check dam, RLI also. The decision of crop selection in all cases of water sharing will remain with the group, where it will be resolved that high water demanding crops cannot be cultivated. Fish reared in the ponds will be equally shared among the group members. This is a common practice in most of the DRCSC facilitated projects in West Bengal. The Committee for managing the Community Drinking Water Facility will make rules so that the villagers have equal access to the facility.

Sharing of produces from plantation: According to agreement with the landowner, an agreed share of the main produces (fruits, firewood, timber, silk cocoons etc.) will be given to the landowner and the rest will be equally shared among the members of the group. In case of grass, the members will have the right to procure it as and when required, provided they do not sell it.

Sharing of disaster-coping mechanisms (Grain Bank, Seed Bank, Fodder Bank): The group will frame separate rules for these facilities that will ensure equal rights of all members of the group.

C. Describe or provide an analysis of the cost-effectiveness of the proposed project / programme.

Sub-component	Current addressing mechanism and loopholes	How this project trying to address this	Cost effectiveness
LUP and WUMP	Water harvesting through IWMP, MGNREGA etc. hardly considers future climatic trends. Support for bore well, submersible pumps are causing more trouble.	Including climate perspective in the planning through WUMP and LUP, it is also considering reduction of water foot print, calculate water demand for future and predict suitable location through trend analysis. The focus is more on	When compared, the planning exercise is bringing invaluable climate resilience factor in the mainstream planning so that all the plans are converged and contextualized - which will make the

Sub-component	Current addressing mechanism and loopholes	How this project trying to address this	Cost effectiveness
		demonstrating some small irrigation measures and taking it to the mainstream planning. The demonstration of low water demanding local crops and small ruminants will also be taken up.	entire investment, from this project and other schemes by the mainstream, sustainable and usable in the longer run and address the water stress scenario.
Weather Station and CRC	Weather Crop advisory, which is most of the time not effective and timely.	SMS advice coupled with weather information for better and advanced planning of agriculture and other natural resource dependent livelihoods.	Timely advice related to agriculture and other natural resource dependent livelihood will reduce chances of greater cash loss due to shocks and disaster. Existing channels for information Dissemination would also be used.
Soil & Water Conservation Measures	Soil and water conservation is being taken-up under watershed programmes under Integrated Watershed Management Programme (IWMP). However, the same do not include climate concerns in the design and implementation mechanism.	Based on ecosystem wise micro planning the rainwater conservation structures will be made to store rainwater. Climate concern would form important part of the component design. This stored water will reduce the uncertainty of rain-fed farming, improve cropping intensity, productivity, aquaculture opportunity will be created and thereby the income opportunities will increase. Soil health will be improved, resulting in productivity improvement	Existing learning from community based soil and water conservation based projects / programmes would be incorporated. The stakeholders would be involved in planning, execution and monitoring, use of locally available material would be encouraged.
Sustainable Integrated Farming System	Efforts are not integrated and holistic. Location specific design are not popularized. Integration of climate concerns in farming systems is lacking	The skill and knowledge of farmers will be enhanced and they will be able to design their production system according to climatic situation.	Creation of demonstration models. Use of exiting extension channel and network is envisaged under implementation.
Disaster	Such measures are not	To mitigate with the disaster	The storage structures

Sub-component	Current addressing mechanism and loopholes	How this project trying to address this	Cost effectiveness
proofing measures like community grain banks, seed banks of local seeds, fodder banks	available due to which availability of seed as well as grain during stress periods is limited.	situation the grain, fodder will be stored at low cost at the time of harvest.	will be made using locally available materials so that those can be maintained locally. Farmers will themselves store seed and will be able to sow at proper time. The local methods, practices and materials will be combined with appropriate knowledge to reduce the cost in long term.
Appropriate technologies like energy efficient ovens, biogas, community based water harvesting and distribution	Penetration of improved cook stove and bio-gas very low in rural areas leading to indoor pollution. Efficiency of the system is poor. Poor quality drinking water particularly in monsoon season and low water availability period (summer) leads to increased number of water borne diseases	Energy security, clean energy, safe drinking water important for rural livelihood. The women drudgery will be reduced. The saved time (from collection of fuel, cleaning, cooking time etc.) of women can be used for other livelihood options.	Low cost, low technology based models will be developed. The energy saving devices will reduce the recurring expenditure for fuel. The local service providers will be able to maintain these products easily.
Advocacy and sharing of best practices	Limited or no Existing channels of knowledge dissemination related to climate change. Non- availability of location specific information related to climate resilient technologies	Information and knowledge dissemination material would be published and circulated. Training and network meetings would be conducted.	The wide range experience sharing will be made through circulation of low cost public education materials. Use of world wide web (www.) through creation of website. Existing extension channels would also be used.

Quantification of Cost Effectiveness

(Amount in INR)

Sl No	Particulars	Model for State Approved by NABARD	Project proposed
1	**Step Pond**		
a	Volume of the pond/ design capacity (m3)	630	18,572
b	Total Cost	44,200	799,980
c	Net cost per cum of earthwork	70.16	43.07
d	Net income from farm per cum of Earthwork	96.87	140.64
2	**Vermicompost tank**		
a	Capacity of the tank (cum)	4.05	2.6
b	Total Cost	19,962	5,000
c	Net cost per cum capacity of vermicompost tank	4,929	3,130
d	Net benefit per cum over a period of 5 yrs	3,341	7,290
3	**Micro irrigation facilities – Dugwell**		
a	Capital cost for Dugwell construction	36,200	26,340
b	Crop cultivation cost in a year per 1 Ha	38,500	38,500
c	Total cost (Dugwell + Crop cultivation) in a year per 1 ha	74,700	64,840
d	Total income in a year from 1 Ha	405,100	405,100
e	Net income per acre from 1 Ha	330,400	340,260
4	**Micro irrigation facilities (Ditch)**		
a	Capital cost for Ditch construction	48,614 (For 24,000 cuft cap.)	15,000 (For 7,500 cuft cap.)
b	Crop cultivation cost in a year	26500	13700
c	Total cost	75114	28700
d	Total income in a year	133350	67100
e	Net income per 1 acre	58236	38400
f	Net income per cuft of earthwork for ditch construction	2.43	5.12

Proposed benefit Derived from other Inventions		**(Amount in INR)**
5. Support for Livestock to Poor families		
SL No	**Particulars**	**Total Cost**
1	Goat (1)	1,000
2	Sheep/Pig/5 Rabbits 91 unit)	1,000
3	Chicks (5months old (10))	900
4	Duck (10)	900
5	Vaccines+Medicine	220
	Total	**4,020**

Income generated out of the Intervention after two years		
1	Goat (6)	12,000
2	Sheep/Pig/Rabbits (6)	9,000
3	Chicks (5months old) (50)	7,500
4	Duck (40)	8,000
	Total	**36,500**
	Net benefit after 02 years	32,480

6. Establishment of Lift irrigation Structure		**Amount (INR)**
1	Establishment cost of 01 LI Structure (Sufficient to irrigate 70 acre)	660,780
2	Crop cultivation cost in one season in a year in 70 acre with our irrigation for one season	406,000.00
3	Crop cultivation cost in 3 season in a year in 70 acre with irrigation for one season	2,563,000.00
4	Net Incremental benefit in a year from 70 acre	2,157,000
	Net Incremental benefit in a year from 1 acre	30,814

(2.5 acres = 1 hectare)

7. Storage of Food grain in the Grain Bank (Capacity : 30 Qtl)

Cost of construction (**INR**) 30,000.00

Year	**Paddy stored at the beginning of the year (Kg)**	**Paddy stored at the end of the year (Kg)**
1	650	900
2	1,600	1,900
3	1,900	2,200
4	2,200	2,600
5	2,600	2,900

8. Plantation of Horticulture Crop in 1 acre

(Amount in **INR**)

a	Establishment cost or 1st year	22,840
b	Maintenance cost of plantation up to 9th year (to be borne by the beneficiary)	40,000
c	Total cost of cultivation up to 09 year	62840
d	Net income per acre over a period of 09 years	90,5160

Viability of Proposed Solutions: DRCSC has been operating in the semi-arid region of West Bengal for the last 15 years. The tried and tested model of crop advisory service will be replicated for the area. The case studies are included for the reference.

D. Describe how the project / programme is consistent with national or sub-national sustainable development strategies, including, where appropriate, national or sub-national development plans, poverty reduction strategies, national communications, or national adaptation programs of action, or other relevant instruments, where they exist.

Key National Policy and Responsible Agency	Project elements consistent with policy
1. National Agriculture Policy	Irrigation water management, soil moisture conservation, soil conservation, land conservation in watersheds, organic agriculture, home gardening, integrated pest management and integrated plan nutrition systems, conserving agro-biodiversity and promoting tolerant species
2. National Disaster Management Policy	Early warning systems linked to community preparedness and risk assessment
3. National Forest Policy	Increasing tree cover in non-forest areas, reducing pressure on natural forests by supporting community woodlots, management of Multiple-use forests
4. National Environmental Policy	Restoration and conservation of ecological systems, conservation of native species and agro-biodiversity, water resources conservation and management, soil conservation
5. National Livestock Policy	Promotion of livestock farming to increase incomes and food security of rural farming households

Details on outcome-wise applicable national and sub-national plans are given below:

Project Outcome	National Action Plan on Climate Change – Priorities/Strategies	State Action Plan on Climate Change for West Bengal – Priorities/Strategies	12th Five Year Plan - Priorities/Strategies
Communities adopt land and water use master plans with the help of Panchayats through better understanding of climate change related impacts	The "National Water Mission" which is one of the missions identified under National Action Plan on Climate Change focuses on improving water storage capacity, creation of new water harvesting structures, soil moisture conservation structures etc.	Creation of Rain water harvesting structures in the undulating slopes of the Red and Lateritic soil area. Construction of check dam for harnessing surface water Implementation of special programme for planting forest trees or fruit plantation s as appropriate to increase the run off infiltration ration.	Watershed development and soil conservation investments have to be complemented with farming systems investments in a watershed-plus framework that takes into account the diversity of rain-fed agriculture.
Livelihoods have become less vulnerable to climate change and achieve higher levels of productivity	The "National Mission for Sustainable Agriculture" which is one of the missions identified under National Action Plan on Climate Change focuses on improving productivity of rain-fed agriculture by adopting suitable agricultural techniques.	Creation of Seed bank Enhanced livelihood of small and marginal farmers by introducing the concept of Integrated Farming System by pooling in their fields for practicing each element of the Integrated Farming System Up scaling of Resource Conservation Tillage Technologies Effective soil nutrient management Promote organic ways for combating weeds, insect, pest and diseases and nutrient management. Real time crop monitoring	There is a need to give emphasis on integrated farming systems, combining crops and livestock, including small ruminants, for different location-specific endowments Strengthening soil organic carbon (SOC) research, particularly on the quality of organic matter and microbial activity, physical properties of SOC, validation and refinement of models and SOC dynamics under different land uses and management

Project Outcome	National Action Plan on Climate Change – Priorities/Strategies	State Action Plan on Climate Change for West Bengal – Priorities/Strategies	12th Five Year Plan - Priorities/Strategies
		and weather forecasting Setting of Agra-Information Center in each of the state of West Bengal Feed and fodder development for livestock	regimes.
Various types of materials on processes and techniques are published and measures are taken to upscale the interventions to improve climate resilience in the red and lateritic zone	The "National Mission on Strategic Knowledge for Climate Change" which is one of the mission identified under focuses on creation of awareness on climate change adaptation among the farming community.	Appropriate crop diversification through training & capacity building of farmers Capacity building of farmers for effective adaptation to climate change Real time weather monitoring and forecasting	The need to increase total domestic energy production in order to reduce import dependence, combined with the need to move away from fossil fuels in the longer run in view of climate change considerations, points to the need for stronger efforts to increase the supply of energy from renewable. Capacity building of farmers for effective adaptation to climate change

E. Describe how the project / programme meets relevant national technical standards, where applicable, such as standards for environmental assessment, building codes, etc., and complies with the Environmental and Social Policy of the Adaptation Fund.

The list of applicable standards for various components proposed under the project are presented in the table below:

Activity	Applicable standards	Application to Project	Monitoring
1. Weather stations & Climate Resource Centres (CRCs)	Technical standards of the instruments to be installed in Automatic Weather Stations & CRCs	By DRCSC Project Management Unit	By DRCSC project Management Unit By District level Project Monitoring Committee By State level Project Monitoring Committee
2. Soil & water conservation measures	Technical standards for creation of Soil & water conservation works, plantation, Check Dam. Micro irrigation, Lift Irrigation as per Panchayati Raj & Rural Development, Water Resources Devt. Dept of the Govt. of West Bengal.	By DRCSC Project Management Unit in consultation with NABARD Regional Office in Kolkata District Panchayati Raj & Rural Development Dept. Water Resources Devt. Dept.	By DRCSC project Management Unit District Panchayati Raj & Rural Devt. Dept. District Water Resources Devt. Dept. State level Project Monitoring Committee
3. Livestock development	Standards applied by Animal Resources Development Dept. of the Govt. of West Bengal.	By DRCSC Project Management Unit in consultation with NABARD Regional Office in Kolkata By Animal Resources Development Dept.	By DRCSC project Management Unit Animal Resources Development Dept. State level Project Monitoring Committee
4. Integrated Farming System	Standards prescribed by Dept of Agriculture, Dept. of Fishery & Dept. of Panchayati Raj & Rural Development, Dept. of Animal Resources Development of the Govt. of West Bengal.	By DRCSC Project Management Unit in consultation with NABARD Regional Office in Kolkata District Agriculture Dept officer District Panchayati Raj &	District Agriculture Dept., District Panchayati Raj & Rural Devt. Dept., Dept of Animal resources Devt.

Activity	Applicable standards	Application to Project	Monitoring
		Rural Development Dept., Dept of Animal resources Devt. Dept of Fishery Dept. of Animal Resources Development	District level Project Monitoring Committee State level Project Monitoring Committee
5. Disaster coping mechanisms like community grain banks, seed banks of local seeds, fodder banks	Standards prescribed by District Agriculture Dept., Bidhan Chandra Krishi Viswa Vidyalaya (BCKV – Agriculture University),	By DRCSC Project Management Unit Dept of Agriculture	DRCSC Project Management Unit District Agriculture Dept District level Project Monitoring Committee State level Project Monitoring Committee
6. Appropriate technologies like energy efficient ovens, biogas, low cost water harvesting, community based drinking water facility	Standards prescribed by West Bengal Renewable Energy Development Agency (WBREDA)	By DRCSC Project Management Unit West Bengal Renewable Energy Development Agency (WBREDA)	By DRCSC project Management Unit By District level Project Monitoring Committee By State level Project Monitoring Committee

F. Describe if there is duplication of project / programme with other funding sources, if any.

The project target area is not the focus of any other climate adaptation initiatives. In fact, this is the first, focused effort to implement a climate adaptation project based on identified priorities on the ground. A number of NGO-led micro projects are field testing adaptive strategies on a much smaller scale. For example Christain Aid, UK and KKS, Germany supported projects for enhancing the food & livelihoods of backward poor people (mostly Scheduled Tribes and Schedule Caste) of some villages in Purulia. WHH, Germany has supported for developing the model of sustainable Integrated Farming System for dry-land among the tribal communities in only few villages of one Gram Panchayat of Bankura district. The lessons and practices of these micro projects have influenced the design of the activities, delivery/monitoring and assessment modality.

DRCSC has implemented the GIZ funded project in the riverbank erosion and waterlogged areas of Malda and Murshidabad districts. In practical terms, the project helps to design and implement integrated farming systems for individual farms so that farmers can rely on other sources of

livelihood in case of climate stress. The measures which can be useful in implementing the proposed project include:

- Land shaping, that is, the redesigning of farmland to permit the use of portion of land during waterlogged periods. Farm ponds, canals and ditches are dug to drain off water. The soil thus excavated is used to elevate beds. Diverse varieties of vegetables and trees are grown on these beds, providing food and fodder throughout the year.
- Introduction of local fish species in the ponds for household consumption and as alternative income generation opportunity
- Preponing the sowing of crops such as paddy and maize within the summer cropping season in preparation for the early monsoon

This project would be the first one to explicitly focus on improving the resilience of communities and preservation of ecosystems as an adaptation strategy. This project will complement on-going government programs that are being implemented to improve rural agricultural productivity, manage drought and landslides, irrigation and watershed management, and conservation of biodiversity.

Project	**Objectives**	**Complementarity**	**Geographical Coverage/Agency**
National Food Security Mission	To increase the production of rice by 10 million tons, wheat by 8 million tons and pulses by 2 million tons by the end of the Eleventh Plan (2011-12) in order to ensure food security.	The project proposes the transfer of sustainable technologies as also the distribution of improved local variety seeds for increasing the existing farm production thereby ensuring food security of the small and marginal farmers.	Dept. of Agriculture, GoI
Bringing Green Revolution to Eastern India	To rejuvenate the farm sector with Techno-managerial advancements to enhance the Productivity, Profitability & Sustainability of the major farming systems in different Agro-climatic regions, thereby attracting and retaining educated youth in farming and substantially improving the livelihood of the farmers of the state.	The project proposes to act as a complement to the programme in discouraging lifting of ground water and increasing growing season by developing micro watershed-based climate-adaptive sustainable agriculture.	7 states in Eastern India including West Bengal. Dept. of Agriculture, GoI
Integrated Scheme of Oilseeds, Pulses, Oil	To harness the best of production & productivity, processing and post-harvest	The project proposes to introduce indigenous varieties that are heat tolerant and less water	Dept. of Agriculture, GoI

Project	Objectives	Complementarity	Geographical Coverage/Agency
Palm & Maize (ISOPOM)	management technologies to accelerate self-reliance on Oil seeds and Maize.	demanding, low fertilizer demanding, soil fertility enhancing seeds as against hybrid varieties	
Dry land Farming programme	To increase the agricultural production and improve the economic condition of the dry land farmer through development of selected micro-watershed, use of improved drought-resistant seeds, fertilizers, improved implements and agro-forestry programme etc.	The project proposes to complement the objectives of the national program only with the exception of introduction of drought-tolerant indigenous variety seeds instead of HYVs and also an innovative crop selection	Dept. of Agriculture, GoI
Mahatma Gandhi National Rural Employment Guarantee Scheme	It is designed at improving the income protection of the people in rural areas by ensuring hundred days guaranteed employment in a financial year, to a rural family.	The project proposes to augment the income scenario of the rural families by making provisions for employment of at least 50 more days over and above the 100 days guaranteed by the govt.	National level programme implemented by the Panchayats
Rashtrya Krishi Vikas Yojana	To ensure the preparation of agriculture plans for the districts and the states based on agro-climatic conditions, availability of technology and natural resources. To ensure that the local needs/crops/priorities are better reflected in the agricultural plans of the states.	Through its actions, the project proposes to fill up the gaps between the actual need of the all-round development of the beneficiaries and the extent to which the national program fulfills it. Project support will be limited to the introduction of the components that are not supported by RKVY.	National level programme implemented by the Dept. of Agriculture, Govt. of West Bengal.

G. *If applicable, describe the learning and knowledge management component to capture and disseminate lessons learned.*

The entire project idea is based on preparing localized development plans involving both scientific knowledge and community experiences. The land and water use master plans generated will provide a scientific base during assessment phase based on which the community will be able to plan the interventions along with the Panchayat and local administration.

The transfer of knowledge generated through the project will be given the utmost priority. Component 4 of the project deals particularly with the knowledge management. The knowledge will include adaptation techniques at the farm level, best practices, crop-weather advisories, sustainable agricultural practices, and other policy recommendations and technical guidelines produced by the project.

The project will generate / record and disseminate both technical and financial knowledge which will be shared with different stakeholders during meetings, workshops and seminars and/or through publication. The audio visual media will also be used as a knowledge management tool so that best practices, evidences etc. can be shared at various level.

It is also envisaged that the project results will be able to influence the Government to adopt the successful models created through the project in the State and National policies so that they are up scaled in the red and lateritic soil zone spread over in different states of the country. The experiences of DRCSC will be documented and shared with Government institutions, Universities, Local Government as well as local. The Information Manager will be responsible for knowledge management and communication responsibilities.

The specific steps proposed for replication are:

1. Presentation of the tested methodologies in meetings of the State Steering Committee, which has membership from key departments of Government (Agriculture, Environment and Rural Development).
2. Developing Technical and Financial Papers highlighting cost effectiveness of the models
3. Developing documents on Best Practices as part of process documentation.
4. Sharing the documents on Best Practices with:
    i. members of State and District level Steering Committees
    ii. community of practitioners through the existing e-groups
    iii. other stakeholders- financial institutions
    iv. Civil Society networks involved in Natural Resource Management and/or Livelihood Enhancement and
    v. Presentation to Academic institutions

H. *Describe the consultative process, including the list of stakeholders consulted, undertaken during project preparation, with particular reference to vulnerable groups, including gender considerations, in compliance with the Environmental and Social Policy of the Adaptation Fund.*

The DRCSC head office and field staff met the villagers at project area for several times to assess the community's need and scope of the project. Based on the problem assessment and needs expressed by the community of the area, a draft project brief was prepared in consultation with Department of Environment and Forest (DoEF), West Bengal. The brief was presented before NABARD and through different consultation processes and the concept was finalised. In the process of preparing the final project various consultation processes with stakeholders were carried out which has been briefly shared in the following table.

Table: List of Consultative Processes

SN	Particulars	Date	Place	Stakeholders participated
1	Consultation with various stakeholders in Purulia	20th November 2013 20th May 2014	Sonathali, Purulia, WB Kashipur, Purulia, WB	Dept. of Agriculture, Horticulture, Sericulture, Fishery, LAMP Society, Block Administrative Office, Representatives from different banks, NABARD officials, LDM, Panchayat officials, DRDC, Scientists etc. and individual farmer, group & cluster representatives and other representatives from NGOs
2	Consultation with various stakeholders in Bankura	5th March 2013 18th December 2013 18th June 2014	Jhunjka Panchayat, Bankura, WB Panchayat Samity Hall, Bankura, WB BDCCB- Board Room, Bankura, WB	
3	Focused Group Discussion	22nd April 2014	Kroshjuri, Purulia	Villagers from the select villages
4	Focused Group Discussion	3rd May 2014	Beriathol, Bankura	-do-

The participatory vulnerability assessments were carried out in at least 5 villages (see Annex 3 for the report) to assess the current and projected vulnerabilities and the existing coping capacities of the community. Series of meetings and visits to similar regions of India were also undertaken as per the details given below:

Sl No.	Particulars	Date	Place	Participants
1	Visit to Gorakhpur Environment Action Group for learning about the crop advisory services	December 2013	Gorakhpur, UP	DRCSC Staff
2	Meeting with Jadavpur University,	7th May 2014	Kolkata	DRCSC Staff

	Department of Oceanographic Department			
3	Meeting with Dr. Kailash Pandey, expert meteorologist for learning more details on crop advisory services, data collection, data analysis etc	2nd & 3rd May 2014	Kolkata	DRCSC Staff
4	Meeting with Dr. Swadesh Mishra, Agro-climatologist regarding climate data analysis	1st may 2014	Kolkata	DRCSC Staff
5	Meeting with Mr. Richard Ewbank, representative of Christian Aid, UK regarding the automated weather station, crop advisories, climate data of West Bengal etc	19th April, 2014	Kolkata	DRCSC Staff
6	Meeting with Executive Committee of DRCSC	15th February & 18th April 2014	Kolkata	All executive members of DRCSC
7	Consultation meeting with Ministry of Environment and Forestry (MoEF)and GIZ	August, 2013	Kolkata	DRCSC staff, Dr. Debal Roy of MoEF, Representatives of GIZ
8	Series of consultancies with NABARD, West Bengal	On various dates starting from September 2013	Kolkata	DRCSC staff and NABARD officials

We conducted 5 Consultation meetings, 2 in Purulia and 3 in Bankura to discuss about the activities to be undertaken with respect to climate change. In the Consultations, different stakeholders, the beneficiaries, the Government Officials, Bank coordinators, representatives of other NGOs working in the area were present. A brief account of one of the Consultations conducted in BDCC- Board Room, Bankura on 18th June 2014 is given below:

Theme	Points Emerged	Resource Persons
Impacts of Climate Change on Agriculture	Paddy saplings cannot be transplanted at the right time due to late onset of monsoon. Fully mature standing crops of paddy are dying due to absence of rain in the late monsoon period. Winter crop is getting severely damaged due to the shifting of rainfall. Pest attack and disease of crops are on the rise. .	Dr. S. Bandopadhyay, DDM, NABARD Mr. Sagar Bandopadhyay, Asstt. Director of Agriculture, Dept. of Agriculture, Govt. of West Bengal Mr. Subodh Hansda, Local farmer
Possible Adaptation Strategies	Harvesting rainwater at village and household level , plantation, proper crop planning, organic fertilizer promotion, cultivating traditional varieties of paddy	Dr. S. Bandopadhyay, DDM, NABARD Mr. Sagar Bandopadhyay, Asstt. Director of Agriculture, Dept. of Agriculture, Govt. of West Bengal

	seeds which have high potential for export, exploring marketing opportunities, processing the produce for value addition, micro-planning, pest and disease management, conservation of traditional local varieties of trees and crops, awareness creation, diversification of livelihood.	Mr. Subodh Hansda, Local farmer Mr. Dipak Ghosh, Ex. District Officer of Khadi Village Industries Mr. Saradindu Banerjee, Secretary, Gandhi Vichar Parishad, Bankura
Possible assistance from Govt. departments and other institutions	Access the maps from MGNREG Cell. Agri Clinics of Agricultural Department to provide extension services. Farmers may be given Agricultural Loan from State Bank of India. Assistance in marketing of produce and organic certification From Department of Agriculture.	Mr. Sagar Bandopadhyay, Asstt. Director of Agriculture, Dept. of Agriculture, Govt. of West Bengal Mr. S. Ghosh, Resource Person, Bangiyo Grameen Bikash Bank Mr. Priyabrata Bandyoppadhyay, SBI District Cooridnator for Bankura and Purulia

During the design of the concept and even during the DPR design, several consultation processes and focus group decisions were held where we ensured the participation of women and representatives of the most vulnerable groups. The detailed household surveys were done for all the households of these two project areas and only the vulnerable households were selected who are poor and marginal and are affected by the climate change scenarios most.

The Participatory Vulnerability Capacity Assessment exercise emphasized the necessity to understand the climate change impacts on rural livelihood, associated risks and vulnerability of local communities inhabited in drought prone Plateau region, in particular, Chhatna and Kashipur block of Bankura and Purulua district respectively.

During PVCA, the tools like Venn Diagram, and a seasonality scarcity matrix were of particular use with the women's group. The separate focused group discussions were organized with these women groups, and they prioritized their problems, and shared their views. After designing and prioritising the activities, again consultations were made with the beneficiaries for obtaining feedback before finalizing the project interventions.

I. *Provide justification for funding requested, focusing on the full cost of adaptation reasoning.*

Component 1: **Land & Water use master plan (LUP & WUMP)**

Baseline scenario

In the project villages, farm families are highly exposed to climate change related livelihood insecurity with no definite clue to the reasons or the solutions. Vulnerability and capacity assessment was never done on behalf of neither PRI nor NGOs operating in the area. LUP & WUMP for the area is not available

with the Panchayat or any other Govt. dept. Thus Panchayat, MGNREGS Cell and individual households excavate water harvesting structures haphazardly without any consideration for the gradient of land or underground aquifers leading to dried up wells and ponds in most of the year. Agricultural production is gradually decreasing and also becoming more risky and less assured.

Adaptation alternatives

The Geo-informatics Appraisal will be the guide to draw LUP and WUMPs in each of the targeted Gram Panchayats. Judicious use of all elements such as land, soil, water and weather and their proper manipulation and management will be ensured for obtaining optimum and sustainable return from land through agriculture. Variability in the weather cycle due to climate change will be synchronized with the normal weather requirement of crop during different stages of its cycle in order to get full advantage of the changes in weather and climate. Recommendation for crop selection will be made according to where and when it is best suited. Community perspective and community ownership of these plans will be ensured by using Participatory Rural Appraisal tools. The beneficiary families will be able to understand the benefits of interventions derived on the basis of WUMP and LUP who will later place it before PRI through Gram Sabhas for inclusion in Village Development Plan.

***Component 2*: Reducing climate risks through timely and appropriate weather specific crop/agro-advisory services in local language (Bengali)**

Baseline scenario

Weather information is not sufficient and effective as information is given just before the incident happens, so most of the time the livestock, food stock and crops cannot be saved and the warning doesn't reach the interior. The system of warning, as it is now, works through a top-down way coming from district via block, police department and Panchayat, often lack the need for immediacy. The weather specific crop-advisory services does not exist in the project area at all. Now some information is available on the site but that is also not very location specific and the dissemination system does not exist.

Adaptation alternatives

The system which will be promoted through this project intervention, will be locally generated, monitored and transferred. Weather stations of high spatial resolution for weather data collection will be established at village level, data will be analyzed by Meteorologists, advisories prepared with the help of Experts from Agriculture Universities and the same will be disseminated to alert the farming community on weather related risks. Such timely crop-weather advisories would help farmers to make critical farming decisions for efficient crop management. The proposed system will provide various types of forecasts such as on time weather forecast, 5 days forecast and long term forecast, on-set of monsoon forecast etc. Crop advisories will be on choice of cultivar, time of cropping, likely crop diversification, type, method, time and quantity of farm inputs. ***Component 3*: Climate resilient technology transfer for enhancing the adaptive capacity of the community**

Baseline scenario

In rain-fed farming areas, rice can only be cultivated during the major cropping season that is mid-June – September, which depends on the quantity and temporal spread of rainfall. In the next season, which is winter season from October to February, other field crops (wheat, mustard etc) could be cultivated depending on water storage in village reservoirs, surface water and ground water availability. Cropping intensity in rain-fed farming areas and minor irrigated areas remain very low which indicated that even

one full season cannot be supported under current climatic uncertainties. The winter season in most rain-fed areas mean that farmers have to migrate out looking for employment or that they undergo severe food and livelihood insecurity and also they become deprived from social and cultural events which is very crucial for backward community. This is the main reason that keeps these families entrenched in poverty.

Without secure livelihoods, many rain-fed farming households engage in environment damaging practices- such as felling trees, stone quarrying, etc. These practices erode soil (mostly topsoil), cause downstream siltation, damage to irrigation structures, reduce water yields and storage in village reservoirs and, in turn, damage the ecosystem and livelihood assets upon which farmers depend so greatly.

Without the project, farm families will continue to face aggravated livelihood and food insecurity. Climate variability has increased livelihood insecurity of these communities. The shifting of rainfall pattern has a direct impact on rain-fed farming practice and storage in small reservoirs. In many cases, farmers are unable to cultivate the major season fully, leaving them bereft of the staple food crop. Longer periods of seasonal drought and intense rainfall, erodes the existing natural resource base on which farm livelihood is hinged- water and soil. There is a discernible worsening of the baseline situation due to climate variability and its associated impacts.

The poor families completely depend on forest and different areas (road side, canal side, and personal area) for collecting firewood. This is quite evident that excessive pressure is there on the forests and therefore deforestation is increasing rapidly. The work of firewood collection is mainly done by the children and women members of the families.

Adaptation alternatives

Soil and water conservation measures will be promoted to harvest the rainwater, reduce the soil erosion (top soil) through checking the run-offs. The harvested water will be able to increase the certainty of rainfed crop (mostly paddy).

The availability of food, fodder, fuel wood will also be increased through plantations (social forestry, orchard plantation, sericulture). The livelihood opportunities will also be created. During climatic stress period or extreme drought situation, families will be able to fall back on these community based assets (social forestry and orchard plantation sites).

Sustainable agriculture practices will be promoted which will help the farmers to integrate different subsystems (inter and intra) to increase the total varied production and productivity. The mono cropping will be replaced by mix cropping which will help to reduce the climate risk. Drought tolerant, nutritive crops will be cultivated on the permanent and/or seasonal fallows and backyard garden which on one hand will add to the total production and on the other hand it will help the families to have a balanced nutritious diet. Therefore the food and nutritional security will be enhanced. Seed savings both at individual and at community level will be encouraged which will help the farmers to become self-reliant and the dependency on market will get reduced. Even during the erratic situation, farmers will be able to sow the seeds for multiple times.

In the semi-arid region, livestock rearing will play an important role as part of the livelihood of the poor families. The project will support rearing of small ruminants and birds, which have capacity to tolerate

extreme climatic stress. Aquaculture in the water harvesting structures will also be promoted as an additional income generation activity for the families.

Energy efficient models, like installation of improved smokeless ovens, biogas will be ensured through this project. These will help to save at least Rs. 5000 per annum incurred for kerosene, firewood, cow dung cakes and coal, And thereby the pressure on natural resources will be reduced,. The drudgery of women will also be addressed through support of low cost water filter, community based rainwater harvesting etc. The women will be able to use their saved time for other income generation activities which will help to reduce the vulnerability due to climatic variability.

***Component 4*: Learning and Knowledge Management**

Baseline scenario

. For translating national and state policies into action, especially at Panchayat level, and decentralizing SAPCC objectives into local context, local level planning at Gram Sansad / Panchayat is very important. Currently the local level planning is not considering climatic threats in to consideration. The Programmes/projects of the Panchayat and other line Departments of Government are implemented without focus on climate related threats.

Adaptation alternatives

The project will take required steps for dissemination of the learnings/ outcomes from the project through films, dedicated website and other printed materials. Mass awareness generation among all the stakeholders including the school children through rallies, Graffiti, village fairs, farmers' convention, days celebration, awareness camps will be given priority. The documentation of best practices, and success stories will help to share the learnings at local, state and national level for wider adoption. Workshops at local, state and national levels will be organised with the participation of PRI members, Block/District/State level officials of different government departments, NGOs, and Scientists for large scale dissemination of the project outcomes. Technical and policy papers produced as part of the project as well as advocacy films shared in these workshops are expected to include similar approaches in the state and national plans so that the models evolved out of the project could be up scaled in the entire red and lateritic soil zone spread over different states of the country.

J. Describe how the sustainability of the project/programme outcomes has been taken into account when designing the project / programme.

Sustainability of Outcomes

. The participatory approach of the project will ensure the ownership of the project by the community, which is expected to ensure the sustainability. The project proposes a livelihood-based approach to adaptation, developing asset / capital base of individual / community in a participatory model. Four types of capital base will be created i.e. human capital, natural capital, physical capital and financial capital. The human capital will be formed through developing adaptive knowledge and skill base of farmers whereas physical capital will be in shape of water harvesting structures, micro irrigation facilities, integrated farming model, home gardens etc. The natural capital will be the scientific basis for drawing up the GP wise plan. This will positively impact on the financial capital of the farmer households. All these will lead to improvement in the adaptive capacity, both at household and

community level. Combined impact of these components will ensure sustainability of the outcome in the long run.

Environment Sustainability

The project proposes the transfer of sustainable technologies and also the promotion of indigenous varieties of seeds/breeds so that environmental sustainability can be ensured. The improved designs of water harvesting structures, plantation on permanent fallows, will help in soil and water conservation and groundwater recharge sustainably. The increased organic waste in the soil will help to regain the soil health and thereby sustainable increase in productivity.

Economic Sustainability

The land and water use master plans prepared on the basis of GIS mapping will give the community a proper scientific basis for planning interventions in future also. It will also save the community from making wrong investments. Economic gains from effectively planned interventions will give impetus to the community to continue the same activities in future also. The crop-weather advisories will help to stabilise the production. The soil and water conservation measures will help to improve the quality of the soil and its moisture retention capacity which will help in making the unutilised lands productive. It will also unleash the scope of alternative income. Introduction of sustainable agriculture practices and integrated farming system will help to reduce the cost of agriculture and increase the total farm production. The extension of growing season will increase the employment opportunity and thereby the income of marginalised farming families. Both seed, grain and fodder banks created as disaster coping mechanism may also be used as community income generation activities. The introduction of appropriate technologies will save the cost for fuel, the wastes can be recycled in the farm as organic input and will reduce the cost of manures purchased from the market. The livestock and fisheries will act as resources for generating supplementary income on a sustainable basis.

Social and Institutional Sustainability

Strengthened community based organisations will help in forming linkages with financial institutions, Panchayat and other stakeholders for accessing different schemes and services. The increased awareness among the community will help to choose the better adaptive options for their livelihood. Further ensuring that the capacity building is inclusive for men and women equally will lead to equal distribution of benefits from the project. These factors will impart social and institutional sustainability to the target communities and groups.

Interventions under Component 3 that need organizational management are the soil water conservation measures (step ponds, contour bunds, check dams, semi-circular bunds, plantation and trenches/pits), grain bank, seed bank, fodder bank and the community-based drinking water facility.

Methodology and Principles of Management

1. ***For Soil Water Conservation Measures*:** All these structures and facilities will be maintained by the groups both during and after the project. DRCSC already has experience of more than 15 years of building similar community assets and having these successfully maintained by the concerned groups till now. Hand-holding support from DRCSC will be provided during the project. After the project is completed, the basic incentive for maintaining these structures and facilities will be the benefits that the groups will derive from them.

The groups will be strengthened through training, exposure visits and regular meetings. Decision-making capacity of the group will also be enhanced through the above facilitations. The groups will also be helped to understand the worth of the community assets in improving their food and livelihood security.

The groups will be motivated to frame their rules and regulations so that the entire action during and after the project are regulated by certain laws; DRCSC will assist in achieving this during implementation.

In the event of any social conflict, the groups will be facilitated to resolve the conflict by holding discussions. For unresolved issues, the local Panchayat will be involved.

2. ***For Grain Bank, Seed Bank, Fodder Bank:*** The groups involved in management of seed bank, grain bank and fodder bank would be trained in these activities in terms of scientific management practices of these units. Here also, the principal incentive and motivation for sustaining all this infrastructure will be the benefits that the groups will be deriving from their use. Grain Banks and Seed Banks previously established by DRCSC in different parts of West Bengal are being managed by groups for over 15 years. In many of these areas DRCSC has now withdrawn its support, but these banks continue to function, as is evident from their books of records.

3. ***Community-based Drinking Water Facility:*** A Managing Committee will be formed from among the beneficiary community for managing the facilities. The Committee will decide on the monthly user fee which will be collected from the beneficiaries. The Committee will make use of the fund thus created for maintaining this infrastructure. In case of major technical faults, this fund will be utilized for hiring technical experts. Capacity building of the Committee members will be done by DRCSC.

A brief account of the sustainability measures against the expected concrete outputs is given below:

Expected Concrete Outputs	**Sustainability measure**
Five Gram Panchayat-wise Land and Water use Master Plans are prepared	Survey and mapping land plots will be done together with the Jadavpur University, PRI and local government officials. The beneficiaries will also be engaged in the process before finalization of the whole plan. The mix of top down and bottom up approach will ensure the ownership of all and hence will make it sustainable.
2.1 Automated Weather stations (AWS) at 6 locations (covering 10 sq.km each), 12 manual data collection centres (MDC) for collection of weather information ***2.2*** The expert group comprising of weather expert and agri experts for	The Climate Resource Centre (CRC) proposed to be set up in the project area can also be merged with Tathyamitra (Information Kiosk) being set up by State Government, thereby complementing the efforts of the Government. The activity will be implemented in close coordination with Panchayats so that after the withdrawal these can be maintained and used further by them in order to collect local

Expected Concrete Outputs	Sustainability measure
analyzing the data collected through AWS and MDC and preparing the 5-days crop-weather advisories ***2.3*** A Climate Resource Centre located at the centre of the project area and 40 weather kiosks managed by climate volunteers for collection and dissemination of crop-weather advisories	data and analyse. The CRC will definitely improve in the information dissemination system related to the weather, agriculture by adopting latest technology in the proposed project villages. Availability of local climate volunteers would help in maintaining the weather kiosks and sustaining it on a long term basis.
3.1 Sustainable soil and water conservation measures (e.g. semi-circular bunds, check dams, gully plugs, infiltration ditches and agro forestry plantations) for various ecosystems introduced for improvement of agricultural productivity and environmental sustainability	Proper repair and maintenance of the structures created under the project will be majorly done by project beneficiaries as well as community The convergence with MGNREG, Soil Conservation department will be made to create and maintain the structures suggested in the process
3.2 Multilevel crop arrangements & integrated farming practices are introduced which improve the total yield, reduce the need for external inputs & seeds as well as improve labour efficiency mainly through popularizing a combination of drought & heat tolerant field crops, fast growing & multipurpose perennials and small livestock	Direct involvement of Agriculture Department and its extension services ensures that farmer field trials are replicated in similar agro-eco zones. If technology and extension services are available, the level of adoption will be high among farm families.
3.3 Disaster-coping mechanisms e.g. community grain banks, local crop & trees seed banks, fodder banks developed in targeted villages	Community organizations and Gram Panchayat to take care of the systems created
3.4 Climate resilient appropriate technologies e.g. energy efficient cook stoves, bio-gas, low cost water filters, community based drinking water facility are promoted.	The intervention will help to reduce the drudgery of women (as they are mainly responsible for cooking, collecting drinking water in the households) and they will be able to invest their saved time for other livelihood activities. Therefore these cost effective structures will be in major demand. The local youth skilled technicians will help to maintain these in long run.
4.1 Production of technical and financial data analysis on processes to improve the resilience of the livelihood in red and lateritic zones of West Bengal	Media exposure and field visits to project sites would bring about longer term coverage. The exchange visits would encourage the replication interest in other communities. The technical and financial papers, best practices and policy briefings would enable Ministry of Agriculture, Ministry of Environment Forests and Department of National Planning to

Expected Concrete Outputs	Sustainability measure
4.2 Improved access to learnings from the project activities to be ensured through short films, dedicated website and other printed materials *4.3* Advocacy with National / State / Local Government and others (NGOs, CBOs, International organizations, climate activists/experts) on processes to identify strategies to adapt to climate change in red and lateritic zone	better target policy and development Interventions

Replication and Scaling up

The institutional arrangement for implementation of the project is based on the institutional capacity and its operational mandate given by State and National Government. This will help to synergise the outcome in future plan and policy of Government. Based on the data and analysis that will be undertaken during implementation, the viability, sustainability and replicability of the model will be tested. The detailed efficacy study will help to monitor the potential of the interventions so that these can be further replicated and expanded.

The inputs provided to the State Steering Committee and reflections of the Climate Change Observatory will create forums and opportunities for parking successful strategies for policy development and designing programmes. The process documentation and evidence based studies will provide the necessary academic support to capitalising these opportunities and enable wider replication of project impacts and successes.

Knowledge management components under the project such as short films, dedicated website and other printed materials coupled with advocacy with National / State / Local Government and others (NGOs, CBOs, International organizations, climate activists/experts) are proposed with the basic objective of replication of the successful models across the vast tracts of red and lateritic zones spread over in other States.

K. Provide an overview of the environmental and social impacts and risks identified as being relevant to the project / programme.

Check-list of eenvironmental and social principles	No further assessment required for compliance	Potential impacts and risks – further assessment and management required for compliance

Compliance with the Law	The project complies with Environment (Protection) Act, 1986 and Forest Conservation Act, 1980.	None
Access and Equity	The project provides fair and equitable access to the project beneficiaries and will not be impeding access to any of the other requirements like health clean water, sanitation, energy, education, housing, safe and decent working conditions and land rights.	None
Marginalized and Vulnerable Groups	The project is basically aimed at providing livelihood and income to marginalised community living in the project area and as such will not have any adverse impact on other marginalised and vulnerable groups	None
Human Rights	The project does not foresee any violation of human rights	None
Gender Equity and Women's Empowerment	The project will ensure participation by women fully and equitably, receive comparable socio-economic benefits and ensure that they do not suffer adverse effect.	None
Core Labour Rights	Payments to labour under the project will be made as per Government approved norms duly following minimum wage rate and hence ensuring core labor rights.	None
Indigenous Peoples	The project will ensure to comply with the rights of the indigenous people set forth by the UN declaration adopted by the Government of India.	None
Involuntary Resettlement	The project does not displace any community and hence no issue of resettlement	NIL
Protection of Natural Habitats	The project does not affect any of the natural habitats but will ensure the conservation and regeneration of biodiversity in the project area.	NIL
Conservation of Biological Diversity	The project does not affect biodiversity in any adverse way.	NIL
Climate Change	The project is basically for enhancing the adaptive capacity and is not expected to contribute to GHG emissions	NIL
Pollution Prevention and Resource Efficiency	Many activities suggested in the project will prevent pollution and improve efficiency of resource use.	NIL
Public Health	No adverse impact on public health related issues is envisaged.	None
Physical and Cultural Heritage	No adverse impact on cultural heritage related issues is identified	. None

Lands and Soil Conservation	Many activities proposed in the project will result in land and soil conservation. The project will not create any damage to land & soil resources.	None

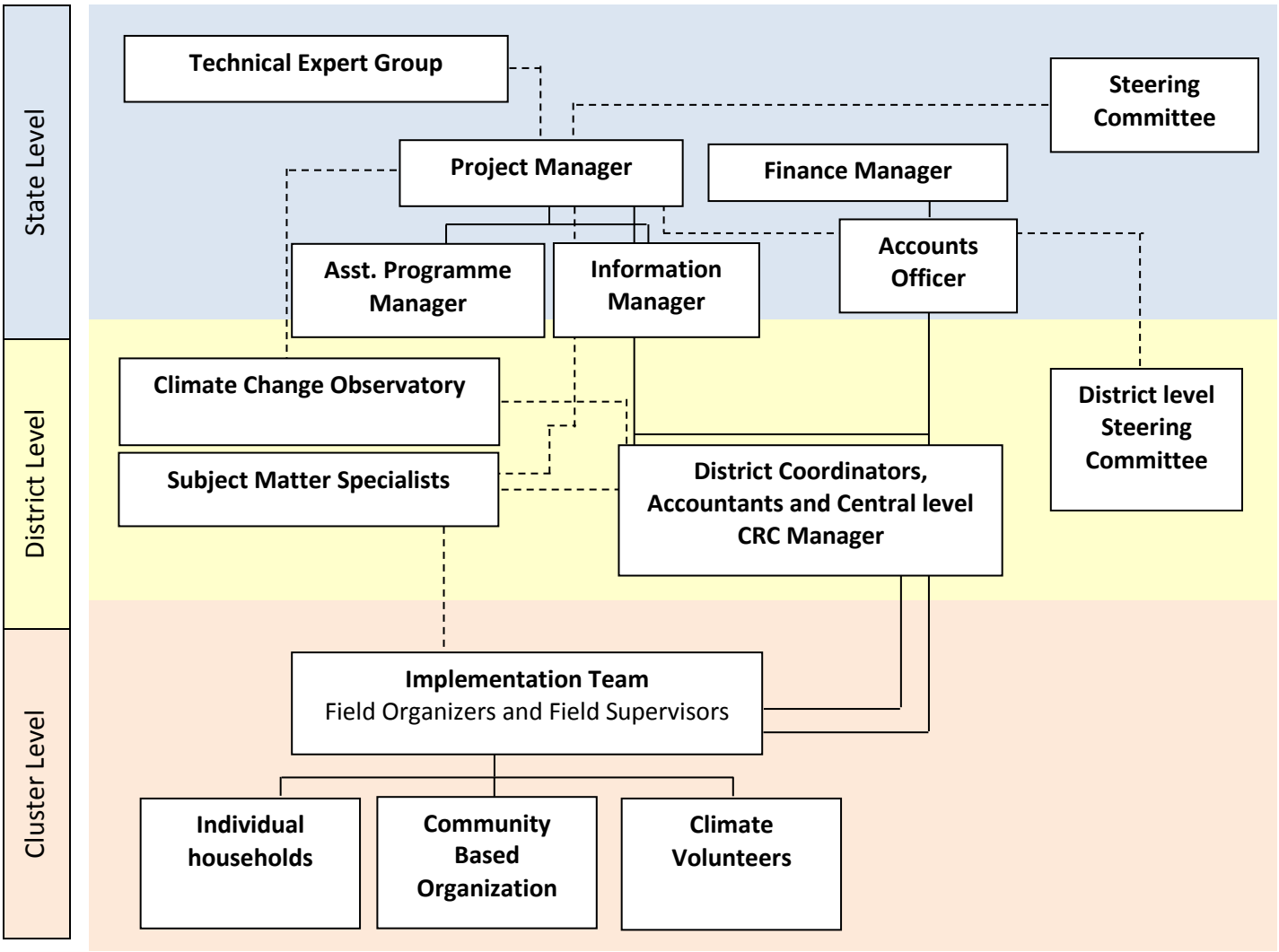
The AFB's Environmental and Social Policy (approved in November 2013) will be made available to project stakeholders and promoted through training and dialogue with implementing agencies to build a common understanding of the principles and practices that have been adopted to enhance development benefits and avoid unnecessary harm to the environment and affected communities. Any potential impacts on marginalized and vulnerable groups will be properly screened and considered by the implementing agencies.

PART III: IMPLEMENTATION ARRANGEMENTS

A. Describe the arrangements for project / programme implementation.

The overall strategy of the programme is people-centered, process-oriented and stakeholder based. The programme will be implemented with the support from Panchayat Raj Institutions under the overall supervision of DSCRC. The following is the process to be followed in programme planning and implementation.

Institutional Arrangement of the Project



Institutional arrangement for the implementation of the project and their role in the project is as follows:

Institutional Structure	Composition/Membership	Role and Responsibility
State Steering Committee	Comprising of membership from the Senior Government officials from the Department of Rural Development; Agriculture; Environment; Soil & water conservation; Fisheries; Panchayat; NGOs; NABARD and Project Manager of the Project Team. NABARD as NIE at the state level will be the Convener of the State Steering Committee.	• Facilitate involvement of Government departments in the implementation process of the project at the state and district level • Provide guidance and direction to the project activities to enable it to achieve its objectives • Monitor the progress of the project against the agreed time lines • Assess the relevance and feasibility of the project activities and impacts and identify policy level issues that can be fed to relevant departments for policy development
Technical Expert Group	Experts with qualification and Experience in: • Sustainable agriculture • Climate Change and development of Adaptation Strategies • Institution Development • Soil and water conservation • Alternative / Renewable Energy • PHE • Natural Resource Management • Fisheries • Livestock The Technical Expert Group will be constituted for the purpose of the project and will be convened by the Project Manager to draw upon the expertise of the Resource Persons from this group.	• Provide technical inputs to the central and district level team members. • Assess relevance and impact of the climate adaptive strategies • Make recommendation to the Project Team on technical matters to incorporate the same in the implementation plan
Project Team	Project team will have three layers: one, at the state level comprising of the Project Manager, Assistant Programme Manager, Information Manager, Finance Manager and the Accounts officer; second, will be at District level with two district coordinators along with 2 Accountants and a central level CRC Manager, and third, the Cluster Implementation Team comprising of Field	• Overall responsibility of the implementation of the project • Engage with external stakeholders to achieve project objectives • Responsible to the NIE and for fulfilling monitoring and evaluation activities under the project

Institutional Structure	Composition/Membership	Role and Responsibility
	organizers and supervisors located at the Panchayat level.	
District level Steering Committee	District level Steering Committee will be comprise of the membership of District Collectors, and district level officials from the department of Agriculture; DRDC, Cooperative banks, Line departments, Panchayat, DDM, Project Manager. The District Coordinator will be the Convener of the District level Steering Committee.	• Facilitate project implementation at the district level • Facilitate coordination between different departments for the smooth implementation of activities at the project level • Monitor the project activities and assess the benefit accruing to the project beneficiary • Provide guidance and direction to the project for the implementation of project • Assess the usefulness of climate adaptive strategies for the region
Climate Change Observatory	Invited members from Universities, Climate change cells, Experts from meteorological departments	• The Observatory will review data generated as part of the project's experiences, climate data from local and IMD sources, and data on adaptation practices in natural resource management from other places. • The meteorological experts and Universities will also help the project directly by analysing the locally collected data and helping in generating the crop-weather advisories and in carrying out the geo-informatics appraisal.
Community Based Organizations (CBO) / Climate Volunteers	The CBOs will comprise of the small and marginal farmers and landless who are directly involved in the natural resource management activities. The groups can be informal livelihood groups and/or Self Help Groups. These groups may be existing or may have been formed under the project. The group leaders or youth of the villages will act as climate volunteers.	• Participate in the project activities at the farm, cluster and district level • Work for the strengthening of activities related to natural resource management and adoption of climate resilient strategies • Participate in capacity building programmes • Adopt sustainable natural resource management techniques, practices and philosophy • Strengthen the organization base of the natural resource dependent community to provide institutional sustainability

The institutional set-up proposed at the field level by DSCRC for effective implementation and monitoring of the project are as under:

Position	Number	Months	Responsibilities
Program Manager	1	48	Coordination of overall programme, Continuous liaison with Technical Expert Group, State Steering Committee, organise workshops/meetings, procurement, budget control, compliance with regulatory laws and policies, organising capacity building events for cluster and district level implementation staff etc. He will also be responsible for the state and district level advocacy programmes.
Assistant Program Manager	1	48	Assist Programme Manager in regular work, follow-up & monitoring, project report preparation.
Information Manager	1	48	Documentation and communication will be the major responsibility. Will facilitate inputs from experts in developing the policy paper and will be responsible for publishing the technical and financial papers. Regular updation of work in websites, best practices and case studies preparation.
Finance Manager	1	48	Overall finance tracking & monitoring, budget control, procurement and liaison with finance person of Funding Agency, compliance with regulatory laws and policies, carrying out auditing process, etc.
Accounts Officer	1	48	Assist Finance Manager, monitoring District Accountants, regular book keeping, cash and bank handling.
Climate Resource Centre Manager	1	48	Data collection from AWS & MDCs, compilation, liaison with Meteorological expert on regular basis, disseminate the crop-weather advisories, collect feedback from the beneficiaries, liaison with government officials
District Co-ordinator (district wise)	2	48	District level overall co-ordination, organise meetings/workshops/trainings at district level, linkages with various stakeholders including Government officials, Panchayat, convening the district steering committee meetings, liaison with Central office, monitoring and providing technical support with the help of subject matter specialists, logistics and administrative work
Accounts Officer (district wise)	2	48	Day to day Accounts maintenance, book keeping, maintaining the processes for cluster level procurements, liaison with central office, helping in logistics and administrative support.
Field Supervisor	4	48	Support to District Co-ordinator and supervise the

Position	Number	Months	Responsibilities
(district wise)			implementation programme, identifying the needs of capacity building, provide support to the field organisers for implementation, linking beneficiaries with different schemes of Panchayats.
Field Organizer (3 in each district)	6	48	Mobilising the beneficiaries, Motivating, Group building, Implementation

Role of NABARD as NIE:

NABARD would be involved in periodic monitoring (on-site and off-site) of the project. Periodicity and structure of monitoring is given below:

1. On-site detailed monitoring would be done on six monthly basis jointly by NABARD Regional Office (West Bengal and Head Office. The frequency of monitoring would be increased if considered necessary.
2. District Development Manager I.e. NABARD officer stationed at the districts would be a part of the monitoring committee for implementation of the project at local level.
3. NABARD would be part of steering committee which would be meeting every six months. The committee would deliberate and review the progress of implementation.
4. Quarterly report submission formats would be designed for submission by executing entity for desk appraisal of progress. This will be structured as a part of the off-site monitoring surveillance system and would be designed to generate warning signals, if any.
5. Progress reporting would be done to AFB on periodic basis (half yearly or more frequently as per requirement of AFB).
6. NABARD would create platform for sharing and dissemination of knowledge at regional and national level.

B. *Describe the measures for financial and project / programme risk management*

Following are few risks associated with the project.

Risk	Risk Perception	Response Measure
Local Government fail to prioritize, sustain and upscale support for climate adaptive interventions in their strategies and plans	Medium	Climate change adaptation needs and priorities are reflected in State, National policies and plans, but a void remains at Gram Panchayat and block level. Inclusion of the learnings and best practices of the project in the future planning at Gram/Block level is proposed through effective implementation of knowledge management component.
Government officials and Panchayat representatives may change	Medium	The project will try to conduct awareness sessions continuously with the community as well as with Panchayat and block level officials and also share the project details with them to avoid any gap

Risk	Risk Perception	Response Measure
Few farmers may not use the crop-advisories	Low	The community will be involved in the process from the very beginning and proper training and awareness will be conducted on the ways to use the crop-weather advisories
Volunteers absenteeism	Low	In each village apart from the responsible volunteers there will be a panel of young people who will also attend the awareness sessions and will be apprised of the tasks of the climate volunteers so that incase of such absenteeism the gaps will be immediately filled by them
Demand for labour near or outside the project area leads to outmigration.	Low	The work opportunity will be created in the villages itself which will restrain the community from outmigration
Major price fluctuation of the recommended commodities	Medium	The project has provisions for mobilizing community contribution and converging with different government schemes to counter risks of major price fluctuations
Macro Planning remains in place but participatory planning at local level for adaptive measures is not taken	Medium	The advocacy done as part of the project will try to address the gap that exists between macro and micro plans and also endeavor to influence the Government both at state and national levels to take a bottom up approach
Policy makers and politicians prioritize economic benefits over sustainable and resilient ecosystems.	Low	The project will demonstrate cost-effective and economically sound models of adaptation and generate local demand, through communication strategies, to influence policy
Additional development (financial and marketing) support for alternate food and livelihoods are unavailable in the target Gram Panchayats at the required time	Low	The project has been designed to provide technology and inputs for such climate-resilient livelihoods, in line with the government's national programs for food security, poverty alleviation and village development. All these programs are active in the project areas, further liaison will be made between regular development programs and project objectives.
Groups have been formed but due to difference in economic, social status they are not effective.	Low	The project has been designed in such a way that more stress will be given towards strengthening of the groups. The quality of the leadership would be made better, so that they themselves will be able to resolve the social conflicts.
Lack of awareness among participating communities and local officials on CC and potential impacts	Low	The project aims at working with both the community and the officials. Various awareness and sensitization sessions will be carried out

C. Describe the measures for environmental and social risk management, in line with the Environmental and Social Policy of the Adaptation Fund.

Even though the project is classified as "Category C" project and is not envisaged to pose any risks indicated under Environmental and Social Policy of Fund, risks if any that may arise during the project implementation would be mitigated as indicated below:

- Project implementation teams would be sensitized on these aspects
- Project Advisory Committee would specifically review issues related to social and environmental risk during its periodical meetings
- NABARD Regional and Head Office would identify specific risks that may arise during implementation based on the monitoring of the project and built in reporting mechanism for the same
- Social audit that would be put in place would also help in mitigation of some of risk enlisted under Environmental and Social Policy of the Fund. Community would be sensitized on contents under Environmental and Social Policy of the Fund.

Mechanism of creation of awareness on Social and Environmental Policy of Fund would be on the following lines:

- Initial orientation during the inception of the project about the systems and procedures.
- Providing guidelines and orientation on the Environmental and Social Policy of the Adaptation Fund to the project team
- Grievance mechanism would be informed to community during the project inception workshop.
- As part of grievance mechanism, communication details of implementation entity co-ordinator and contact person would be available to direct beneficiaries as well as community at large through display of project information boards placed at prominent common places within the project area.

D. *Describe the monitoring and evaluation arrangements and provide a budgeted M&E plan.*

Monitoring components

Baseline**:** Geo-informatics appraisal done at the beginning of the project will give us a baseline picture of the project area. WUMP and LUP prepared on the basis of the geo-informatics appraisal will also act as a baseline to the project as well as a planning document. The progress of the project can be tracked through tracking WUMP and LUP by the community itself. Geo-informatics appraisal done at the end of the project will give an exact idea of the differences made by the interventions done as part of the project.

Monitoring Plan, Visits and Reports**:** In order to ensure accountability and transparency, a monitoring plan is developed at the beginning of the project by the Programme Manager and Information Manager in consultation with the Advisory Committee.

Community planning and Monitoring**:** The inclusion of the target groups in planning and monitoring of a project form a non-negotiable component. The project design itself with PVCA, WUMP and LUP ensure community participation from the beginning. The monitoring strategy details are presented in the table below:

Monitoring and Evaluation Plan			
Type of M&E Activity	**Responsible Parties**	**Budget (US$)does not include staff time**	**Time Frame**
Project Inception Workshop	Project Director / State NABARD	500	Within first three months
Inception Report	Project Director/ District level Project coordinator	150	One Month after IW
Half-yearly report	Project Director/ District level Project coordinator	1,500	End of every six months
Annual report	Project Director/ District level Project coordinator	2,400	End of each year
Project review & monitoring Meeting	Representatives of MOE/ Dept. of Govt /Project Director/NABARD	2,500	First after IW (Inception workshop) (monthly
Mid-term evaluation	External Evaluator/ Representatives of MOE/ Dept. of Govt / Technical Consultants/ Project Director	2,000	At mid-point of project execution (2nd year)
End term evaluation	External Evaluator/Representatives of MOE/ Dept. of Govt / Technical Consultants/ Project Director	5,000	At end of Project cycle
Final Report	Project Director/ District level Project coordinator	1,500	3 months after end of the Project
Total Amount		**15,550**	

NABARD will do the overall monitoring and district officials will closely monitor the programme.

The Programme Manager and senior management of DRCSC along with the management personnel of local partners will be responsible to monitor the programme on annual basis. The district level workshops will be conducted to review the programme and make necessary action plan for the next phase. Local administration representatives District Manager, ADO, BDO, Panchayat Pradhan, NABARD will be engaged in reviewing the programme followed by the Field Visits. Log Frame will act as a basic document to measure the impact.

For the monitoring of an adaptation project, the link to climate change needs to be monitored in addition to the output, use of output and outcomes. The adaptation hypothesis that explains how project activities address climate risks should therefore be part of the monitoring framework and be referred to throughout the monitoring phase. In addition, it should be explained how any one activity reduces or prepares for climate risks, or how activities enhance adaptive capacities.

E. Include a results framework for the project proposal, including milestones, targets and indicators.

Goal	Developing climate adaptive and resilient livelihood systems through diversification, technology adoption and natural resource management for rural small and marginal farmers associated with agriculture and allied sector in red and Lateritic Zone of West Bengal.				
	Indicator	**Baseline**	**Target**	**Means of Verification**	**Assumptions & Risks**
Objective: To enhance adaptive capacity of climate vulnerable families in red lateritic zone of Purulia and Bankura districts of West Bengal	Percentage of target population adopting risk reduction measures for livelihoods and energy consumption	Less than 5% of target 5,000 households (250 hh) practice climate risk reduction measures	80% of target 5,000 households (4000 hhs (19096 persons) — 9427 female and 9669 male beneficiaries) continue to practice at least one climate risk reduction measure introduced through project interventions	Household survey at the start and end of project	**Assumption:** Climate risk information and Livelihood demonstrations convince farm families to adapt at household and community level **Risk:** Local Government fail to prioritize, sustain and upscale support for climate adaptive interventions in their strategies and plans
Component 1: Land & Water Use Master Plan					
Outcome 1 Communities adopt land and water use master plans with the help of Panchayats through better understanding of climate change related impacts	Number of households able to take informed decisions about climate adaptive interventions Percentage of planned interventions included in Village Development Plans by Panchayat	Farm families highly exposed to climate change related livelihood insecurity having no definite clue about the reasons or the solutions No scientific information and participatory processes are involved in planning land and water use	At least 80% of 5,000 target households (4000 hhs (19096 persons) — 9427 female and 9669 male beneficiaries) are able to take informed decision about climate adaptive interventions. At least in 90% cases the interventions planned are included in Village Development Plans	Household survey at the beginning and end of the project. Dialogue with beneficiaries Checking of records, photographs etc Panchayat records	**Assumption:** All stakeholders will participate and contribute in the preparation of plans **Risk:** An all party consensus may not emerge
Output 1.1 Five Gram Panchayat -wise	LUP & WUMPs for the targeted GPs are in	LUP & WUMP for the area is not available	In all the GPs, communities and Panchayat consider land and	WUMP & LUPs for the target area	**Assumption:** Gram Sabhas are held

Land and Water use Master Plans are prepared	place	with the Panchayat or any other Govt. dept.	water use master plans at the time of making village development plans	Copies of Village Development Plan (VDP) available with Panchayat	regularly
Component 2: Reducing climate risks through timely and appropriate weather specific crop/agro-advisory services in local language (Bengali)					
Outcome 2 Farmers are better prepared for climate resilient agriculture and wastelands development	Percentage of farmers having ready access to and making use of crop-weather advisory in local language	Crop-weather advisory services are not available to the farmers in the project locations	More than 6,200 farmers (including 3720 women farmers) in target area receive crop-weather advisory in local language (Bengali)	Feedback from farmers Focussed Group discussions Project reports, evaluation reports	**Assumptions:** Farmers accept suggested changes in selection of crops/varieties/trees **Risks:** Few farmers may not use the crop-advisories
Output 2.1 Automated Weather stations (AWS) at 6 locations (covering 10 sq.km each), 12 manual data collection centres (MDC) for collection of weather information	Number of AWS & MDC are in place and operating effectively	No AWS installed for collecting village level weather data	AWS at 6 locations, 12 MDC installed for collection of weather information	Physical verification Data repository	**Assumptions:** Community shows interest in making use of weather data to reduce climate risks to their livelihoods
Output 2.2 The expert group comprising of weather expert and agri experts analyzes the data collected through AWS and MDC and prepares the 5-days crop-weather advisories	A committee comprising of 2-3 experts from agri universities and climate experts is formed Number of crop-weather advisories prepared per month	Weather reports are available at State and District level but no location specific crop-weather advisory services are available	Five to six crop-weather advisories are generated per month	Repository of weather advisories	**Assumption:** AWS are performing well without technical trouble and provides basic data continuously for generating advisories
Output 2.3 A Climate Resource Centre located at the centre of the project area and 40 weather kiosks managed by climate volunteers for collection and dissemination of crop-	Climate Resource Centre and Weather kiosks are in place Number of crop-advisory services disseminated	No system for regular dissemination of crop-weather advisories	1 climate resource centre at central location and 40 weather kiosks are in place 5-6 crop-weather advisories per month are disseminated to the entire community	Physical verification The SMS messages and display materials Record of feedback	**Assumption:** Farmers are using the information for crop planning. Community donate sites for kiosks **Risk:** Volunteers

weather advisories	A feedback mechanism for verifying efficacy of the advisory services is in place				absenteeism
Component 3: Climate resilient technology transfer for enhancing the adaptive capacity of the community					
Outcome 3 Livelihoods have become less vulnerable to climate change and achieve higher levels of productivity	Number of beneficiaries, particularly women, with diversified livelihoods Number of farmers achieving higher level of sustainable productivity Status of community with improved food-fodder-fuel reserve as a drought proofing measure	Most farm families under rain-fed conditions highly exposed to climate change induced livelihood insecurity Beneficiary farmers depend only on rain-fed farming Common properties as reserves are degrading fast Families face food-fodder-fuel crisis at least for 4 months in a year	All 5,000 (target Households of population 22810 [male : 11548 & female : 11262] have developed climate resilient livelihood strategy to diversify their sources of income Whole farm productivity is increased by 30% for at least 60% beneficiary families i.e. 3000 hhs Food-fodder-fuel reserve is ensured for 100% targeted families (which includes women population of 11262).	Field monitoring reports Household & market survey reports Group discussions & interactions End of project Survey Comparison with cost and profitability norms as originally anticipated	**Assumption:** Local government will provide access to commons and agree to negotiate with the groups. Marketing arrangements exist for all recommended commodities **Risk:** Demand for labour near or outside the project area leads to outmigration. Major price fluctuation of the recommended commodities

Output 3.1 Sustainable soil and water conservation measures (e.g. semi-circular bunds, check dams, gully plugs, infiltration ditches and agro forestry plantations) for various ecosystems introduced for improvement of agricultural productivity and environmental sustainability	Area brought under soil-water conservation structures Area under vegetative cover	Low water retention capacity of the soil, fertile top soil erosion Large area lying fallow (seasonally or perennially)	300 hectares of fallow land brought under soil-water conservation structures More than 250 hectares of area brought under vegetative cover and protected by live fences, hedgerows, aerodynamic windrows, boundary plantation & other agroforestry systems	SW Conservation structures, Muster Roll, Group Records, Internal & External Evaluation Reports, Project Progress Report	**Assumption:** PRIs agree to include SW conservation structures in Village Development Plan through convergence with mainstream schemes **Risk:** Overall plan is not developed in time
Output 3.2 Multilevel cropping systems & integrated farming practices are introduced mainly through popularizing a combination of drought tolerant field crops, fast growing & multipurpose perennials and small livestock	Hectares of land brought under cultivation Increase in cropping diversity & intensity Increase in cropping months and food availability Increase in self supply of seeds & inputs	Integrated Farming System is practised by 10 farmers in the target area. A very few target families have knowledge about sustainable agriculture techniques and practices	400 hectares of single crop land turned into at least double crop At least 4,000 target families enjoy an increase in income from diversified sources Food & nutrition security is ensured for at least 80% beneficiaries (9009 female and 9238 male beneficiaries) round the year. At least 4,000 target families have reduced their dependency on market for the inputs for agriculture	Household level survey before and after the project Periodic monitoring report	**Assumption:** Community shows eagerness to attend training and replace conventional agriculture with sustainable agriculture Risks: Farmers disinclination in adoption of recommended farming systems
Output 3.3 Disaster-coping mechanisms like community grain banks, local crop & trees seed banks, fodder banks, developed in targeted villages	Number of Grain Banks, Seed Banks and Fodder Banks established Number of families able to meet up their food, fodder, input (especially availability of seed) crisis	A very few community grain banks and no seed or fodder banks exist in the area.	40 grain banks, 5 seed banks and 5 fodder banks are established. The food/fodder/input crisis and emergencies met up for at least 1500 hhs through these interventions	Household level survey before and after the project Periodic monitoring report	Assumption: Farmers are convinced of the proposed interventions

	in emergencies				
Output 3.4 Climate resilient appropriate technologies like energy efficient cook stoves, bio-gas, low cost water filters, community based drinking water facility, are promoted.	No. of target families using energy efficient cook stoves, biogas, low cost water harvesting, low cost water filters, community based drinking water facility. Number of community based facilities established Number of target families accessing mainstream schemes for installation of climate adaptive structures	450nos. of target families use energy efficient cook stoves. 100 families have biogas units. 110 low cost water filters are in use. No community-based drinking water facility 1000 no. of target families access mainstream schemes for installation of climate adaptive structures	At least 2400 nos. of target families use energy efficient ovens, 250 biogas and 2500 low cost water filters (3200 female beneficiaries are directly impacted). At least 5 no. of community based drinking water facilities are established (At least 500 female beneficiaries are directly impacted by this intervention in terms of reduced labour, time and drudgery) At least 5000 families (11262 female and 11548 male beneficiaries) accessing mainstream schemes for installation of climate adaptive structures	Household and village survey before and after the project Periodic monitoring report	**Assumption:** Community eagerness to make use of climate adaptive structures and maintain them PRIs show promptness to help the beneficiaries in accessing mainstream schemes
Component 4: Learning and Knowledge Management					
Outcome 4 Various types of materials on processes and techniques are published and measures taken to upscale the interventions to improve climate resilience in the red and lateritic zone	Replication of the interventions in neighboring villages along with the project area Govt. adopted the climate resilient models in their policies	local level planning does not consider climate change related aspects Only few farmers practice ecological farming and livelihood practices	Climate resilient livelihood strategies adopted by other Gram Panchayats and Blocks The project learning documents aligned to the SAPCC are advocated for adoption with relevant government departments at both state and national levels	Government documents Interaction with the community External evaluation reports Reports and meetings	**Assumption:** Local Governments, State/National Governments convinced of the approach demonstrated through the project **Risk:** Unwillingness of Governments (local/state/national) to accept change in their planning approach
Output 4.1 Production of technical and	Number of technical reports published	Absence of location specific analytical	At least 5 technical reports & 1 policy paper published for wider	Reports	

financial data analysis on processes to improve the resilience of the livelihood in red and lateritic zones of West Bengal		reports	dissemination		
Output 4.2 Improved access to learnings from the project activities to be ensured through short films, dedicated website and other printed materials	Number of audio visual publications, awareness materials (e.g. folders, brochures, pamphlets, posters, newsletters, journals, IEC materials) published Dedicated website created and updated regularly Number of mass awareness generation measures (e.g. participation in village fairs, rallies, campaigns)	No appropriate awareness materials available, especially in vernacular No website at present Limited awareness generated through mainstream mass media e.g. television, radio.	At least 5 audio visual publications, 7 types of awareness materials published for wider dissemination in the state A web space is created for regular dissemination of project learnings At least 6 types of awareness generation activities to address the communities in and around the project villages	Printed and Audio Visual materials Photo documentation	
Output 4.3 Advocacy with National / State / Local Government and others (NGOs, CBOs, International organizations, climate activists/experts) on processes and practices adopted under the project	Number of Advocacy films prepared Number of workshops organised Number of stakeholders participated	No advocacy films are available No workshops organised involving the stakeholders	2 Advocacy films are prepared 8 local level, 3 state level experience sharing workshop and 1 national level advocacy workshops/seminar involving all stakeholders	Advocacy films Workshop proceedings and reports Photos and other reports	

F. Demonstrate how the project / programme aligns with the Results Framework of the Adaptation Fund

Project Objective(s)[36]	**Project Objective Indicator(s)**	**Fund Outcome**	**Fund Outcome Indicator**	**Grant Amount (USD)**
To enhance adaptive capacity of climate vulnerable families in red lateritic zone of Purulia and Bankura districts of West Bengal	Percentage of target population adopting risk reduction measures for livelihoods and energy consumption	Outcome 5: Increased eco-system resilience in response to climate change and variability-induced stress Outcome 6: Diversified and strengthened livelihoods and sources of income for vulnerable people in targeted areas	5: Ecosystem services and natural assets maintained or improved under climate change and variability-induced stress 6.2: Percentage of targeted population with sustained climate-resilient livelihoods	2,533,533
Project Outcome(s)	**Project Outcome Indicator(s)**	**Fund Output**	**Fund Output Indicator**	**Grant Amount (USD)**
Outcome 1: Communities adopt land and water use master plans with the help of Panchayats through better understanding of climate change related impacts	Number of households able to take informed decisions about climate adaptive interventions Percentage of planned interventions included in Village Development Plans by Panchayat	*Output 6:* Targeted individual and community livelihood strategies strengthened in relation to climate change impacts, including variability	6.1.1: Number and type of adaptation assets (physical as well as knowledge) created in support of individual or community-livelihood strategies	54,165
Outcome 2 Farmers are better prepared for climate	Percentage of farmers having ready access to and making use of	*Output 2.2:* Targeted population groups covered by	2.2.1. Percentage of population covered by adequate risk-reduction	55,401

[36] The AF utilized OECD/DAC terminology for its results framework. Project proponents may use different terminology but the overall principle should still apply

resilient agriculture and wasteland development	crop-weather advisory in local language	adequate risk reduction systems	systems 2.2.2. Number of people affected by climate variability	
Outcome 3 Livelihoods have become less vulnerable to climate change and achieve higher levels of productivity	Number of beneficiaries, women in particular, with diversified sources of income to reduce risk of dependency on only climate dependent livelihoods Number of farmers achieving higher level of sustainable productivity Status of community food-fodder-fuel reserve is improved as a drought proofing measure	*Output 6:* Targeted individual and community livelihood strategies strengthened in relation to climate change impacts, including variability *Output 5:* Vulnerable physical, natural, and social assets strengthened in response to climate change impacts, including variability	6.1.1.Number and type of adaptation assets (physical as well as knowledge) created in support of individual-or community-livelihood strategies 6.1.2. Type of income sources for households generated under climate change scenario 5.1. Number and type of natural resource assets created, maintained or improved to withstand conditions resulting from climate variability and change (by type of assets)	1,877,373
Outcome 4 Various types of materials on processes and techniques are published and measures are taken to upscale the interventions to improve climate resilience in the red	The works are being replicated in neighboring villages along with the project area Govt. adopted the climate resilient models in their policies	*Output 7:* Improved integration of climate-resilience strategies into country development plans *Output 3*: Targeted population groups participating in adaptation and risk	7.1. Number, type, and sector of policies introduced or adjusted to address climate change risks 7.2. Number or targeted development strategies with incorporated climate change priorities enforced	126,284

and lateritic zone		reduction awareness activities	3.1.1 Number and type of risk reduction actions or strategies introduced at local level 3.1.2 Number of news outlets in the local press and media that have covered the topic	

Alignment with Adaptation Fund Core Impact Indicators:

Adaptation Fund Core Impact Indicator "Number of Beneficiaries"				
Date of Report	19.09.2014			
Project Title	Enhancing Adaptive Capacity and Increase in Resilience of Small and Marginal Farms in Purulia and Bankura districts of West Bengal			
Country	India			
Implementing Agency	National Bank for Agriculture and Rural Development (NABARD)			
Project Duration	4 years			
	Baseline *(absolute number)*	Target at project approval *(absolute number)*	Adjusted target first year of implementation *(absolute number)*	Actual at completion[37] *(absolute number)*
Direct beneficiaries supported by the project	0	22810		
Female direct beneficiaries	0	11262		
Youth direct beneficiaries	0	5236		
Indirect beneficiaries supported by the project	0	26288		
Female indirect beneficiaries	0	13965		
Youth indirect beneficiaries	0	6490		

37 At project completion, the proponent could report on % targeted population reached or successfully supported (the absolute numbers could then be deduced from that figure)

Adaptation Fund Core Impact Indicator "Early Warning Systems"				
	Baseline	Target at project approval	Adjusted target first year of implementation *(absolute number)*	Actual at completion*38* *(absolute number)*
Adopted Early Warning Systems *(Category targeted – 1, 2, 3, 4; and absolute number)* *Weather-crop advisory services* *(1) risk knowledge,* *(2) monitoring and warning service,* *(3) dissemination and communication,* *(4) response capability.* *(report for each project component)* *(based on the scale of 1 to 4)*	 0 0 0 0	 3 4 4 4		
Hazard *(select from the list on page 2)* *Hydro-meteorological hazard* *(report for each project component)*	Drought and extreme temperature Erratic rainfall Increase in length of summer season	Impact of drought will be less Dependence on timely rainfall will be reduced		
Geographical coverage*(km2)* *Weather-crop advisory services* *(report for each project component)*	0	60 km^2		
Number of municipalities*(number)* *(report for each project component)*	None	5 Gram Panchayats in 2 districts		

Adaptation Fund Core Impact Indicator "Assets Produced, Developed, Improved, or Strengthened"				
	Baseline	Target at project approval	Adjusted target first year of implementation	Actual at completion
Sector (identify)	Rural Development, Food Security, Water Management, Agriculture			
Targeted Asset 1) Health and Social Infrastructure *developed (Scale 1 to 5)*				
• Provision of expanded and improved food security systems	0	4		
• Land and Water Use Management Plan and Micro Planning	0	5		
2) Physical assets produced (absolute No)				
• Automated Weather stations	0	6		
• Manual Weather Stations	0	12		
• Climate Resource Centres	0	1		
• Climate KIOSKs	0	40		
• Step Pond	0	40		
• Bioinput production (vermicompost pits)	0	2000		
• Irrigation Facilities (Ditches, Dugwells)	0	800		
• Lift irrigation	0	5		
• Grain bank	0	40		
• Seed bank	0	5		
• Fodder bank	0	5		
• Energy efficient ovens	0	2400		
• Biogas	0	250		
• Low cost water filters	0	2500		
• Community based drinking water facilities	0	5		
(produced/improved/strengthened)				
Changes in Asset *(Quantitative or qualitative depending on the asset)*				
• Automated Weather stations, Manual Weather Stations, Climate Resource Centres,	0	6,200 families are capable of responding to climate		

Climate KIOSKs		variability and its impacts		
• Step Pond	0	196,252,361 gallons of water will be available for agriculture		
	0			
• Bio-input production (vermicompost pits)	0	2,820 tons vermicompost production		
	0			
• Irrigation Facilities (Ditches, Dugwells)	0	56,401,393.6 gallons of water will be available for agriculture		
	0			
• Lift irrigation	0	cultivation can be done in all three seasons over 100 hectares of rainfed land		
	0			
• Grain bank	0	Food availability for 1000 families will be ensured during critical period of 75 days		
	0			
• Seed bank		Seed availability would be ensured locally during emergencies for at least 500 hhs		
• Fodder bank		Fodder availability ensured during		

• Energy efficient ovens • Biogas • Low cost water filters • Community based drinking water facilities		emergencies for at least 500 hhs Save at least 3 – 8 kg of firewood (on an average) per day. Reduce in carbon emission (5.4 kg per family per day on an average) 10,600 beneficiaries will have improved health 2,120 beneficiaries will have improved health. Women's drudgery will get reduced.		

Adaptation Fund Core Impact Indicator "Natural Assets Protected or Rehabilitated"				
	Baseline	Target at project approval	Adjusted target first year of implementation	Actual at completion
Natural Asset or Ecosystem *(type)* • Rehabilitation of degraded land • Afforestation • Biodiversity Conservation (crop, land, animals etc) • Ecosystem based agriculture	0	300 ha 250 ha Atleast 25 varieties (crop-10 varieties, plants & trees – 7 varieties, aquatic flora & fauna 4-5 varieties, small ruminants – 3 varieties) 1,015 ha		

Change in state *Ha or km Protected/rehabilitated, or* *Effectiveness of protection/rehabilitation - Scale (1-5)*		300 ha of degraded land improved – scale 4 Afforestation on 250 ha of area – scale 4 Biodiversity conservation – 4 1015 hac will be included under ecosystem based agriculture – 4		
Total number of natural assets or ecosystems protected/rehabilitated		2 (Biological Assets – forest, biodiversity) Land Asset – soil, land and water)		

G. Include a detailed budget with budget notes, a budget on the Implementing Entity management fee use, and an explanation and a breakdown of the execution costs.

Sl No	OUTPUT	Output wise Total (USD)	Component wise Total (USD)
Component 1: Land & Water use master plan (LUP & WUMP)			
1	5 Gram Panchayat -wise Land and Water use Master Plans are prepared	54,165	**54,165**
Component 2: Reducing climate risks through timely and appropriate weather specific crop/agro-advisory services in local language (Bengali)			
2.1	Automated Weather stations (AWS) at 6 locations (covering 10 sq.km each), 12 manual data collection centres (MDC) for collection of weather information	18,360	**55,401**
2.2	The expert group comprising of weather expert and agri experts for analyzing the data collected through AWS and MDC and preparing the 5-days crop-weather advisories	27,888	
2.3	A Climate Resource Centre located at the centre of the project area and 40 weather kiosks managed by climate volunteers for collection and dissemination of crop-weather advisories	9,153	
Component 3. Climate resilient technology transfer for enhancing the adaptive capacity of the community			
3.1	Sustainable soil and water conservation measures (e.g. semi-circular bunds, check dams, gully plugs, infiltration ditches and agro forestry plantations) for various ecosystems introduced for improvement of agricultural productivity and environmental sustainability	745,390	**1,877,373**
3.2	Multilevel crop arrangements & integrated farming practices are introduced which improve the total yield, reduce the need for external inputs & seeds as well as improve labour efficiency mainly through popularizing a combination of drought & heat tolerant field crops, fast growing & multipurpose perennials and small livestock and fishery	901,813	

Sl No	OUTPUT	Output wise Total (USD)	Component wise Total (USD)
3.3	Disaster-coping mechanisms e.g. community grain banks, local crop & trees seed banks, fodder banks developed in targeted villages	28,330	
3.4	Climate resilient appropriate technologies e.g. energy efficient cook stoves, bio-gas, low cost water filters, community based drinking water facility are promoted.	201,840	
Component 4: Learning and Knowledge Management			
4.1	Production of technical and financial data analysis on processes to improve the resilience of the livelihood in red and lateritic zones of West Bengal	10,000	**126,284**
4.2	Improved access to learning from the project activities to be ensured through short films, dedicated website and other printed materials	64,084	
4.3	Advocacy with National / State / Local Government and others (NGOs, CBOs, International organizations, climate activists/experts) on processes to identify strategies to adapt to climate change in red and lateritic zone	52,200	
	TOTAL		**2,113,223**
	Project / Programme Execution Cost		201,162
	Total Project / Programme Cost		2,314,385
	Project/Programme Cycle Management		196,469
	Amount of Financing Requested		**2,510,854**

The detailed budget note is annexed in Annexure VI.

Details on NIE cost:

The project management fee (8.5% of the total budget) will be utilised by NABARD, the National Implementing Entity, to cover the costs associated with the provision of general management support. Table below provides a breakdown of the estimated costs of providing these services.

Breakdown of costs for the project management fee Cost	**Amount US$**
Financial Management	29,772
Performance Management - Progress Monitoring- Field Monitoring	58,000
Information and Reporting (MIS etc)	39,697
Programme Support - Technical and Other to EE	69,000
Total	**196,469**

Notes:

1. **Financial Management:** This covers general oversight of financial management and budgeting and quality control. NABARD will:
   - Ensure compliance with standards and internal control processes, transparency.
   - manage, monitor and track AF financial resources including allocating and monitoring expenditure based on agreed work plans, financial reporting to the AFB and the return of unspent funds to AF;
   - ensuring that financial management practices comply with AF requirements and support audits as required;
   - ensuring financial reporting complies with AF standards; and

2. **Performance Management**. This includes:
   - Providing oversight of the monitoring and evaluation function of the Executing Agency
   - Undertake field monitoring of the project through District Development Managers, Regional Office (West Bengal) and Head Office officials.
   - Providing technical support in the areas of risk management, screening of financial and risk criteria;
   - Providing guidance in establishing performance measurement processes; and
   - Technical support on methodologies, TOR validation, identification of experts, results validation, and quality assurance.

3. **Information and Reporting Management**.

This includes maintaining information management systems and specific project management databases to track and monitor project implementation. Progress reporting to AFB and create platform for information dissemination.

5. **Program Support**. This includes:

- Technical support, troubleshooting, and support missions as necessary;
- Policy, programming, and implementation support services;
- Supporting evaluation missions and participating in briefing / debriefing;
- Providing guidance on AF reporting requirements;

H. Include a disbursement schedule with time-bound milestones.

S.No	Major Activity	Time line
1	Project Inception Workshop	0-2 months
2	GIS Mapping- Assessment, Implementation & Evaluation	2- 48 months
3	Gram Panchayat -wise Land and Water use Master Plans	2-12 months
4	Establishment of Automated Weather stations (AWS) and Manual Data Collection Centres (MDC)	2-6 months
5	The expert group comprising of weather expert and agri experts for analyzing the data collected through AWS and MDC and preparing the 5-days crop-weather advisories	6 -48 months
6	Establishment of Climate Resource Centre and Weather Kiosks	2-6 months
7	Capacity building of CBO, Pos, PRI & Networking	3-48 months
8	Sustainable soil and water conservation measures	6-45 months
9	Multilevel crop arrangements & integrated farming practices , Livestock, Fishery, Irrigation Facilities development, Organic manure production etc	7- 45 months
10	Disaster-coping mechanisms e.g. community grain banks, local crop & trees seed banks, fodder banks developed in targeted villages	9–39 months
11	Climate resilient appropriate technologies e.g. energy efficient cook stoves, bio-gas, low cost water filters, community based drinking water facility are promoted.	9- 46 months
12	Production of technical and financial documents – Printing & Audio visual materials	7- 45 months

13	Improved access to learnings from the project activities to be ensured through short films, dedicated website and other printed materials	7-48months
14	Advocacy with National / State / Local Government and others (NGOs, CBOs, International organisations, climate activists/experts)	8- 48 months
15	Programme Management activities	1 – 50 month
16	Reporting- Inception, biannual, annual	3- 48 months
17	Mid-term monitoring by stakeholder's team	24 months
18	Final Evaluation	**45 months**
19	**Final Report submission**	51 months

DISBURSEMENT MATRIX

	Year 1	Year 2	Year 3	Year 4	**Total**
Scheduled Date	Oct 14 – Sep 15	Oct 15 – Sep 16	Oct 16 – Sep 17	Oct17 –Sep 18	
Project Funds	347158	810035	810035	347158	2314386
Implementing Entity Fee	29470	68764	68764	29470	196469
Total	376628	878799	878799	376628	2510855

Time bound Milestones:

Project Implementation																
Component	Year1				Year 2				Year 3				Year 4			
	Qt 1	Qt 2	Qt 3	Qt 4	Qt 1	Qt 2	Qt 3	Qt 4	Qt 1	Qt 2	Qt 3	Qt 4	Qt 1	Qt 2	Qt 3	Qt 4
1.1 5 Gram Panchayat -wise Land and Water use Master Plans are prepared	15%	25%	35%	50%	45%	50%	55%	70%	65%	70%	75%	85%	85%	90%	100%	
2.1 Automated Weather stations (AWS) at 6 locations (covering 10 sq.km each), 12 manual data collection centres (MDC) for collection of weather information		40%	80%	100%												
2.2 The expert group comprising of weather expert and agri experts for analyzing the data collected through AWS and MDC and preparing the 5-days crop-weather advisories			18%	25%	31%	37%	43%	50%	56%	62%	68%	75%	81%	87%	93%	100%
2.3 A Climate Resource Centre located at the centre of the project area and 40 weather kiosks managed by climate volunteers for collection and dissemination of crop-weather advisories		40%	80%	100%												
3.1 Sustainable soil and water conservation measures (e.g. semi circular bunds, check dams, gully plugs, infiltration ditches and agro forestry plantations) for various ecosystems introduced for improvement of agricultural productivity and environmental sustainability			5%	10%	19%	28%	37%	47%	56%	65%	74%	85%	90%	95%	100%	
3.2 Multilevel crop arrangements & integrated farming practices are introduced which improve the total yield, reduce the need for external inputs & seeds as well as improve labour efficiency mainly through popularizing a combination of drought & heat tolerant fieldcrops, fast growing & multipurpose perennials and small livestock		4%	8%	12%	20%	28%	36%	46%	55%	64%	73%	84%	90%	95%	100%	
3.3 Disaster-coping mechanisms e.g. community grain banks, local crop & trees seed banks, fodder banks developed in targeted villages				10%	20%			40%	60%			85%	100%			
3.4 Climate resilient appropriate technologies e.g. energy efficient cook stoves, bio-gas, low cost water filters, community based drinking water facility are promoted.			6%	12%	21%	30%	39%	48%	57%	66%	75%	85%	100%			
4.1 Production of technical and financial data analysis on processes to improve the resilience of the livelihood in red and lateritic zones of West Bengal		2%	4%	7%	10%	13%	16%	20%	22%	24%	25%	26%	51%	76%	100%	
4.2 Improved access to learnings from the project activites to be ensured through short films, dedicated website and other printed materials		5%	10%	16%	24%	32%	40%	47%	54%	61%	68%	76%	82%	88%	94%	100%
4.3 Advocacy with National / State / Local Government and others (NGOs, CBOs, International organisations, climate activists/experts) on processes to identify strategies to adapt to climate change in red and lateritic zone		7%	14%	21%	26%	31%	36%	42%	48%	54%	60%	66%	74%	82%	90%	100%

PART IV: ENDORSEMENT BY GOVERNMENT AND CERTIFICATION BY THE IMPLEMENTING ENTITY

A. **Record of endorsement on behalf of the government** *Provide the name and position of the government official and indicate date of endorsement. If this is a regional project/programme, list the endorsing officials all the participating countries. The endorsement letter(s) should be attached as an annex to the project/programme proposal. Please attach the endorsement letter(s) with this template; add as many participating governments if a regional project/programme:*

Ravi Shankar Prasad, IAS, Joint Secretary, Ministry of Environment and Forest (MoEF), Government of India	Date:*14 August 2014*

B. Implementing Entity certification *Provide the name and signature of the Implementing Entity Coordinator and the date of signature. Provide also the project/programme contact person's name, telephone number and email address*

I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans (National Action Plan on Climate Change) and subject to the approval by the Adaptation Fund Board, commit to implementing the project/programme in compliance with the Environmental and Social Policy of the Adaptation Fund and on the understanding that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.	
 *(Dr. R. M. Kummur)* *Chief General Manager* *NABARD, Head Office, Mumbai* *(Implementing Entity Co-ordinator)*	
Date: *September,01, 2014*	Tel. and email: +91 22 2653 0083, +91 7738175446 rm.kummur@nabard.org
Project Contact Person: Dr. P. Radhakrishan, General Manager, NABARD, Head Office, Mumbai	
Tel. and Email: +91 22 2653 9384, +91 9167499397 p.radhakrishnan@nabard.org, climate.change@nabard.org	

रवि एस. प्रसाद
आई.ए.एस
संयुक्त सचिव
Ravi S. Prasad
I.A.S.
Joint Secretary

सत्यमेव जयते

भारत सरकार
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
Government of India
Ministry of Environment, Forests & Climate Change

D.O. No. 14/40/2013-CC **Dated: 14th August 2014**

Subject: Endorsement for the proposal on "Enhancing Adaptive Capacity and Increasing Resilience of Small and Marginal Farmers in Purulia and Bankura Districts of West Bengal"

In my capacity as designated authority for the Adaptation Fund in India, I confirm that the above national project / programme proposal is in accordance with the government's National priorities in implementing adaptation activities to reduce adverse impacts of, and risks, posed by climate change in India.

Accordingly, I am pleased to endorse the above project proposal with support from the Adaptation Fund. If approved, the project will be implemented by National Bank for Agriculture and Rural Development and executed by Development Research Communication and Services Centre (DRCSC).

Sincerely,

(Ravi S. Prasad)

The Adaptation Fund Board
c/o Adaptation Fund Board Secretariat
Email: Secretariat@Adaptation-Fund.org
Fax: 202 522 3240/5

ANNEXURE-I

CLIMATE, CLIMATE VARIABILITY, CLIMATIC TREND AND VULNERABILITY ANALYSIS AND RECOMMENDATIONS ON AGRICULTURE OF PURULIA AND BANKURA DISTRICT OF WEST BENGAL

Success in agriculture and its sustainability depends principally upon judicious use and manipulation of its principal denominators or indicators like climate, terrain, soil and water. The disadvantaged physical environment, particularly weather and climate, topography and soil are usually blamed for the backwardness of Purulia and Bankura – the two most underdeveloped districts of the western tract of West Bengal.

But the hard reality is our negligence, ignorance and reluctance to understand the components of the physical environment specially weather and climate. We feel satisfied to blame the environment (weather and climate) rather than its proper understanding and management. We are in general in a habit to identify the area as unsuitable for agriculture if it is extensively not suitable for rice cultivation. However, for a prospective and positive objective let us know the (a) climatic environment in details with its changing trend as a firm step towards the agricultural policy development and farm management of this area. The next step involves necessary adaptation strategies for agricultural development.

PURULIA

Purulia, the western most district of the state of West Bengal covering a total area of 6256.46 sq. km. lies between 22^0 43' N and 23^0 42' N latitude and 85^0 49' E and 86^0 55' E longitude at a distance of about 200 km. from the Bay of Bengal to its southeast. Tropic of Cancer has passed through the district dividing it into two slightly unequal halves. The district is bounded by Dhanbad, Bokaro, Hazaribag, Ranchi, West and East Singhbhum districts of Jharkhand to its north west, west and south west and Paschim Medinipur, Bankura and Burdwan of West Bengal to its south west, east and north east. The district is identified as the 'drought prone' undeveloped area of the state. A close examination at per capita income, persons or families living below poverty level, productivity, cropping intensity, proportion of seasonal and permanent fallow land etc. undoubtedly indicate its backwardness. The diverse physical environment, particularly weather and climate,

topography and soil are usually blamed for its backwardness. The key of development prosperity more particularly agricultural development lies with proper understanding, assessment, analysis and optimum utilization of all related weather parameters for agriculture.

Topographically the region is a part of Chotonagpur Plateau and gradually rises from east to west. The terrain is undulating in character and dotted with residual hillocks or small hilly blocks. The largest and highest among these are Ajodhya Hills, the highest point of which is located at 677 meter. Physiographically 150 meter contour line may be considered as its boundary towards east. The landmass has been dissected by a number of streams flowing from west to east. The important among Kongsabati and Kumari Subarnarekha marks a greater part of its boundary with Jharkhand towards west.

Red and lateritic soil dominates the landscape. Gravelly soils are also found in patches in the vicinity of the hills. In general the soils are thin, coarse grained, poor in organic matter and very poor in moisture holding capacity.

Weather and Climate

Weather and climate of the district is mainly influenced by its continental location, undulating terrain with residual hills, porous soil with very poor moisture retentive capacity and absence of large water bodies or perennial rivers. In a general term the climate of the district may be called 'tropical sub-humid continental with prolonged dry season'. (After S.Mishra 1991)

Rainfall:- Purulia is known as the driest district in the state. Pattern of distribution of rainfall in the district is guided by its location with respect to the moisture laden monsoon wind coming from the south and south east and local relief. Average annual rainfall of the district is 1321.9 mm. which varies from 1218.8 mm. at Burrabazar in the south western part to 1426.6 mm. at Bagmundi on the foot of Ajodhya Pahar which comes between 66.1 and 74.1 rainy days. (Table-1)

TABLE-1

AVERAGE MONTHLY, SEASONAL AND ANNUAL RAINFALL (MM) AND NO. OF RAINY DAYS

DISTRICT – PURULIA

		WINTER(DEC,JAN,FEB)				SUMMER(MAR,APR,MAY)				MONSOON(JUN,JULY,AUG,SEPT)					POST MONSOON			ANNUAL
STATION		DEC	JAN	FEB	TOTAL	MAR	APR	MAY	TOTAL	JUN	JULY	AUG	SEPT	TOTAL	OCT	NOV	TOTAL	
PARA	RF	11.4	10.6	20.1	42.1	20.2	29	46.1	95.3	259	293.8	284.9	218	1056	65.4	18.2	83.6	1277
	RD	0.8	1.3	1.7	3.8	1.6	2.4	3.8	7.8	10.9	14.6	14.5	10.5	50.5	3	1	4	66.1
KASHIPUR	RF	12.9	9.9	16	38.8	19.2	27.4	62.2	108.8	243	305.7	299.6	242	1090.2	73.1	18.6	91.7	1329.5
	RD	0.8	1.1	1.4	3.3	1.7	2.7	4.5	8.9	11.4	15.6	14.9	11.6	53.5	4.2	1.1	5.3	71
HATWARA	RF	9.1	13.5	18	40.6	22	30.2	56.2	108.4	233.4	291.4	310.3	258	1092.7	83	13.9	96.9	1338.6
	RD	0.8	1.3	1.9	4	1.8	2.3	4.3	8.4	11.5	16.2	15.9	12.6	56.2	4.4	1.1	5.5	74.1
HURA	RF	17.8	10.7	23.4	51.9	20.5	30.4	66.3	117.2	257	313.2	287.1	243	1100.4	77.5	18.9	96.4	1365.9
	RD	1	1.1	1.5	3.6	1.9	2.4	4.5	8.8	10.7	15.2	15.4	10.8	52.1	3.5	1.1	4.6	69.1
JHALDA	RF	11.4	12.4	16.9	40.7	33.2	29.9	57.5	120.6	232	285.2	289.9	226	1033	58.3	20	78.3	1272.6
	RD	1.1	1.2	1.7	4	2.7	2.5	4	9.2	11	16	15.7	12	54.7	2.9	1.2	4.1	72
BAGHMUNDI	RF	14.2	11.3	28.1	53.6	22.7	25.9	58.6	107.2	279.9	342.8	306.8	249	1178	64.4	23.4	87.8	1426.6
	RD	1.2	1.2	1.9	4.3	2.1	2.6	4.6	9.3	11.1	16.4	16.6	11.7	55.8	3.3	1.3	4.6	74
BURRABAZAR	RF	9.9	13.8	20.7	44.4	19.8	35.1	65.7	120.6	256.4	260.3	264.4	189	970.3	66.4	17.1	83.5	1218.8
	RD	0.6	1.3	1.6	3.5	2	2.9	4.5	9.4	11.3	14.5	14.9	10	50.7	3.4	1.1	4.5	68.1
MANBAZAR	RF	14.2	14.5	17.1	45.8	19.6	37.3	59.7	116.6	262.4	295.6	284.4	246	1088.3	71.9	24.4	96.3	1347
	RD	1.2	1.5	1.6	4.3	1.8	3.8	5.3	10.9	11.6	14.7	15.7	11.5	53.5	3.7	1	4.7	73.4

Co-efficient of variability of annual rainfall in the district lies around 20%.

Temperature:- Purulia is one of the warmest district of the state with high average daily temperature and very high diurnal and annual range of temperature. (Table-2)

TABLE-2

AVERAGE TEMPERATURE IN ^{0}C

DISTRICT-PURULIA (HATWARA)

MONTH	WINTER			SUMMER			MONSOON				POST MONSOON		ANNUAL
	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	
Mean daily max.	25.6	25.3	28.5	34	38.5	39.6	36.2	32.1	31.5	31.6	31.1	28.6	31.9
Mean daily min.	12.9	12.4	15.2	19.8	24.5	26.5	26.2	25.1	24.8	24.4	21.9	17	20.9
Mean daily	19.2	18.8	21.9	26.8	31.5	33	31.2	28.6	28.2	28	26.5	22.8	26.4
Diurnal range	12.7	12.9	13.3	14.2	14	13.1	10	7	6.7	7.2	9.2	11.6	11

May is the hottest month when the average daily maximum temperature lies close to 40^0 c and January is the coldest month with average daily minimum temperature lies close to 12^0 c. The difference between the average temperature of the warmest and coldest month is as high as 14.2^0 c.

Relative humidity:- **Since Purulia is the driest district of the state, the average relative humidity is comparatively low. Average daily morning (at local mean time 07-00 hrs.) and noon (at 14-00 hrs.) relative humidity values of both above hours are 79 and 50 respectively. (Table-3)**

TABLE-3

AVERAGE RELATIVE HUMIDITY
DISTRICT-PURULIA (HATWARA)

MONTH	WINTER			SUMMER			MONSOON				POST MONSOON		ANNUAL
	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	
Mean daily max.	78	80	73	63	58	73	85	90	92	91	88	79	79
Mean daily min.	38	38	32	28	26	39	64	76	77	73	59	45	50
Mean daily	58	59	52.5	45.5	42	56	74.5	83	84.5	82	73.5	62	64.5
Diurnal range	40	42	41	35	32	34	21	14	15	18	29	34	29

Wind direction and speed:- **In Purulia wind direction is mainly controlled by two principal seasonal pressure pattern of this sub continent. Southeasterly wind is dominant from May to October while during the rest part of the year northwesterly and westerly (Table-4)**

TABLE-4

AVERAGE WIND SPEED IN KM PER HR AT 10 M
DISTRICT-PURULIA (HATWARA)

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
	3.1	3.9	4.5	5.6	6.7	6.7	6	5.4	4.9	3.5	2.9	2.8	4.7

wind becomes important. Winds from other direction are relatively less frequent. Due to interior location wind speed is low (4.7 km. per hour) which varies from 2.8 in December to 6.7 in May and June.

Average Period of Bright Sunshine Hours per Day:- Since it is the driest district, the region registers the highest amount of bright sunshine hours per day. (Table-5)

TABLE-5

AVERAGE PERIOD OF BRIGHT OF SUN SHINE HOURS PER DAY
DISTRICT-PURULIA (HATWARA)

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
	8.4	9	9	9.5	8.6	6.1	4.4	4.7	5.8	7.8	7.9	8.1	7.4

The average annual value is as high as 7.4 hrs per day.

Amount of dew:- Although not very large in amount but dew plays a significant role as a secondary source of moisture during non rainy periods. Dew deposition starts from the end of the monsoon season and ceases in April with highest concentration between October and January. Nearly 40 mm. of water is received in Purulia in the form of dew. (Table-6)

TABLE-6

AVERAGE AMOUNT OF DEW(MM) IN DIFFERENT MONTHS
DISTRICT-PURULIA (HATWARA)

MONTH	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
DEW	5	9.7	6.2	7	6.7	3.2	1.3	0.3	39.4

Water deficiency and surplus:- An analysis of monthly values of precipitation (P), potential evaporation (PE) of Purulia shows that there is a period of water deficit lasting for about 8 months and the amount of deficit is 700.2mm. The amount of water surplus

although lasts for 4 months only (June – September) but the quantity is 617.7mm. This surplus amount should be preserved for cultivation of crops during Rabi and Pre-Kharif period. (Table-7)

TABLE-7

WATER BUDGET
DISTRICT-PURULIA (HATWARA)

	WINTER			SUMMER			MONSOON				POST MONSOON		ANNUAL
	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	
PRECIPITATION (P)	12.6	12.1	20	22	30.6	59	252.9	298.5	290.9	233.8	70	19.3	1321.9
POTENTIAL EVAPORATION (PE)	67.6	72.3	94.7	142.5	175.2	196.3	145.5	108.2	102.5	102.2	111.8	85.6	1405.1
P-PE	-55	-60.2	-74.7	-120.3	-144.6	-137.3	107.4	190.3	188.4	131.6	-41.8	-66.3	-83.2
PET/2	-27.5	-30.1	-37.4	-60.2	-72.3	-68.7	53.7	95.2	94.2	65.8	-20.9	-33.2	-41.6

Water Deficit	Period	Water Surplus	Period
-700.2	Oct-May	617.7	Jun-Sept

Seasons

Cold weather season (December – February):- Low temperature and humidity, clear sky, bright sunshine, and gentle northwesterly or westerly wind is the normal feature of weather of the season. This is the driest period of the year contributing only 2.9 to 3.8 % of the average annual rainfall which varies from 38.8 mm. to 53.6 mm. in different parts of the district. Rainfall of the season is associated with the passage of western disturbances and the amount is highly variable from one year to the other. Co-efficient of variability of rainfall of the season is the highest and lies around 90%. Moderate cold wave condition sometimes occur in the rear of the western disturbances when the minimum drops suddenly 6^0c or more below normal reaching the lowest value even up to 5^0c. Average daily temperature of the season varies from 18.9^0c in January to 21.8^0c in February while the diurnal range varies from 12.7^0c to 13.3^0c.

Hot weather season (March – May):- March to May is usually a period of rapid rise of temperature and fall of barometric pressure. Average daily temperature rises from

26.9^{0}c in March to 33.1^{0}c in May with high diurnal range varying from 13.1^0 to 14.2^{0}c. Heat wave condition frequently occur when the maximum temperature goes 47^{0}c or beyond.

Humidity of the air steadily declines in consequence of the rapid rise of temperature and onset of dry westerly or northwesterly continental wind. During summer noon's flow of hot dry westerly and northwesterly wind bring the relative humidity below 5%. This phenomenon is known as 'loo' and is frequent during every summer.

Pre-monsoon thunderstorms during the afternoon or evening sometimes bring relief after mid day heat. This season contributes 7.5% to 15% of the total annual rainfall which varies from 95.3 mm to 120.6 mm. in 8 to 11 rainy days in different parts of the district. The amount of rainfall of the season, however, suffers from the co-efficient of variability ranging between 37 and 55 per cent.

<u>South west monsoon season (June – September)</u>:- This is the principal rainy season of the year contributing 79 to 83 percent of the total annual rainfall. The amount of average rainfall of the season varies from 970mm. to 1178 mm. in different parts of the district which comes between 50 and 56 rainy days. The amount of monsoon rainfall is more dependable and suffers from low variability ranging between 21 and 25 per cent. Monsoon rain usually starts by the end of the second week of June and continues up to the first week of October and characterized by alternatively wet and dry spells lasting for 4 or 5 days to more than 10 to 15 days. Maximum temperature suddenly drops along with the onset of monsoon rain. July and August are the rainiest months. From September rainfall gradually diminishes along with the weakening of monsoon. In September the region occasionally receives heavy to very heavy rainfall persisting for a couple days in association with the passage of slow moving low pressure systems or depressions.

This is a season of general rain accompanied by high humidity, moderately uniform temperature with minimum diurnal range and shortest period of bright sunshine hours per day.

<u>Retreating monsoon (October – November)</u>:- This is a period of transition between the outgoing monsoon and incoming winter. As a result the weather rapidly changes along with the progress of the season. South west monsoon usually withdraws from the region by the second week of October. After the withdrawal of monsoon sky gradually becomes clear resulting steady increase in the period of bright sunshine hours, amount of incidences of rain gradually decreases. Minimum temperature begins to drop faster than the maximum temperature causing a gradual increase in the diurnal range. Deposition of dew becomes important.

The season accounts for 6 to 7 per cent of the average annual precipitation amounting from 78.3 mm. to 96.9 mm. within 4 and 5 rainy days most of which comes within the first fortnight of October. From October to November the change is more rapid. Amount of rainfall remarkably reduces and the temperature fall is more rapid.

Cyclonic storms and depressions in the Bay of Bengal occasionally brings a spell of cloudy sky with rain and gusty wind.

BANKURA

Bankura one of the 'drought prone' under developed district of the 'western tract' covering a total area of 6879.98 sq. km. extends between 22^0 38' N and 23^0 38' N latitude and 86^0 36' E and 87^0 46' E longitude. Tropic of Cancer has passed through the northern periphery of the district. The district is bounded by Purulia to its west, Burdwan to the north, Hooghly to the east and Paschim Medinipur to its south. Like Purulia the diverse physical environment, particularly extreme weather and climate, topography and soil are usually blamed for its backwardness. The key of prosperity and development more particularly agricultural or rural development lies with proper understanding, assessment, analysis and optimum utilization and proper management of all related weather parameters for agriculture.

Physiographically the region is a part of Chotonagpur Plateau fringe which gradually rises from the east to west. 150 meter contour roughly marks its western boundary with Purulia while 10 to 50 meter contour lines roughly mark its southern and south eastern limit with Burdwan, Hooghly and Paschim Medinipur. The landmass is dissected by a number of streams flowing from the west to east and south east following the general slope of the land the important among these are Damodar, which marks the boundary with Burdwan, Dwarakeswar, Silai, Kumari and Kasai. The terrain is undulating in character and dotted with a few residual hillocks or small hilly blocks. The largest and highest among these is Susunia with its summit at 440 meter. Biharinath another hill rises to 448 meter. Red and lateritic soil dominates the landscape and gradually merges with old alluvium towards east. Gravelly soils are also found in patches in the vicinity of the hills. In general the soils are thin, coarse grained, poor in organic matter and very poor in moisture retentive capacity.

Weather and Climate

The controlling factor of weather and climate is similar to that of its adjacent district Purulia and characterized by continentality, dryness and extremity. The weather and climate of the district differs slightly within its upland section of the west and north west and plain section of the east and south east. However, in general the climate of the district may be called 'tropical sub humid continental'.

Rainfall:- Average annual rainfall of the district is 1385.9 mm. which is about 50 mm. higher than the average rainfall of its adjacent district Purulia. The amount varies from 1310.8 mm. at Susunia to 1575.3 mm. at Taldangra which comes between 68.9 and 79.1 rainy days. (Table-8)

TABLE-8

AVERAGE MONTHLY, SEASONAL AND ANNUAL RAINFALL AND NO. OF RAINY DAYS
DISTRICT - BANKURA

		WINTER(DEC,JAN,FEB)				SUMMER(MAR,APR,MAY)				MONSOON(JUN,JULY,AUG,SEPT)					*POST MONSOON*			ANNUAL
STATION		DEC	JAN	FEB	TOTAL	MAR	APR	MAY	TOTAL	JUN	JULY	AUG	SEPT	TOTAL	OCT	NOV	TOTAL	
SALTORA	RF	15.7	11.4	21.3	48.4	20.7	32.7	66.4	119.8	239.5	293.5	290.2	236	1059.2	85.2	17.9	103.1	1330.5
	RD	0.9	1	1.5	3.4	1.9	2.5	4.5	8.9	10.8	16	15.1	11.6	53.5	4	1	5	70.8
SUSUNIA	RF	8.5	9.4	26.5	44.4	22.7	32.1	71.9	126.7	215	313.4	298.9	226.3	1053.6	74.6	11.5	86.1	1330.8
	RD	0.5	0.8	1.8	3.1	1.8	2.4	4.5	8.7	10.8	15.7	14	11.5	52	4.2	0.9	5.1	68.9
BANKURA	RF	8.2	13.7	18.9	40.8	26.6	31.5	70.9	129	214.1	300.7	290.8	229.8	1035.4	104	16	120.4	1325
	RD	0.5	1.2	1.6	3.3	1.8	2.5	4.6	8.9	10.4	15.7	16	11.5	53.6	5.2	0.9	6.1	71.9
BARJORA	RF	21.4	7.4	25.8	54.6	22	39	96.9	157.9	220.2	281.2	290.2	227.4	1019	67.5	26	93.5	1325
	RD	1.3	0.9	1.8	4	2.1	3	6	11.1	11.6	15.5	13.8	11.7	52.6	5.3	1.8	7.1	74.8
RANIBANDH	RF	16.3	10.5	23.3	50.1	37.2	39.9	80.5	157.6	239.6	286.3	293.8	229.7	1049.4	94	24.5	118.5	1375.6
	RD	1.1	1.2	1.8	4.1	2.4	3.2	5.5	11.1	10.8	15.2	16.2	11.2	53.4	4.8	1	5.8	74.4
TALDANGRA	RF	26.2	12.9	30.8	69.9	24.3	48.8	108	181.1	277.3	355.3	326.7	265.3	1224.6	76.9	22.8	99.7	1575.3
	RD	1.2	0.9	2.6	4.7	1.8	3.5	5.9	11.2	12.9	17.5	15.9	11.6	57.9	4.3	1	5.3	79.1
JOYPUR	RF	14.1	12.6	26.2	52.9	33.7	50.2	109	193.3	248.8	304	314.1	238.4	1105.3	77.7	13.7	91.4	1443.1
	RD	0.8	1.2	1.8	3.8	2.7	3.8	5.9	12.4	11.1	14.7	15	11.4	52.2	4.1	0.7	4.8	73.2
INDUS	RF	5.2	11.9	28.6	45.7	31.5	48.3	96.9	176.7	252.7	261.6	265.6	234.7	1014.6	87.9	18	105.9	1352.9
	RD	0.8	1	2	3.8	2.4	2.9	6	11.3	10.9	13.9	14.9	10.5	50.2	4.3	0.8	5.1	70.4
JOYRAMBATI	RF	10.2	8.1	31	49.3	39	49.9	109	197.6	265.6	302.4	295.8	231.7	1095.5	72.6	19.1	91.7	1434.1

	RD	0.9	0.9	2.2	4	2.3	3.6	6	11.9	12.1	14.4	15.1	11.7	53.3	3.8	0.9	4.7	73.9

Among three sub-divisions of the district Bankura, Sadar sub-division with 1322.8 mm. average annual rainfall is the driest, forested Khatra sub-division to the south west with 1475.4 mm. is the wettest and Bishnupur to the south east receives an average annual rainfall of 1410 mm. lies between these two extremes. Amount C.V. of the annual rainfall in the district varies from 15 to 21 per cent.

Temperature:- **Bankura, another warmest district of the state registers high daily average and large diurnal and annual range of temperature. (Table-9)**

TABLE-9

AVERAGE TEMPERATURE IN °C

DISTRICT-BANKURA

STATIONS		WINTER			SUMMER			MONSOON				POST MONSOON	
		DEC	JAN	FEB	MARCH	APRIL	MAY	JUN	JUL	AUG	SEP	OCT	NOV
	mean daily max	25.6	24.9	27.8	33.2	36.6	38.2	35.3	31.4	31.7	31.7	31.1	29.2
SUSUNIA	mean daily mini	12	11.3	14.2	19.1	23.6	25.9	25.9	25.7	25.8	25.2	21.9	17.3
	mean daily	18.8	18.1	21	26.15	30.1	32.1	30.6	28.6	28.8	28.5	26.5	23.25
	diurnal range	13.6	13.6	13.6	14.1	13	12.3	9.4	5.7	5.9	6.5	9.2	11.9
TALDANGRA	mean daily max	25.6	25	28.8	33.7	37.1	38	34.1	31.8	31.2	31.5	31.3	29
	mean daily mini	11.2	10.6	14	18.7	23	24.4	25	25.1	25.2	24.8	21.9	15.9
	mean daily	18.4	17.8	21.4	26.2	30.05	31.2	29.6	28.5	28.2	28.5	26.6	22.45
	diurnal range	14.4	14.4	14.8	15	14.1	13.6	9.1	6.7	6	6.7	9.4	13.1
JOYPUR	mean daily max	25.8	24.7	28.5	34.1	36.6	37.5	34.4	32.2	31.6	31.9	31.1	30
	mean daily mini	12.2	11.4	14.7	19.7	22.5	24.6	25.5	25.4	25.5	25.3	22.1	17.2
	mean daily	19	18.1	21.6	26.9	29.55	31.1	30	28.8	28.6	28.6	26.6	23.6
	diurnal range	13.6	13.3	13.8	14.4	14.1	12.9	8.9	6.8	6.1	6.6	9	12.8
BANKURA	mean daily max	27	26.8	30.1	35.3	39	39.5	36.8	33.2	32.6	33	32.4	30.4
	mean daily mini	12.1	11.5	14.3	18.9	23.5	25	25.7	25	24.8	24.4	22	17
	mean daily	19.6	19.2	22.2	27.1	31.25	32.3	31.3	29.1	28.7	28.7	27.2	23.7
	diurnal range	14.9	15.3	15.8	16.4	15.5	14.5	11.1	8.2	7.8	8.6	10.4	13.4

May is the hottest month when the average daily maximum lies close to 40^0 c and January is the coldest month with average daily minimum temperature remains 11.5^0 c. The difference between the average temperature of the warmest and coldest month is 13^0 c.

Relative humidity:- **Since the district is located on the drier western tract of the state the relative humidity is comparatively low. Average morning (at local mean time 07-00 hrs.) and noon (at 14-00 hrs.) humidity which roughly corresponds with daily maximum and daily minimum values varies from 82 – 91 and 49 – 57 per cent respectively. (Table-10)**

TABLE-10

AVERAGE RELATIVE HUMIDITY
DISTRICT- BANKURA

STATIONS		WINTER			SUMMER			MONSOON				POST MONSOON	
		DEC	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV
SUSUNIA	RH AT 07-00 LMT	81	80	76	63	72	80	86	90	91	91	87	82
	RH AT 14-00LMT	39	40	35	28	30	41	58	72	75	74	58	43
	AVG. DAILY	60	60	56	45.5	51	60.5	72	81	83	82.5	72.5	62.5
	DIURNAL RANGE	42	40	41	35	42	39	28	18	16	17	29	39
TALDANGA	RH AT 07-00 LMT	86	86	83	74	69	81	89	91	92	91	88	86
	RH AT 14-00LMT	40	39	39	27	27	41	62	72	74	72	61	46
	AVG. DAILY	63	62.5	61	50.5	48	61	76	81.5	83	81.5	74.5	66
	DIURNAL RANGE	46	47	44	47	42	40	27	19	18	19	27	40
JOYPUR	RH AT 07-00 LMT	91	91	90	86	85	86	92	96	96	96	94	92
	RH AT 14-00LMT	48	49	42	38	38	45	64	75	79	75	71	60
	AVG. DAILY	69.5	35	66	62	61.5	65.5	78	85.5	87.5	85.5	82.5	76
	DIURNAL RANGE	43	42	48	48	47	41	28	21	17	21	23	32

Wind direction and speed:- **Wind flow pattern is much similar to the pattern of Purulia. Due to interior location average wind speed at Bankura is fairly low. (Table-11)**

TABLE-11

AVERAGE WIND SPEED IN KM PER HR AT 10 M
DISTRICT-BANKURA

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
BANKURA	1.9	1.8	2.2	2.1	2.5	2.7	2.9	2.4	2.5	2.1	1.8	1.6	2.2

Period of Bright Sunshine Hours:- **Since Bankura is a relative dry district record fairly large period of bright sunshine hours per day. (Table-12)**

TABLE-12

AVERAGE PERIOD OF BRIGHT OF SUN SHINE HOURS PER DAY
DISTRICT-BANKURA

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SUSUNIA	7.8	8.5	8.7	8.8	8.2	5.9	4.2	4.6	5.5	7.3	7.9	8.1	7.1
TALDANGA	7.7	8.4	8.8	9.3	8.4	5.8	4.3	4.7	5.4	7.1	7.9	7.9	7.2
JOYPUR	6.8	7.7	8.5	8.8	8.3	5.7	4.4	4.3	5.1	7.1	7.3	7.1	6.8

Amount of dew:- **Dew plays a significant role as a secondary source of moisture during non rainy period specially in such a dry region. The total amount varies from 41.6 mm. to 131.5 mm. within the district. (Table-13)**

TABLE-13

AVERAGE AMOUNT OF DEW(MM) IN DIFFERENT MONTHS
DISTRICT-BANKURA

STATION	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
TALDANGA	7.3	19.7	24.8	32.3	28.2	14.1	5.1	0	131.5
JOYPUR	9.4	15.8	16.1	17	18	10.8	8.2	3.6	98.9

Water deficiency and surplus:- **An analysis of monthly values of precipitation (P), potential evaporation (PE) of different stations of Bankura shows that there is a period of water deficit lasting for about 8 months and the amount of deficit at different stations varies from 591.7 mm. to 873.4 mm. The amount of water surplus although lasts for 4 months only (June – September) but the quantity is quite encouraging which varies from 592.3 mm. to 808.6 mm. This surplus amount should be preserved for cultivation of crops during Rabi and Pre-Kharif period. (Table-14)**

TABLE-14

WATER BUDGET

DISTRICT-BANKURA

STATION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SUSUNIA	P	9.4	26.5	23	32.1	71.9	215	313	298.9	226	74.6	11.5	8.5	1330.8
	PE	85	116	193	240	241	143	107	107.7	104	89.2	84.2	81	1590.6
	P-PE	-76	-90	-171	-208	-169	72.2	207	191.2	122	-14.6	-72.7	-72	-259.8
TALDANGA	P	13	30.8	24	48.8	108	277	355	326.7	265	76.9	22.8	26	1575.3
	PE	63	92.6	165	194	211	141	102	89.3	83	83.4	71.5	62	1357
	P-PE	-50	-62	-141	-145	-103	136	253	237.4	182	-6.5	-48.7	-36	218.3
JOYPUR	P	13	26.2	34	50.2	109	249	304	314.1	238	77.7	13.9	14	1443.1
	PE	79	96.8	156	194	212	174	117	96.7	93.2	85.5	82.1	80	1464.7
	P-PE	-66	-71	-122	-144	-102	75.3	187	217.4	145	-7.8	-68.2	-66	-21.6

STATION	WATER DEFICIT	PERIOD	WATER SURPLUS	PERIOD
SUSUNIA	-873	OCTOBER-MAY	592.3	JUNE-SEPTEMBER
TALDANGA	-591.7	OCTOBER-MAY	808.6	JUNE-SEPTEMBER
JOYPUR	-646.6	OCTOBER-MAY	624.9	JUNE-SEPTEMBER

Seasons

Cold weather season (December – February):- **Clear sky, bright sunshine, low temperature, humidity and gentle northwesterly or westerly wind are the normal feature of weather of the season. This is the driest period of the year contributing only 3.1 to 4.4 per cent of the average annual rainfall which varies from 40.8 mm. to 69.9 mm. in different of the district. Rainfall of the season mainly comes in association with the passage of western disturbances and suffers from high variability. The C.V. of rainfall of the season varies between 68 and 81 per cent. Moderate cold wave condition sometimes occurs in the rear of the western disturbances when the minimum temperature drops 6^0 c or more below its normal. The lowest temperature value at a few places reached below 5^0 c. January is the coldest month of the season when the mean daily temperature varies between 17.8^0 c and 18.1^0 c and average daily minimum temperature lies close to 11^0 c. Fog sometimes occur in association with the western disturbances. This season register very high diurnal range of temperature which varies from 13^0 to 14^0 c.**

Hot weather season (March – May):- **March to May is a period of rapid rise of temperature. Average daily temperature rises from 26^0 c in March to 32^0 c in May. March registers the largest diurnal range of temperature which varies between 14^0 c and 15^0 c and slowly decreases along with the progress of the season. Heat wave condition frequently occurs when the maximum temperature rises even above 47^0 c. Relative humidity of air steadily declines in consequence of rapid rise of temperature and onset of dry continental westerly or northwesterly wind specially during day time. Southeasterly wind during the evening and night sometimes give relief after the mid-day heat. During summer noons flow of hot dry westerly or northwesterly winds brings down the relative humidity below 5%. This phenomenon is known as 'loo' and very frequent during every summer.**

Pre-monsoon thunderstorms during the afternoon and evening sometimes bring relief after the mid-day heat. This season contributes 9.0 to 13.8 per cent of the average annual rainfall which varies from 119.8 mm. in 8 to 12 rainy days in different parts of the district. The amount of rainfall of the season suffers from the C.V. ranging between 41 and 44 per cent.

South west monsoon season (June – September):- **South west monsoon is the period of general rain contributing 75 to 80 per cent of the average annual rainfall. The amount varies from 1014.6 mm. to a 1224.6 mm. in different parts of the district which comes between 50.2 and 57.9 rainy days. The monsoon rainfall is more dependable than the rainfall of other seasons and the C.V. varies from 17 to 23 per cent in different parts of the**

district. Monsoon rain usually starts by the end of the second week of June and continues up to the first week of October and characterized by alternately wet and dry spells lasting for 4 or 5 days to more than 10 to 15 days. Dry spells are usually longer than the wet spells. Maximum temperature abruptly drops due to the appearance of monsoon cloud and onset of rain. Minimum temperature does not fall much resulting in a much shorter diurnal range. Both the maximum and diurnal range of temperature suddenly increases during the period of breaks. July and August is the peak monsoon months. From September the amount as well as incidences of rain gradually decreases along with the weakening of monsoon. The region occasionally receives heavy to very heavy rainfall persisting for 2 to 3 days in association with the passage of slow moving low pressure systems or depressions.

South west monsoon season is the period of general rain, moderately uniform temperature with minimum diurnal range, high humidity and shortest period of bright sunshine hours per day.

<u>Retreating monsoon (October – November)</u>:- Retreating monsoon is the period of transition between the outgoing monsoon and advancing winter. The weather rapidly changes along with the progress of the season. South west monsoon usually withdraws by the second week of October. After its withdrawal sky becomes gradually clear resulting in steadily increase in the period of bright sunshine hours, amount of rainfall decreases and the incidences become few and far between. Minimum temperature begins to drop faster than the maximum temperature causing a gradual increase in the diurnal range. Deposition of dew increases.

The season accounts for 6 to 9 per cent of the average annual rainfall amounting from 86.1 mm. to 120.4 mm. within 4.7 and 7.1 rainy days most of which comes within the first half of October. The C.V. of rainfall of the season varies from 63 to 89 per cent.

From October to November the change is more rapid. Amount of rainfall remarkably reduces and the temperature fall becomes more rapid.

Cyclonic storms and depressions in the Bay of Bengal sometimes bring spells of cloudy weather, rain and gusty wind during the season.

CLIMATE CHANGE AND CLIMATIC TREND ANALYSIS

Salient features of the trend are as follows:

Rainfall (1961-2010):- An analysis of rainfall data of last 50 years using the technique of semi average trend shows the following facts:

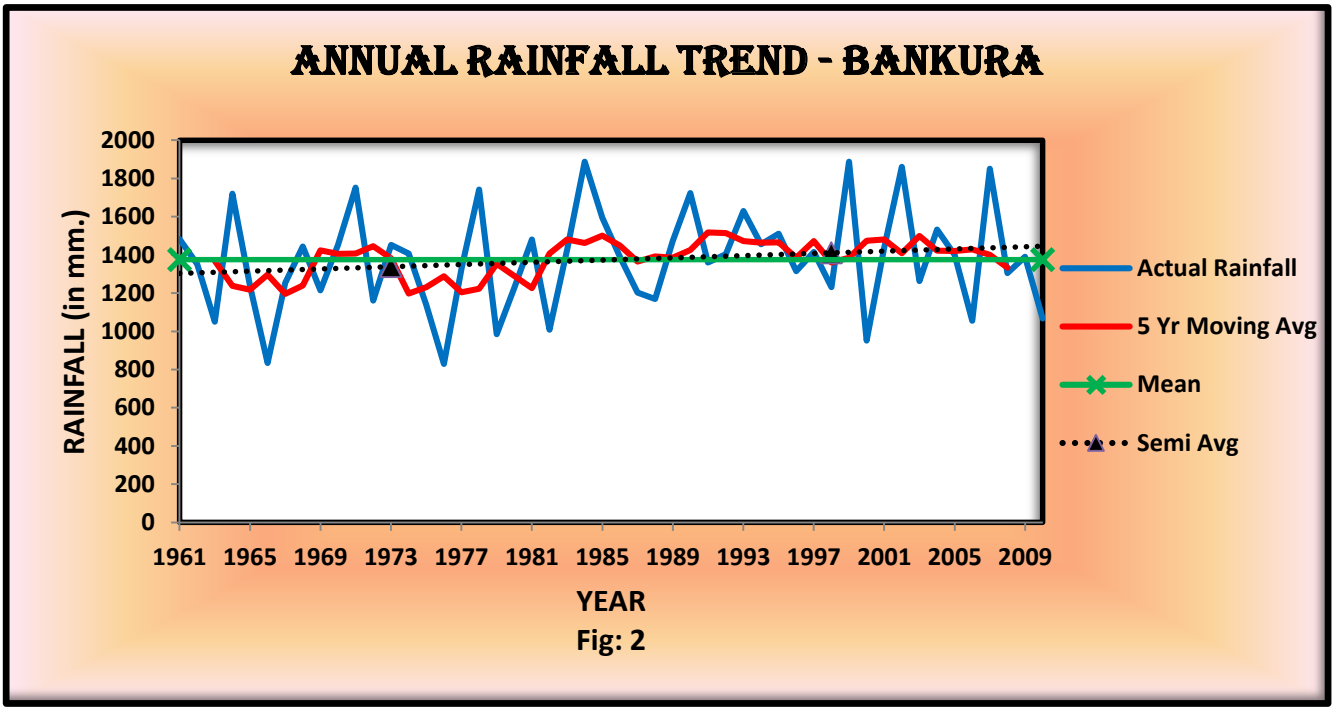


Fig: 2

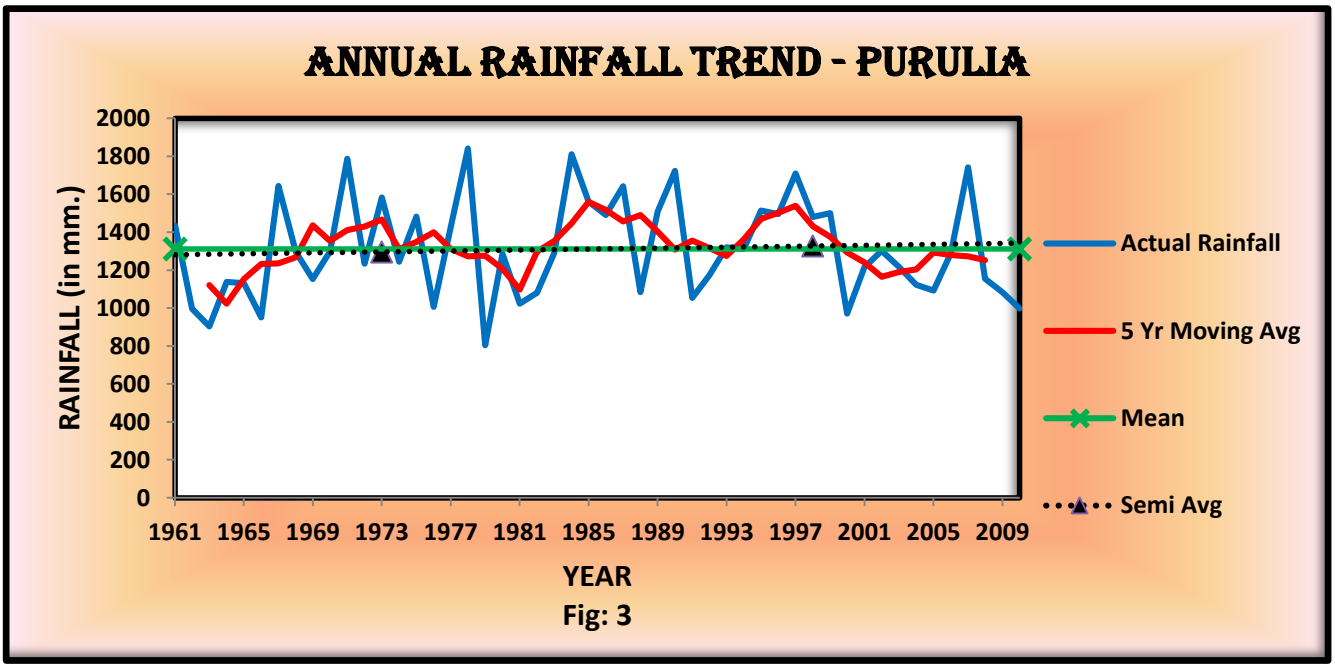
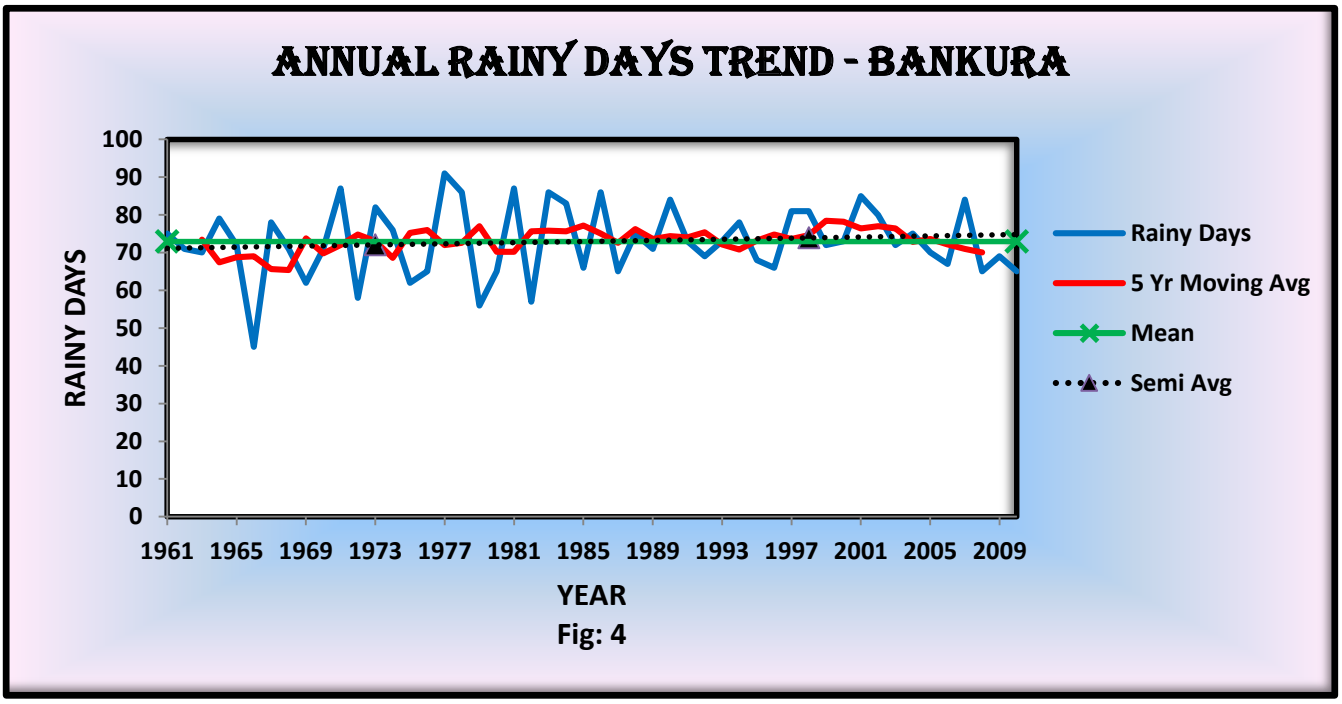


Fig: 3

TABLE-15

ANNUAL RAINFALL (IN MM.)

Station	1961-2010 (X)	1961-1985 (X_1)	1986-2010 (X_2)	X_1-X_2	X_1-X_2 as % to X	Remarks
Bankura	1374.7	1338.3	1411.1	72.8	5.3	Marginal increase
Purulia	1311.8	1296.1	1327.4	31.3	2.4	No appreciable change



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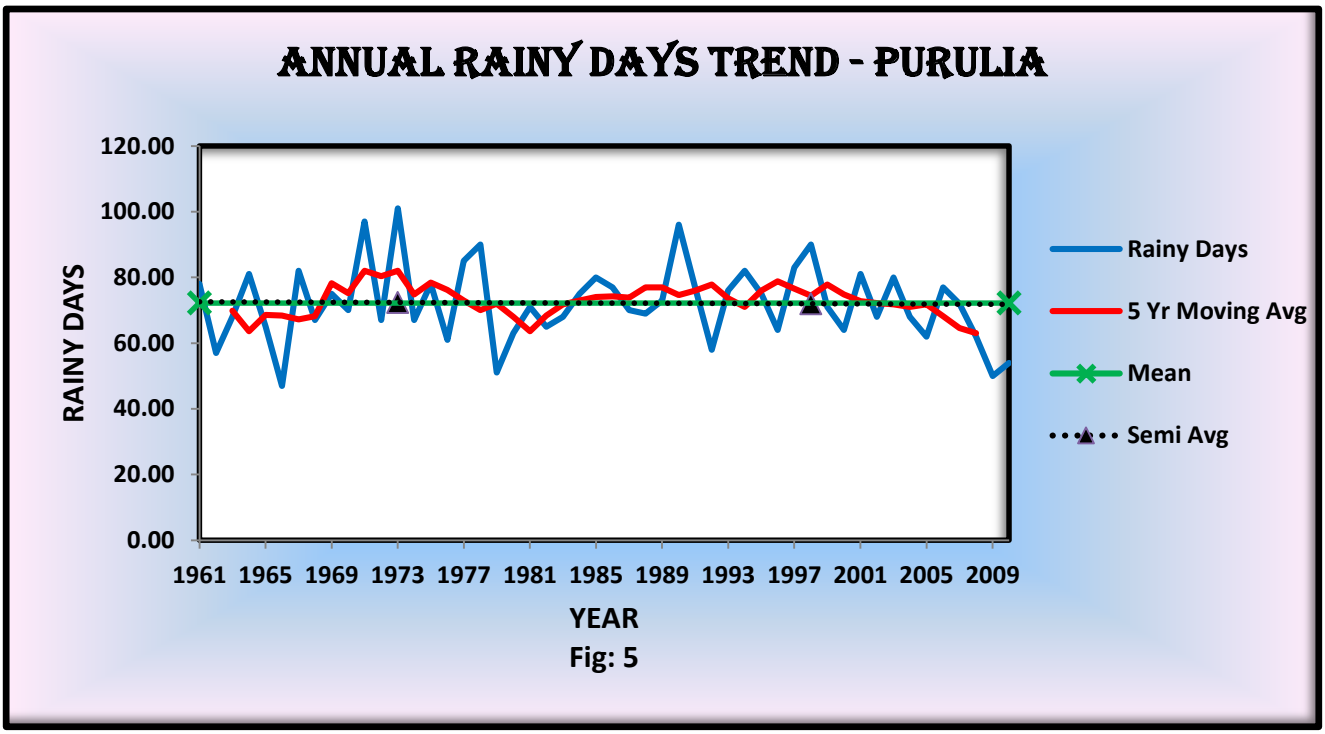


Fig: 5

TABLE-16

ANNUAL NO. OF RAINY DAYS

Station	1961-2010 (X)	1961-1985 (X_1)	1986-2010 (X_2)	X_1-X_2	X_1-X_2 as % to X
Bankura	73.0	72.0	73.9	1.9	2.6
Purulia	72.2	72.4	72.0	-0.4	-

Monsoon rainfall trend (Jun-Sept):-

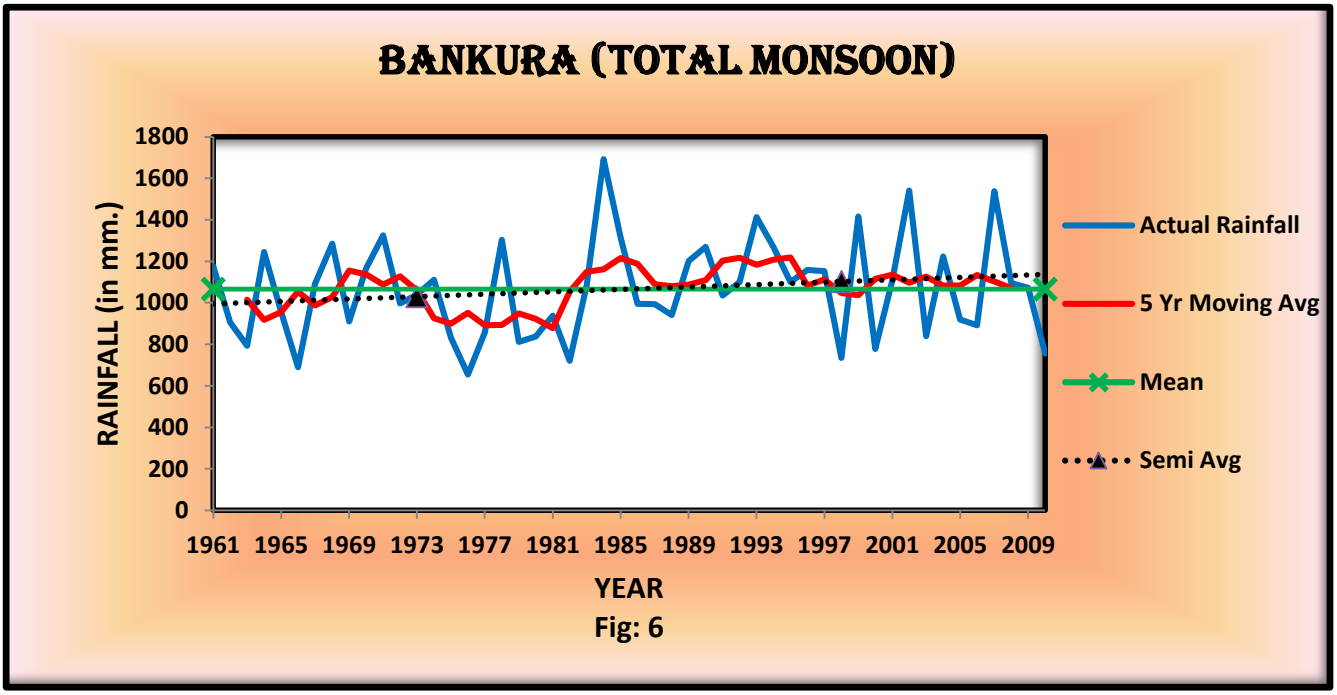


Fig: 6

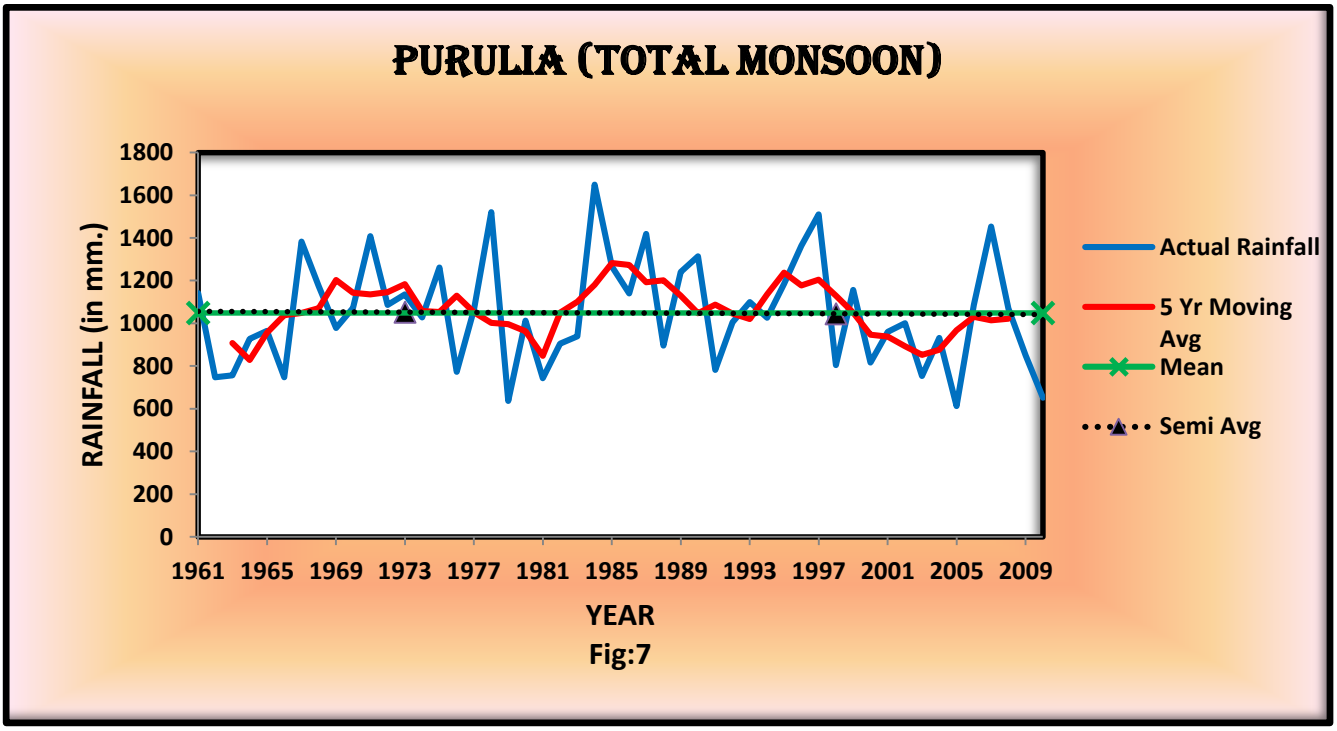


Fig:7

TABLE-17

MONSOON RAINFALL

Station	1961-2010 (X)	1961-1985 (X_1)	1986-2010 (X_2)	X_1-X_2	X_1-X_2 as % to X	Remarks
Bankura	1065.8	1029.7	1101.9	72.2	6.8	Marginal increase
Purulia	1048.8	1052.7	1044.9	-7.8	-0.7	No appreciable change

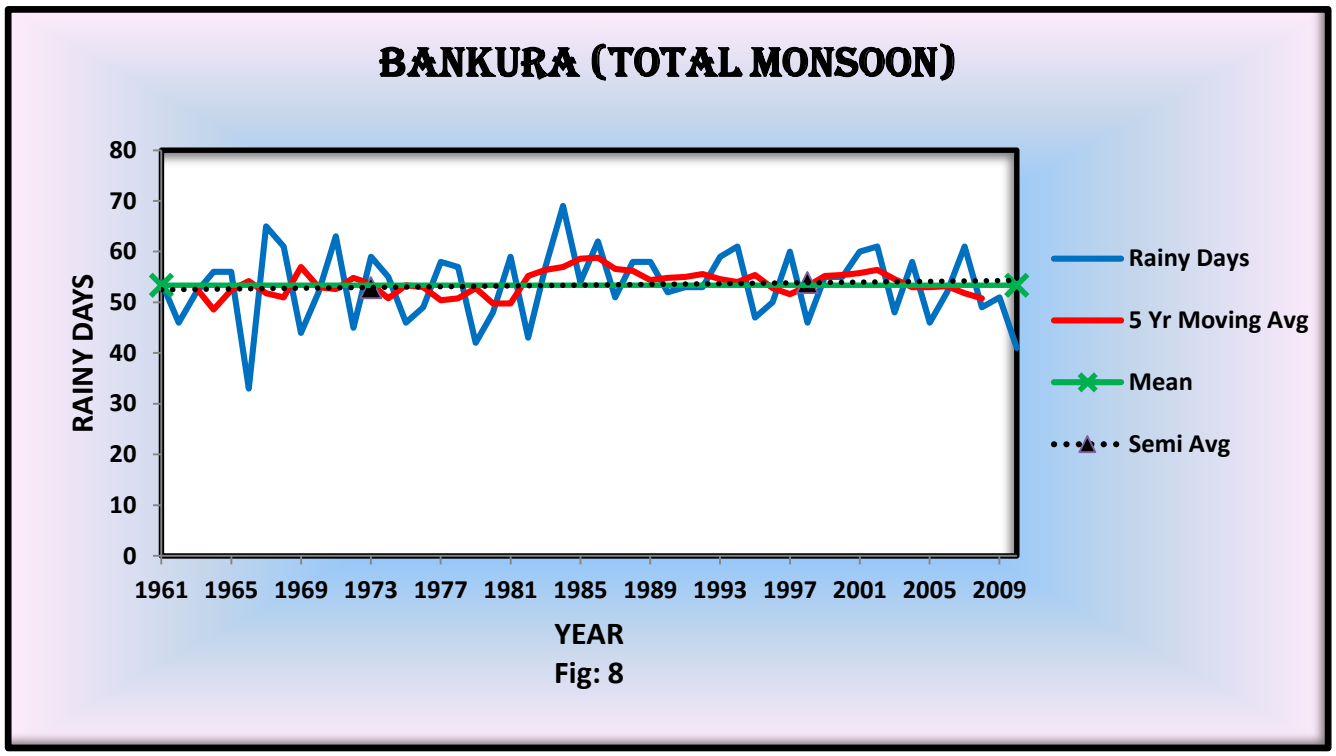


Fig: 8

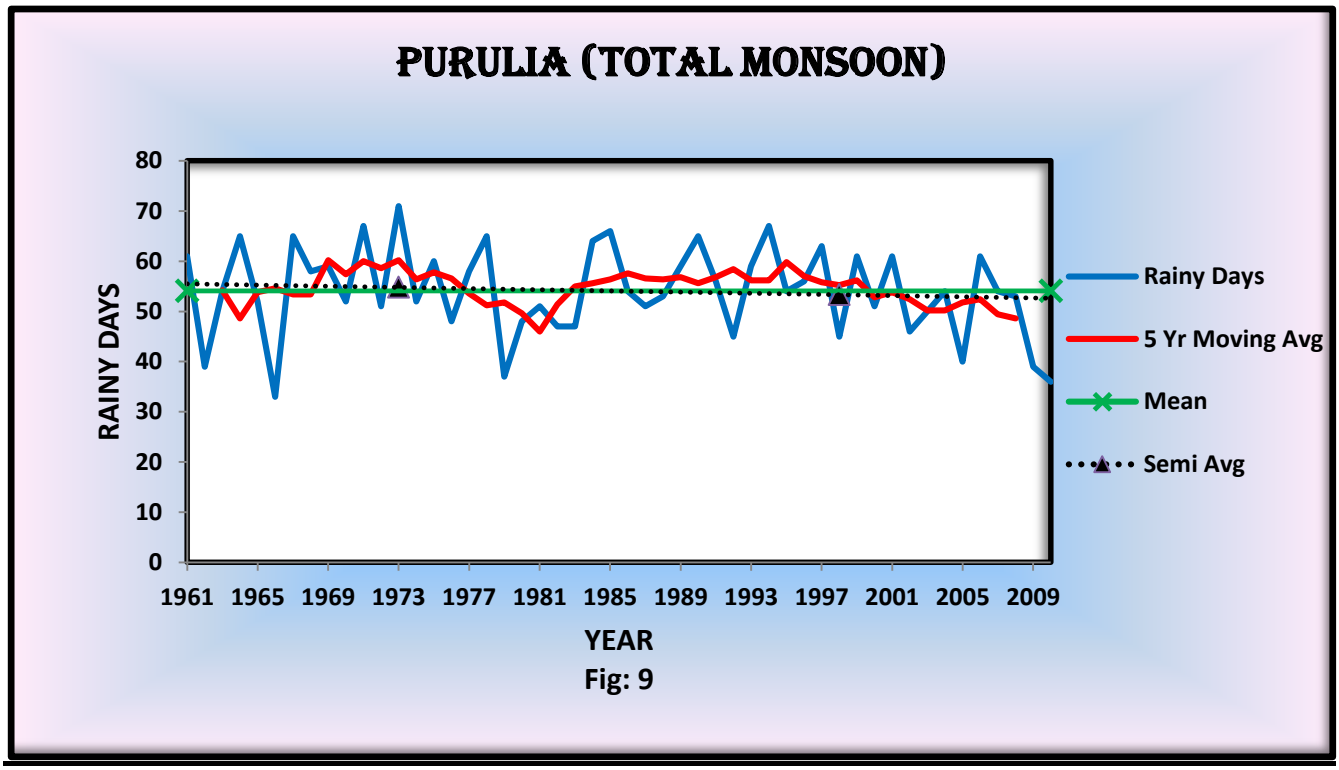


Fig: 9

TABLE-18

NO. OF RAINY DAYS – MONSOON

Station	1961-2010 (X)	1961-1985 (X_1)	1986-2010 (X_2)	X_1-X_2	X_1-X_2 as % to X
Bankura	53.4	52.9	53.9	1.0	-
Purulia	54.1	54.8	53.3	-1.5	-

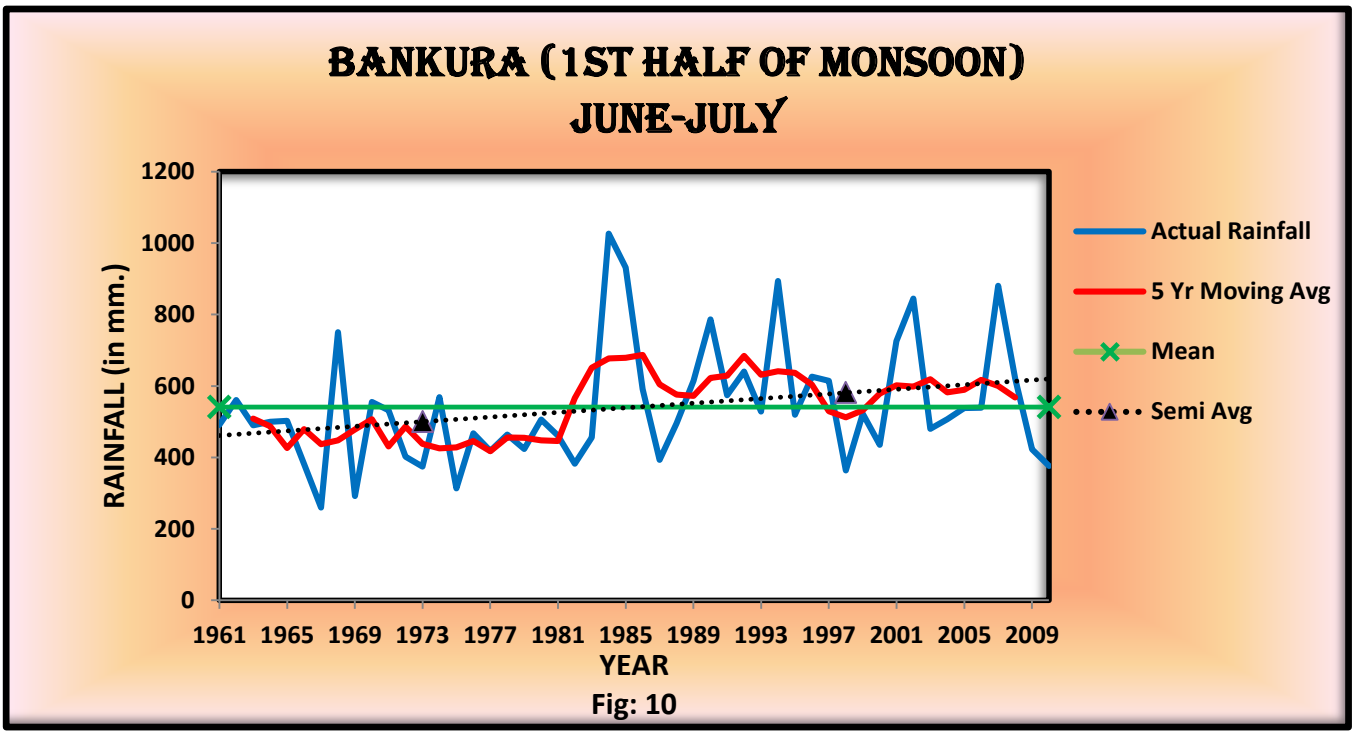

BANKURA (1ST HALF OF MONSOON)
JUNE-JULY
RAINFALL (in mm.)
1200
1000
800
600
400
200
0
1961 1965 1969 1973 1977 1981 1985 1989 1993 1997 2001 2005 2009
YEAR
Actual Rainfall
5 Yr Moving Avg
Mean
Semi Avg

Fig: 10

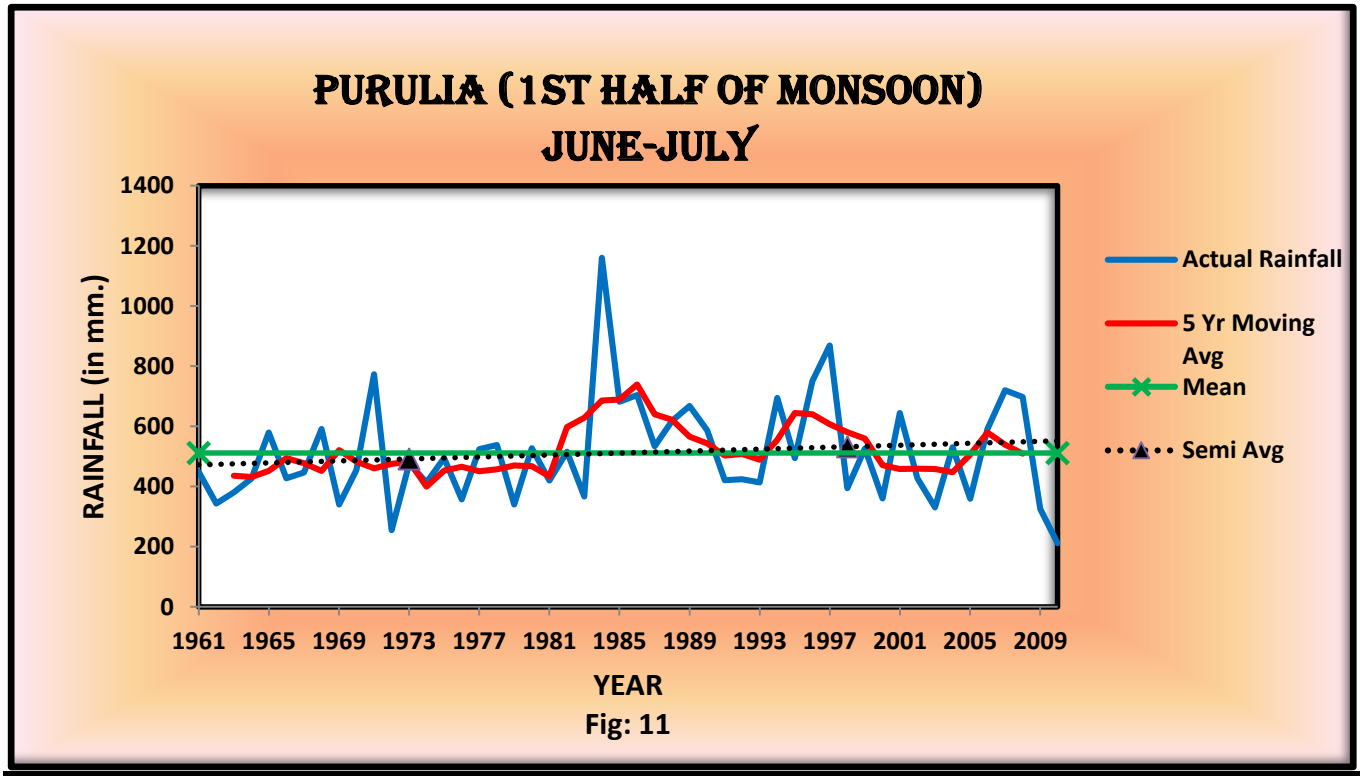

PURULIA (1ST HALF OF MONSOON)
JUNE-JULY
RAINFALL (in mm.)
1400
1200
1000
800
600
400
200
0
1961 1965 1969 1973 1977 1981 1985 1989 1993 1997 2001 2005 2009
YEAR
Actual Rainfall
5 Yr Moving Avg
Mean
Semi Avg

Fig: 11

TABLE-19

1ST HALF OF MONSOON RAINFALL (JUNE-JULY)

Station	1961-2010 (X)	1961-1985 (X_1)	1986-2010 (X_2)	X_1-X_2	X_1-X_2 as % to X	Remarks
Bankura	540.9	500.4	581.4	81	15.0	Moderate increase
Purulia	511.6	491.3	531.8	40.5	7.9	Marginal increase

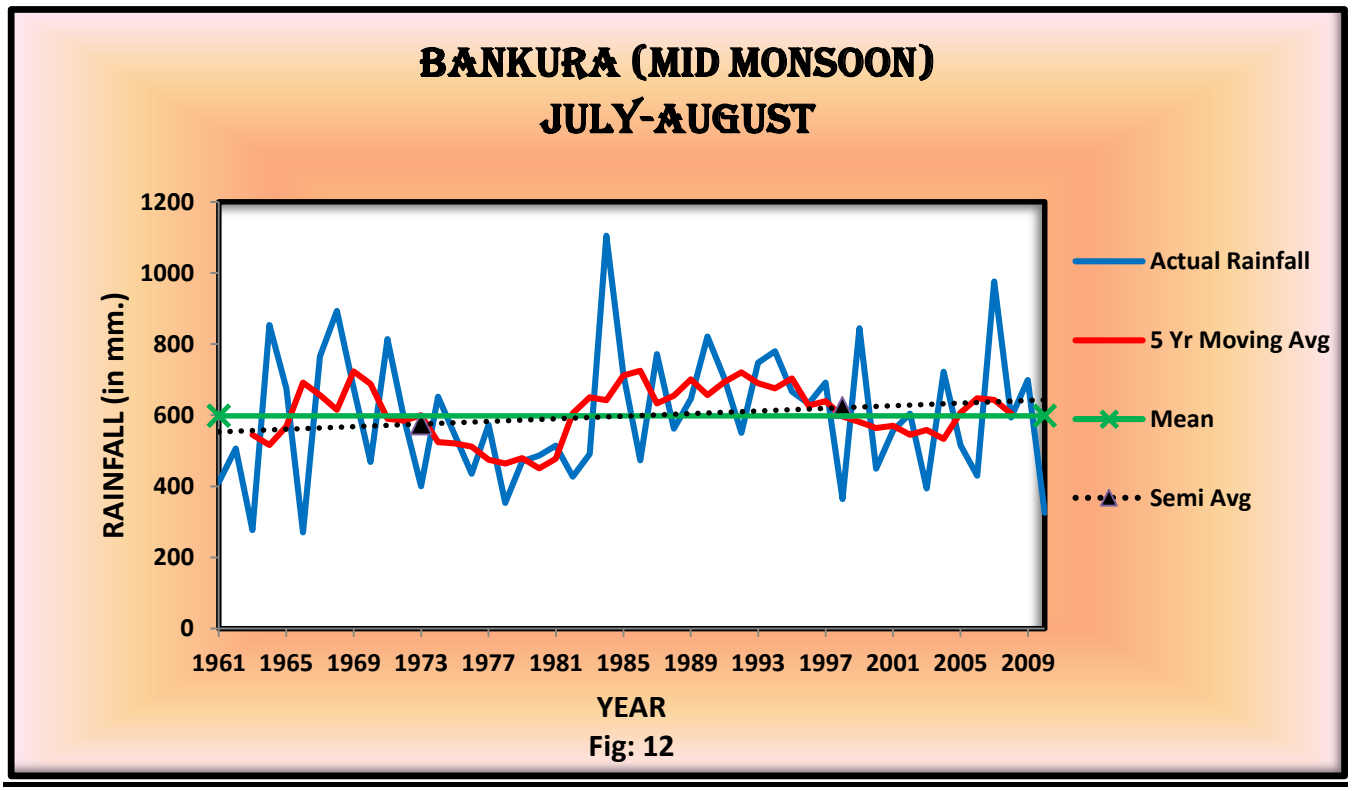


Fig: 12

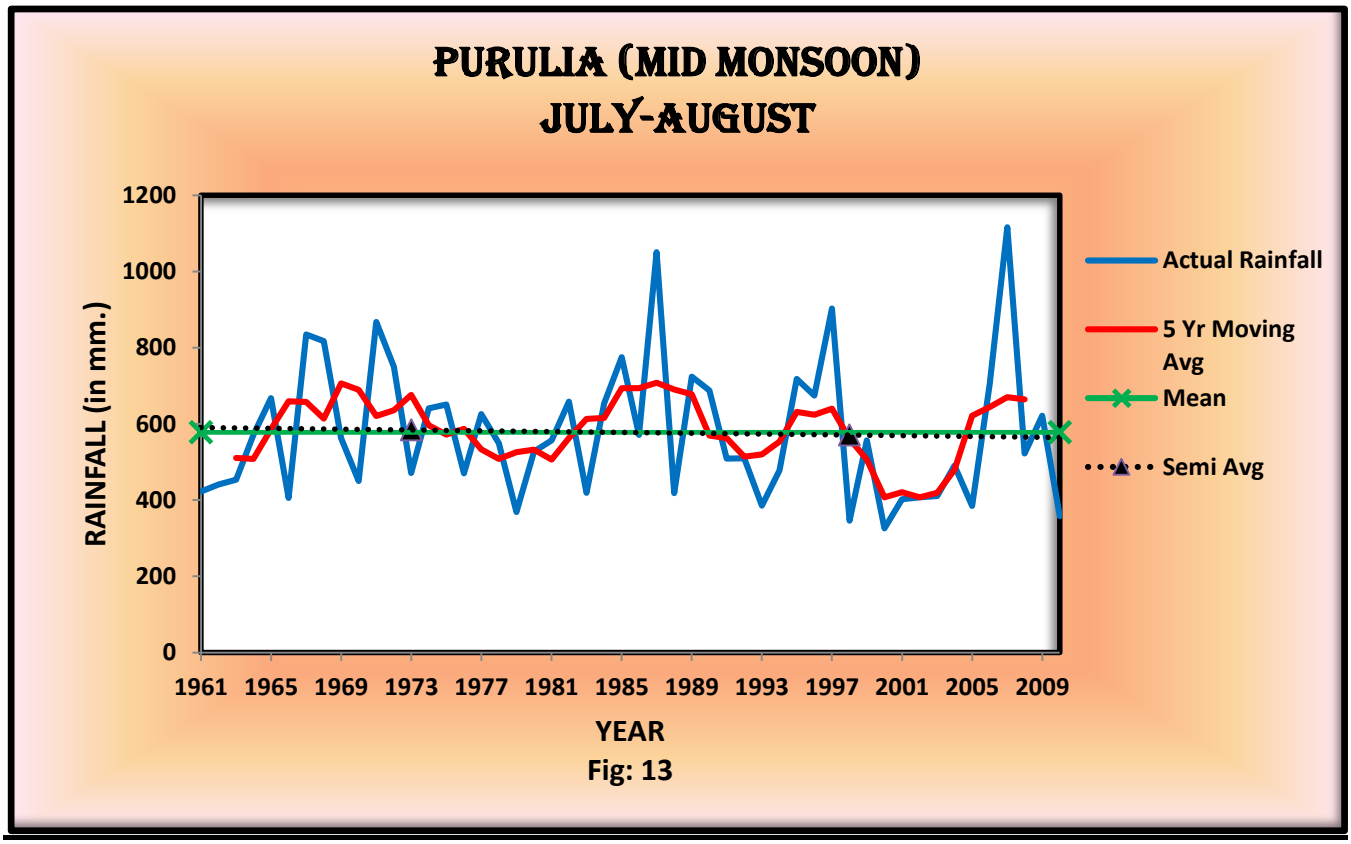


Fig: 13

TABLE-20

MID MONSOON RAINFALL (JULY-AUGUST)

Station	1961-2010 (X)	1961-1985 (X_1)	1986-2010 (X_2)	X_1-X_2	X_1-X_2 as % to X	Remarks
Bankura	597.7	574.7	620.7	46.0	7.7	Marginal increase
Purulia	577.8	584.5	571.1	-13.4	-2.3	No appreciable change

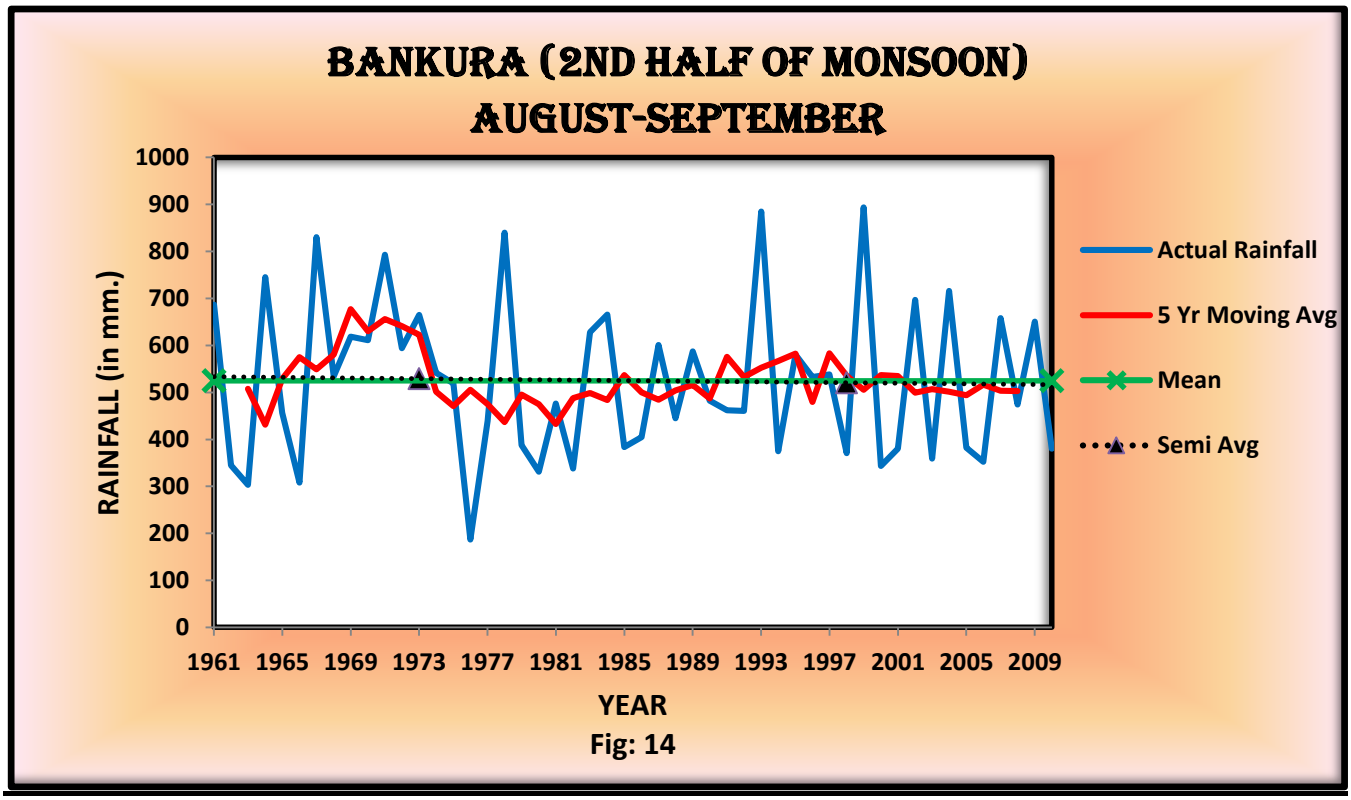

BANKURA (2ND HALF OF MONSOON)
AUGUST-SEPTEMBER
RAINFALL (in mm.)
1000
900
800
700
600
500
400
300
200
100
0
1961 1965 1969 1973 1977 1981 1985 1989 1993 1997 2001 2005 2009
YEAR
Actual Rainfall
5 Yr Moving Avg
Mean
Semi Avg

Fig: 14

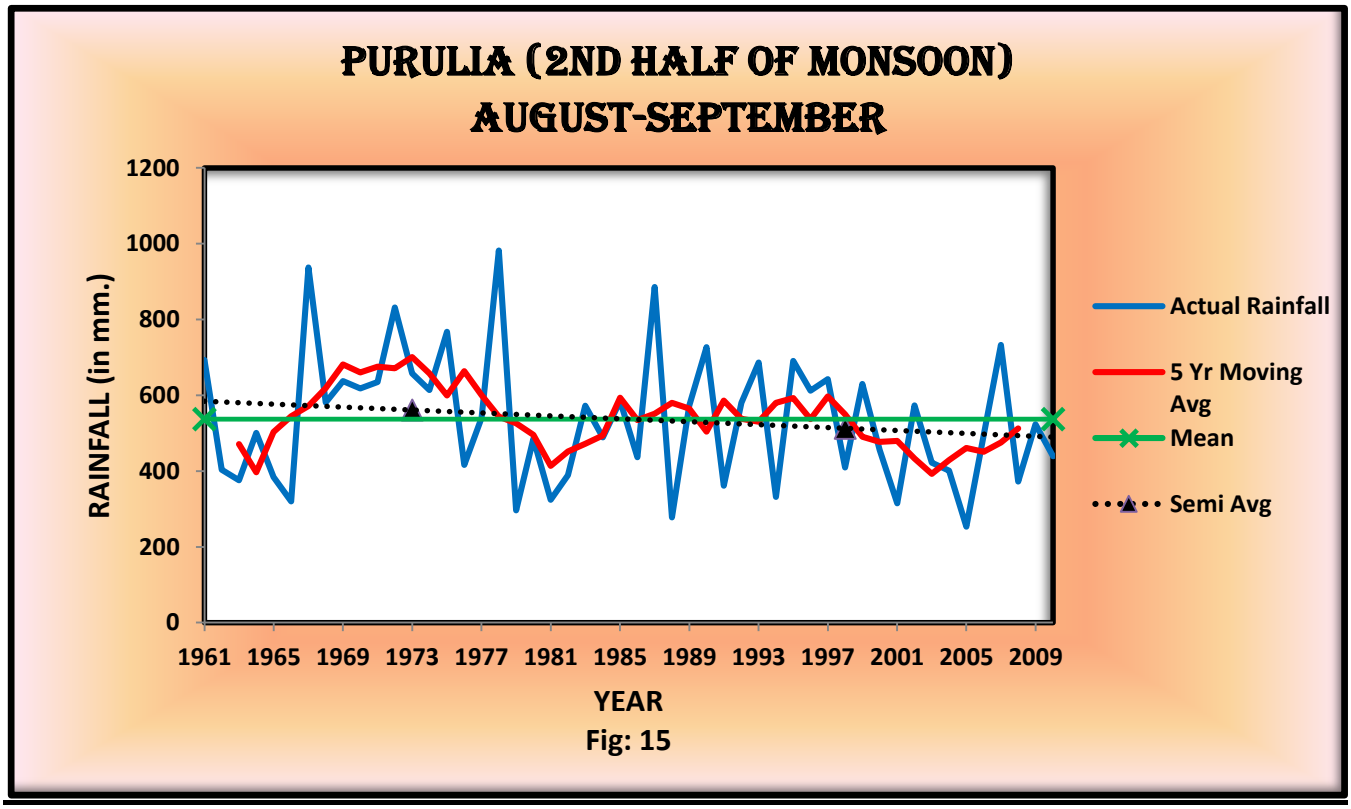

PURULIA (2ND HALF OF MONSOON)
AUGUST-SEPTEMBER
RAINFALL (in mm.)
1200
1000
800
600
400
200
0
1961 1965 1969 1973 1977 1981 1985 1989 1993 1997 2001 2005 2009
YEAR
Actual Rainfall
5 Yr Moving Avg
Mean
Semi Avg

Fig: 15

TABLE-21

2ND HALF OF MONSOON RAINFALL (AUGUST-SEPTEMBER)

Station	1961-2010 (X)	1961-1985 (X_1)	1986-2010 (X_2)	X_1-X_2	X_1-X_2 as % to X	Remarks
Bankura	524.9	529.2	520.5	-8.7	-1.7	No appreciable change
Purulia	537.3	561.5	513.1	-48.4	-9.0	Marginal decrease

Post monsoon rainfall trend (Oct-Nov):-

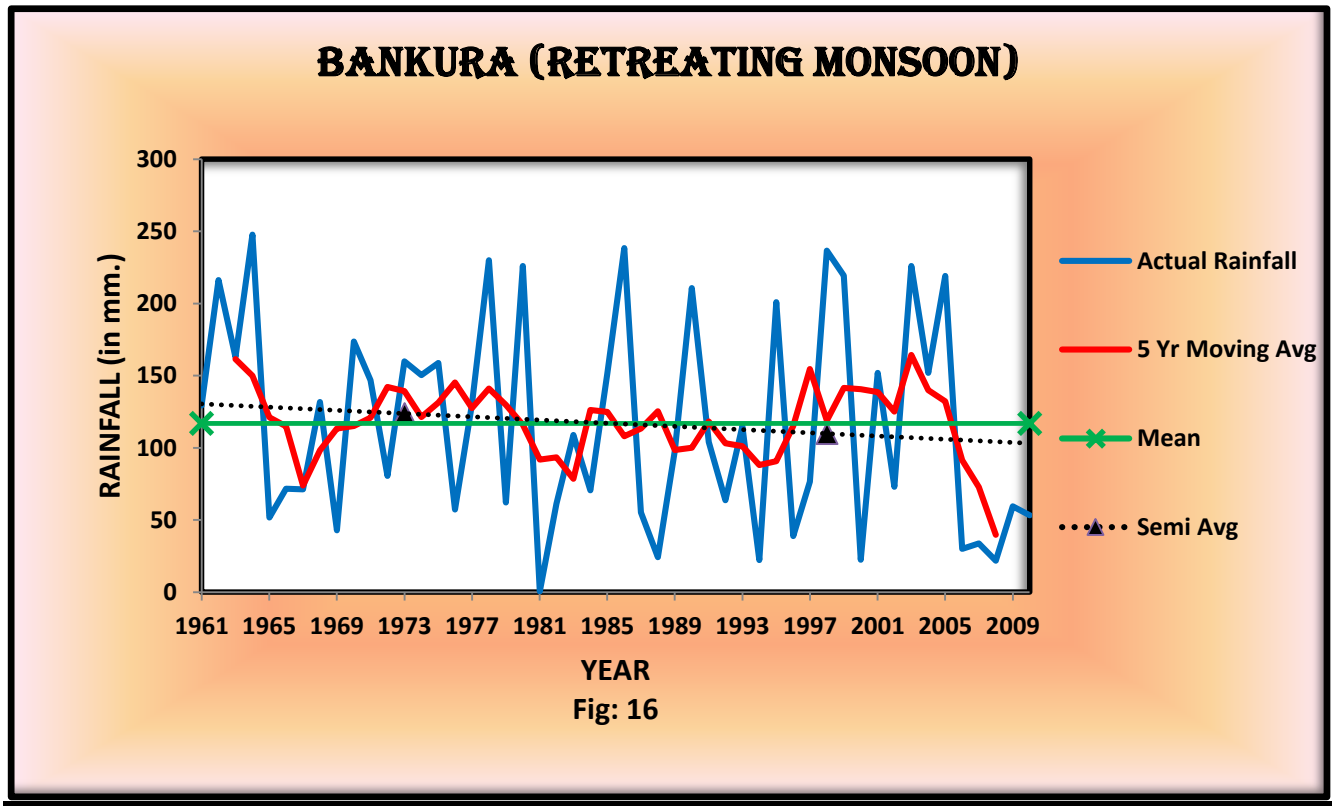


Fig: 16

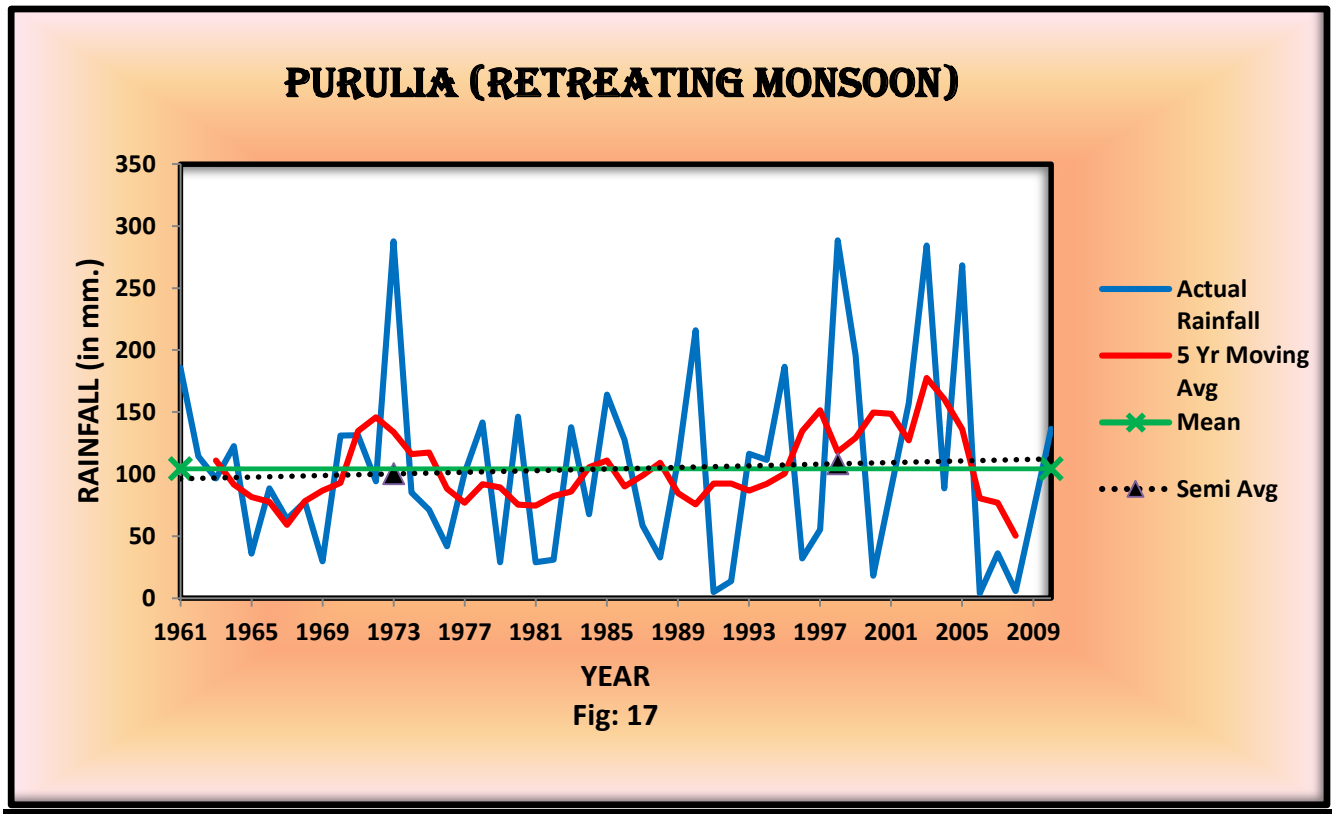


Fig: 17

TABLE-22

POST MONSOON RAINFALL (OCTOBER-NOVEMBER)

Station	1961-2010 (X)	1961-1985 (X_1)	1986-2010 (X_2)	X_1-X_2	X_1-X_2 as % to X	Remarks
Bankura	116.8	123.7	109.8	-13.9	-11.9	Moderate decrease
Purulia	104.2	100.2	108.3	8.1	7.8	Marginal increase

Hot weather rainfall trend (Mar-May):-

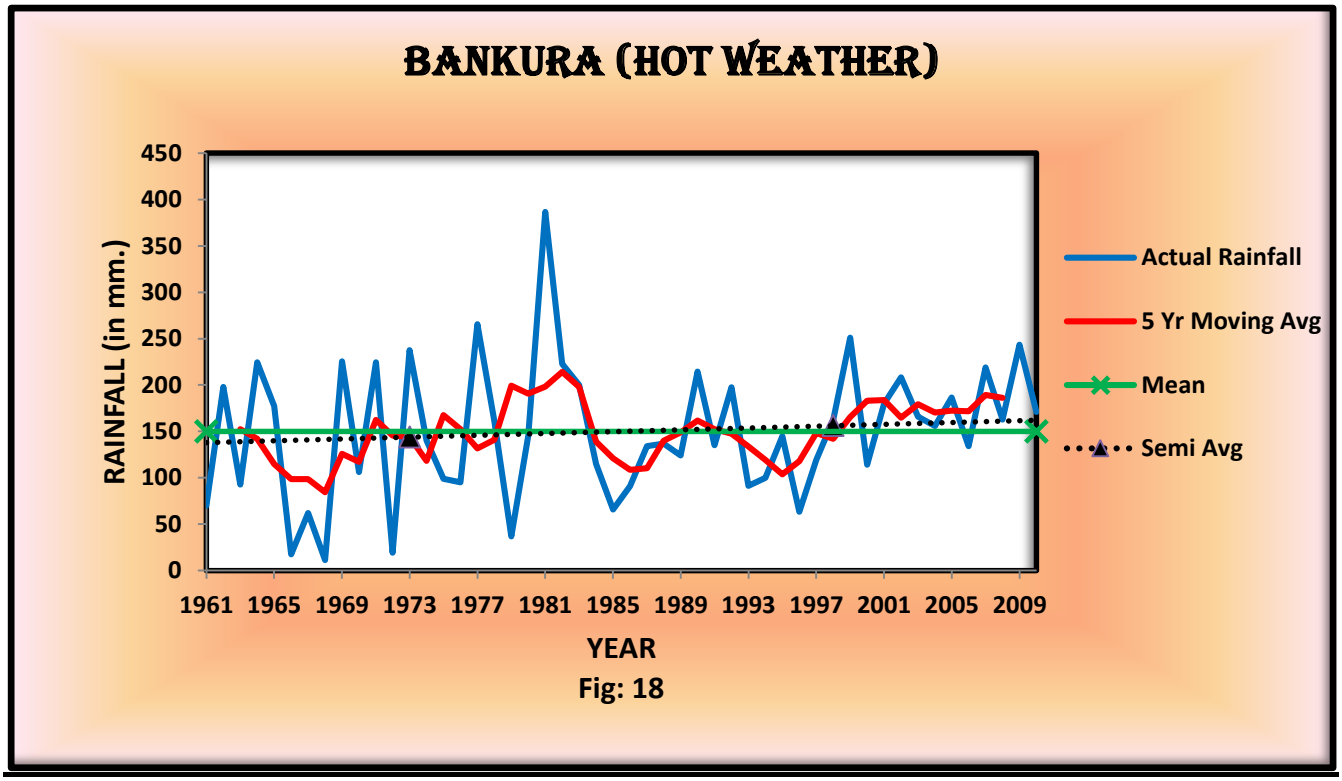


Fig: 18

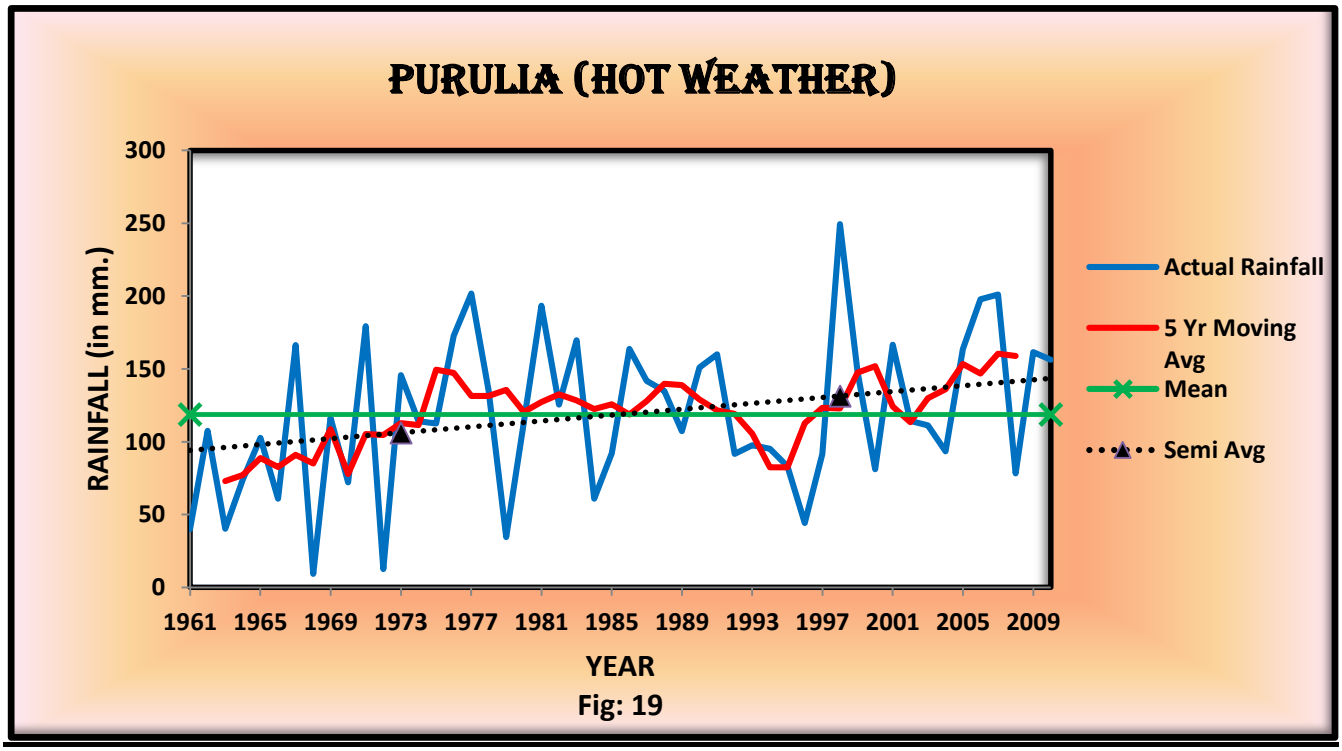


Fig: 19

TABLE-23

HOT WEATHER RAINFALL (MARCH-MAY)

Station	1961-2010 (X)	1961-1985 (X_1)	1986-2010 (X_2)	X_1-X_2	X_1-X_2 as % to X	Remarks
Bankura	150.1	143.9	156.2	12.3	8.2	Marginal increase
Purulia	118.8	106.1	131.4	25.3	21.3	Marked increase

Temperature:- Analysis of different components of temperature shows that average daily temperature is increasing almost everywhere. Average daily minimum temperature is rising faster than the average daily maximum temperature causing a reduction in the diurnal range. After 1970, increasing trend is well marked and more marked since the beginning of the present century.

Onset and withdrawal of monsoon (1905-2010):- Normal date of onset of monsoon over Gangetic West Bengal now stands as on 13th instead of the 7th June. So the date of onset has been delayed by about a week, but the date of its withdrawal remains almost unchanged i.e, by 10th October causing a general reduction in the span or duration of monsoon in this part. However in recent years, delayed withdrawal is noticed.

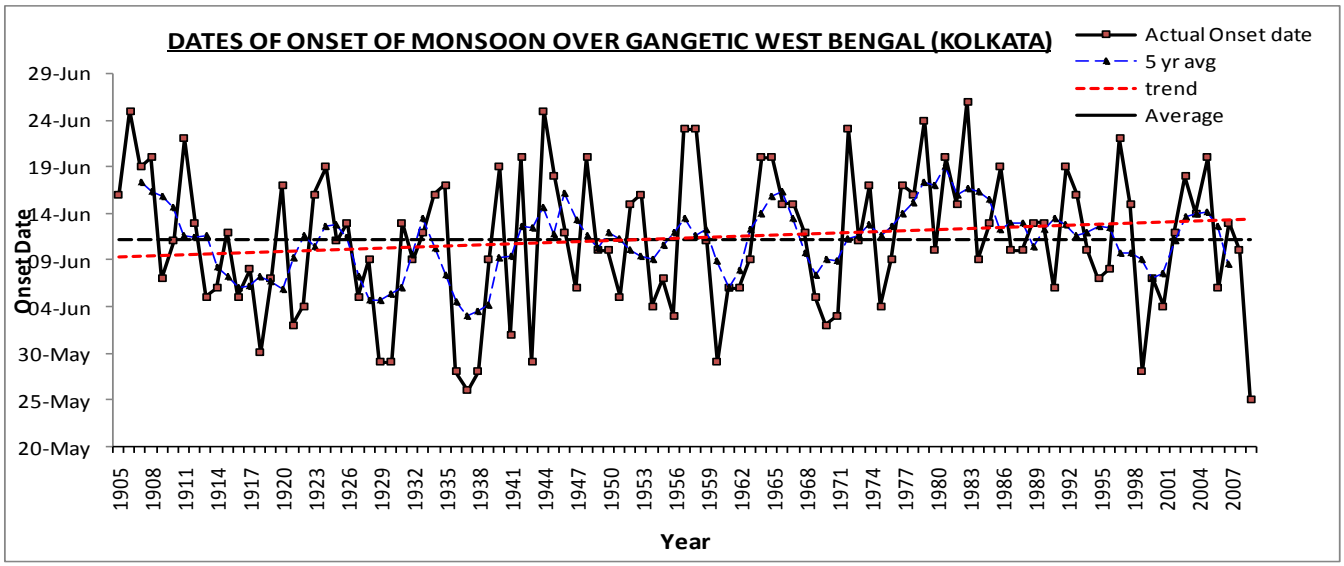
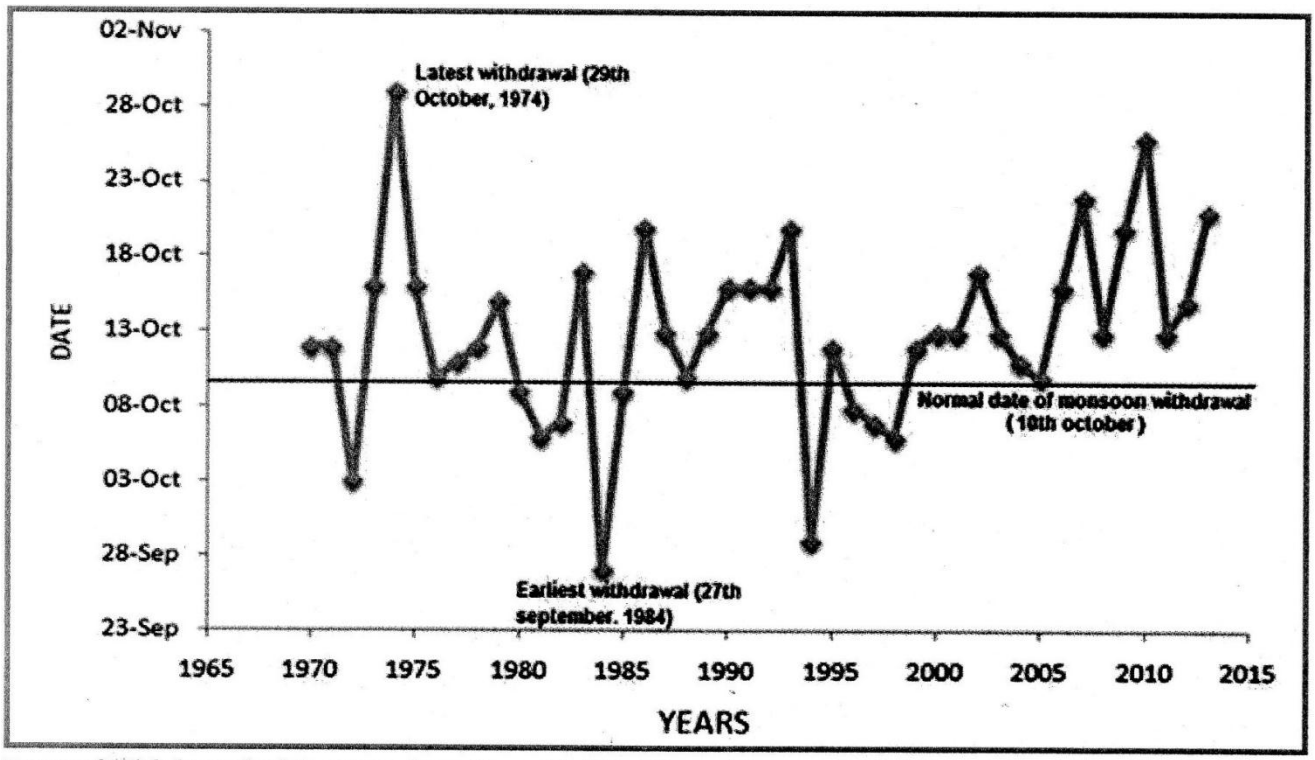


Fig: 20



Dates of Withdrawal of Monsoon from Gangetic West Bengal (1970-2013)

Fig: 21

<u>Incidences of Drought during monsoon (1961-2010)</u>:- Although the area is well marked as 'drought prone' but the dryness is more due to poor moisture holding capacity of the soil rather than poor rainfall. However, the tendency of occurrence of drought during different phases of monsoon is shown in the following table. (Table-24)

TABLE-24

PERCENTAGE NUMBER OF YEARS WITH DROUGHT DURING DIFFERENT PHASES OF MONSOON

Station	1st half of monsoon (Jun-Jul)	Mid monsoon (Jul-Aug)	2nd half of monsoon (Aug-Sep)	Total monsoon (Jun-Sept)
Bankura	20	22	32	14
Purulia	24	26	26	20

Recent or on-going trend of weather and climate:- In phase two the study of recent changing trend of weather and climate has been made for a period of the last three and a half decade. The salient features are listed as follows:

i. Deposition of dew is decreasing.

ii. Erratic nature in weather behaviour is increasing.

iii. Typical seasonal character of weather is disappearing.

iv. Exceptional incidences are becoming the usual ones.

Changes in winter weather:-

- **Span of winter has reduced up to 7 days.**
- **Intensity of winter has decreased.**
- **Average daily minimum temperature is rising faster than the daily maximum temperature.**
- **January temperature has slightly decreased while average temperature of all other months is rising.**
- **In general average winter temperature is rising everywhere varying from 0.1^0c to 0.5^0c per one and a half decade.**
- **During winter intervention of warm spells have increased. On the contrary frequencies of cold spells are few and far between. Warm spells are usually longer than the cold spells.**
- **Winter rainfall is decreasing everywhere although not at the same rate.**
- **Completely dry winter seasons have become more frequent during the last 15 years compared to the previous period of the same span.**
- **Number of rainy days is also decreasing everywhere.**

In general winters are becoming shorter, warmer and drier.

Summers are becoming longer

Monsoons are becoming more variable:-

- **Onset of monsoon is being delayed while the withdrawal remaining almost the same causes a reduction in the span of monsoon.**
- **Variability of rainfall of the monsoon months has increased without causing much change in the total quantity of the season.**
- **Incidences of partial break in one region and heavy rainfall in the other causing partial drought and flood is on the rise.**

Post monsoon weather is becoming too uncertain and variable:- **In recent years wet spells are becoming longer even after withdrawal of monsoon.**

ADAPTATION STRATEGIES

Obtaining optimum and sustainable return from the land through agriculture essentially needs judicious use of all components like land, soil, water and weather and their proper manipulation and management.

To get full advantage of weather and climate, we must synchronize the cycle of weather with the normal weather requirement of crop during different stages of its cycle and we should limit the cultivation of crops in those areas in that part of the year where and when it is best suited. Unfortunately in spite of having fairly satisfactory infrastructural facilities, we are reluctant to utilize it fully for this purpose. As a result low yields are obtained in one hand and much of the production potentials of climate go unutilized on the other.

By 2050 probable change of the climatic environment of these two western districts – Bankura and Purulia will be as follows:-

- **Bankura will register a marginal increase in the amount of rainfall. The projected amount of average annual rainfall is likely to be around 1425 mm. and will be characterized by large fluctuation from one year to the other.**
- **In case of Purulia the projected figure of average annual rainfall does not show any appreciable change and the annual rainfall value will remain around 1340 mm.**
- **Variability of rainfall will increase and the agriculturists will have to face more incidences of weather aberration.**
- **Frequency of drought will increase up to 30%.**
- **Both the districts will register a rise in temperature.**
- **Average daily maximum will increase up to 0.7^0c and the minimum will rise up to 1.3^0c from the present value.**
- **Span of winter will be reduced up to two weeks.**
- **Delayed withdrawal of monsoon will be more frequent.**

Outline of the adaptation strategy may broadly be divided into two stages:

A) Recent climate and climate variability adaptation
B) Climate change adaptation

A) <u>Recent climate and climate variability adaptation:-</u>

I. Land use pattern in the undulating terrain should be designed in such a way that every unit of land is suitably utilize using forest species, horticultural and agricultural crops.

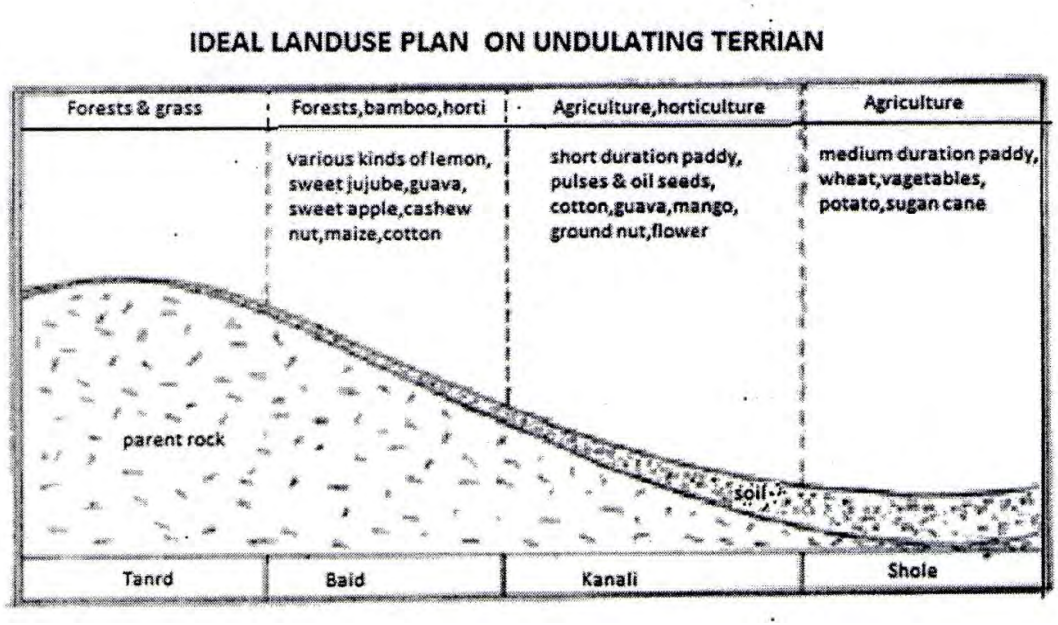
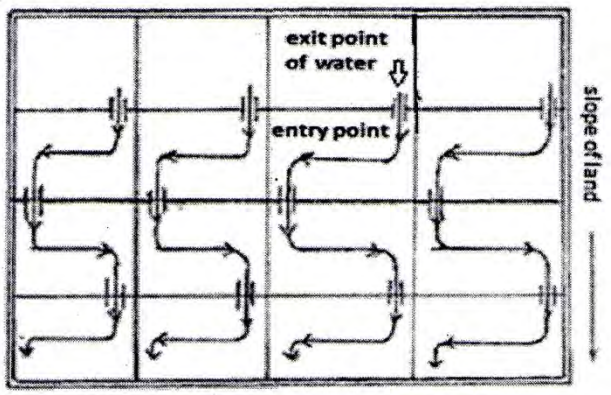


Fig: 22

II. Intense rainwater harvesting and water conservation should be done by
a) Plot to plot run off control



CONTROL OF PLOT TO PLOT SURFACE WATER MOVEMENT

Fig: 23

b) Plot to plot water storage

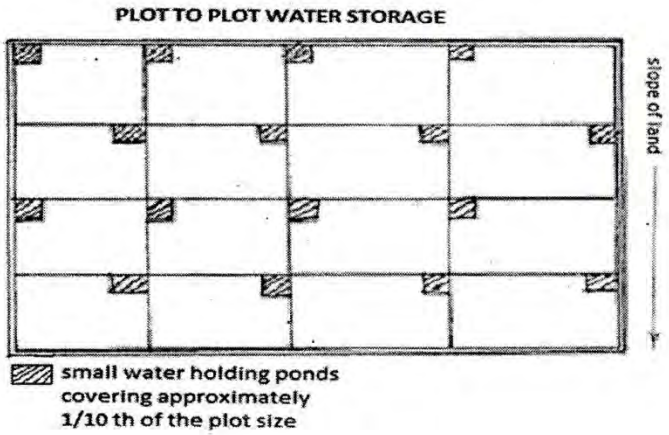


Fig: 24

c) Constructing small reservoir or check dams using terrain character

WATER CONSERVATION USING UNDULATING TERRIAN

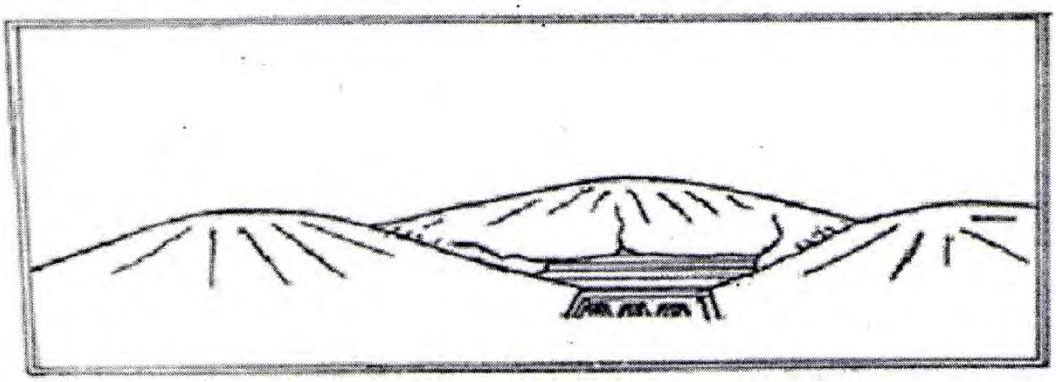


Fig: 25

III. **Rain fed agriculture should be limited within the growing period when the rainfall satisfies crop need. In Purulia the length of growing season is a little less than 135 days and in Bankura it varies from about 135 days to more than 160 days.**

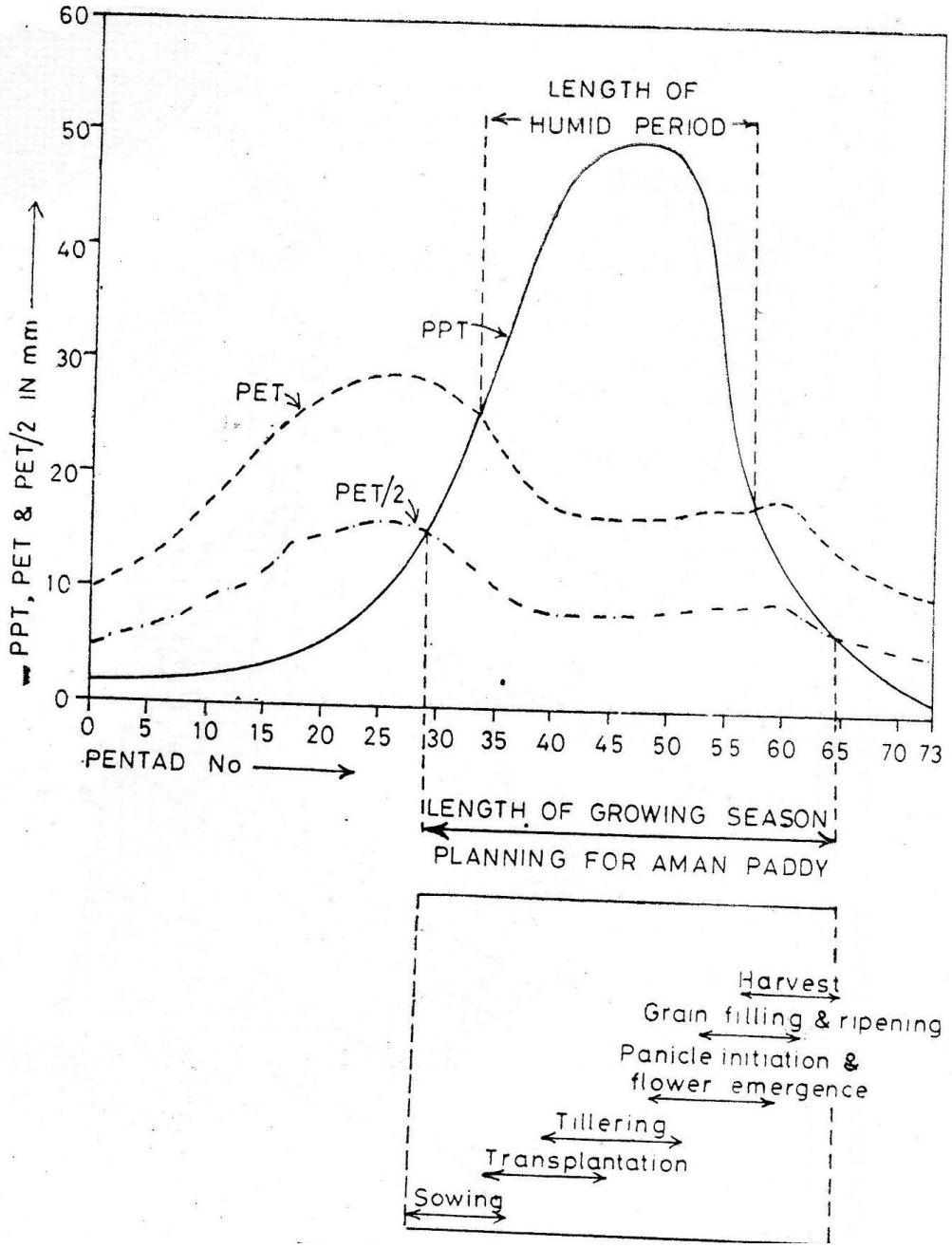

LENGTH OF
HUMID PERIOD
PPT
PET
PET/2
PPT, PET & PET/2 IN mm
PENTAD No
LENGTH OF GROWING SEASON
PLANNING FOR AMAN PADDY
Harvest
Grain filling & ripening
Panicle initiation &
flower emergence
Tillering
Transplantation
Sowing

Fig: 26

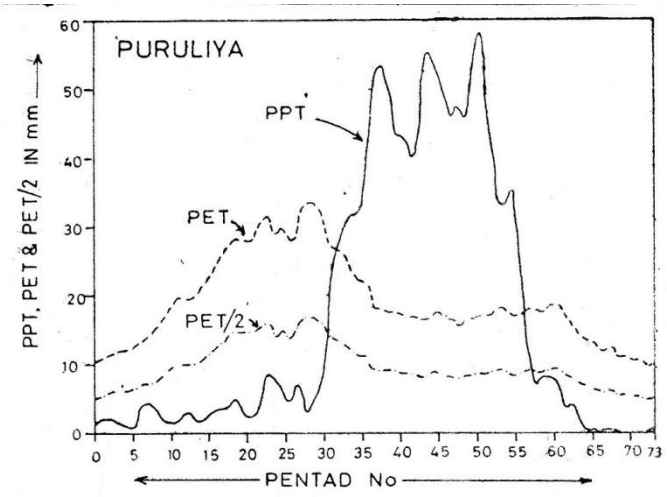

PURULIYA
PPT
PET
PET/2
PPT, PET & PET/2 IN mm
PENTAD No
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 73
0 10 20 30 40 50 60

Fig: 27

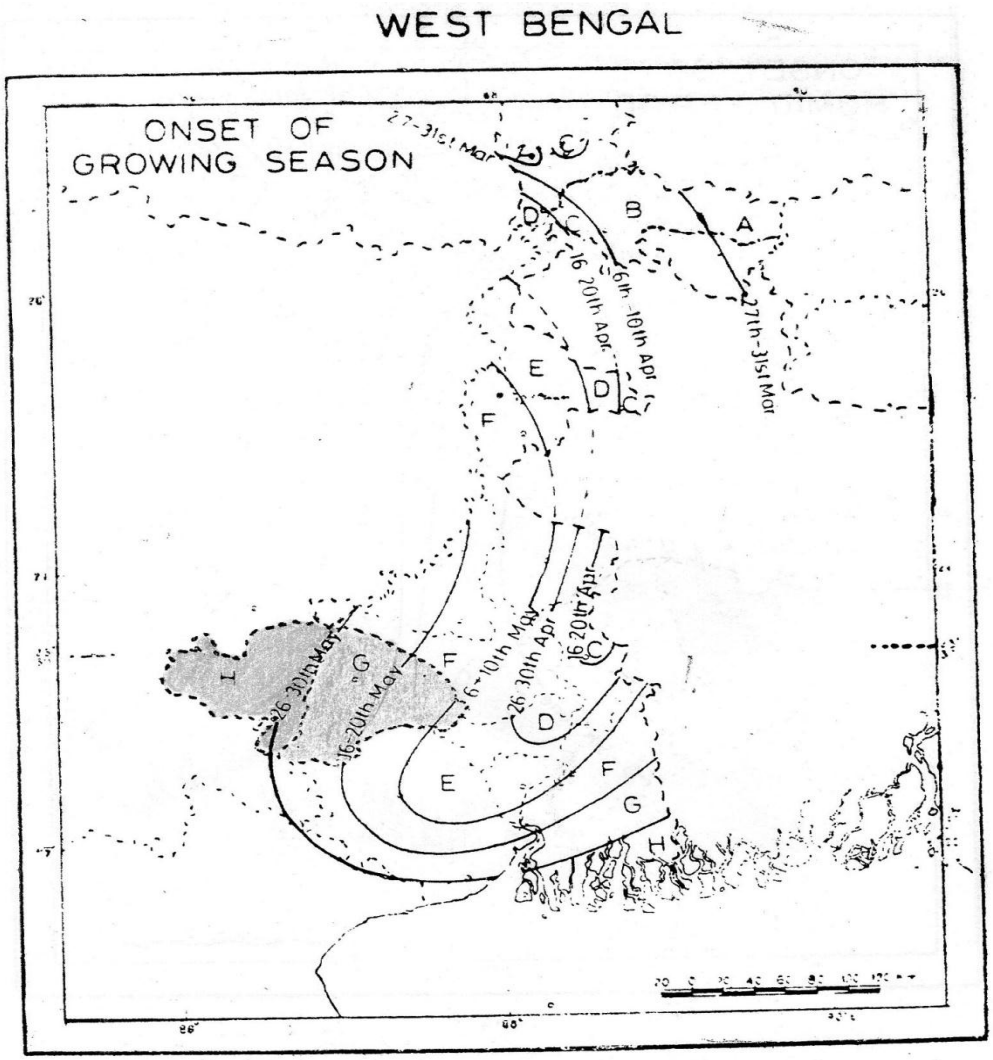

WEST BENGAL
ONSET OF
GROWING SEASON
27-31st Mar
16-20th Apr
6th-10th Apr
27th-31st Mar
26-30th Apr
16-20th May
6-10th May
26-30th May
16-20th May
A
B
C
D
E
F
G
H
I

Fig: 28

WEST BENGAL

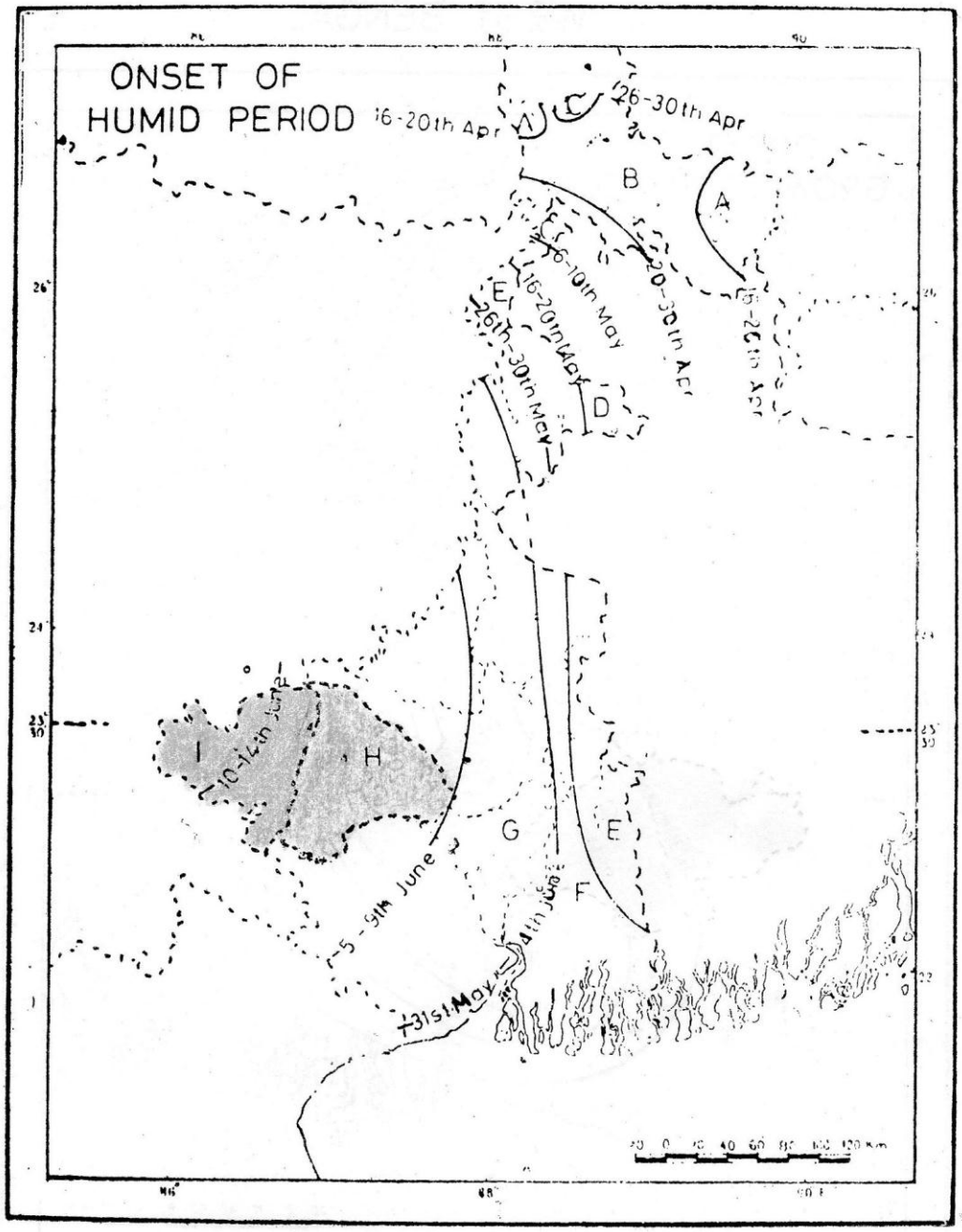


Fig: 29

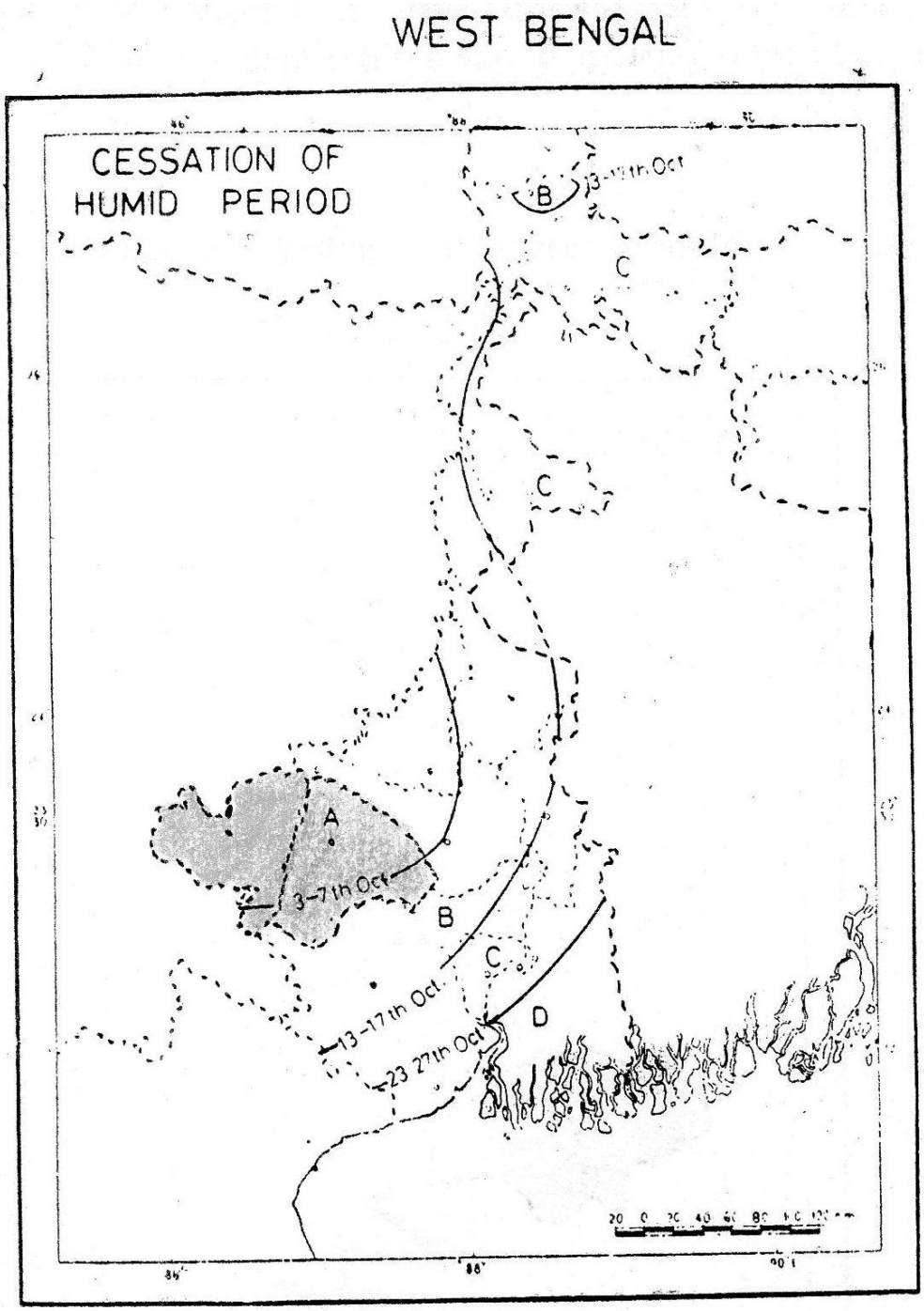

WEST BENGAL
CESSATION OF
HUMID PERIOD
A
B
C
D
3-7th Oct
13-17th Oct
23-27th Oct

Fig: 30

WEST BENGAL

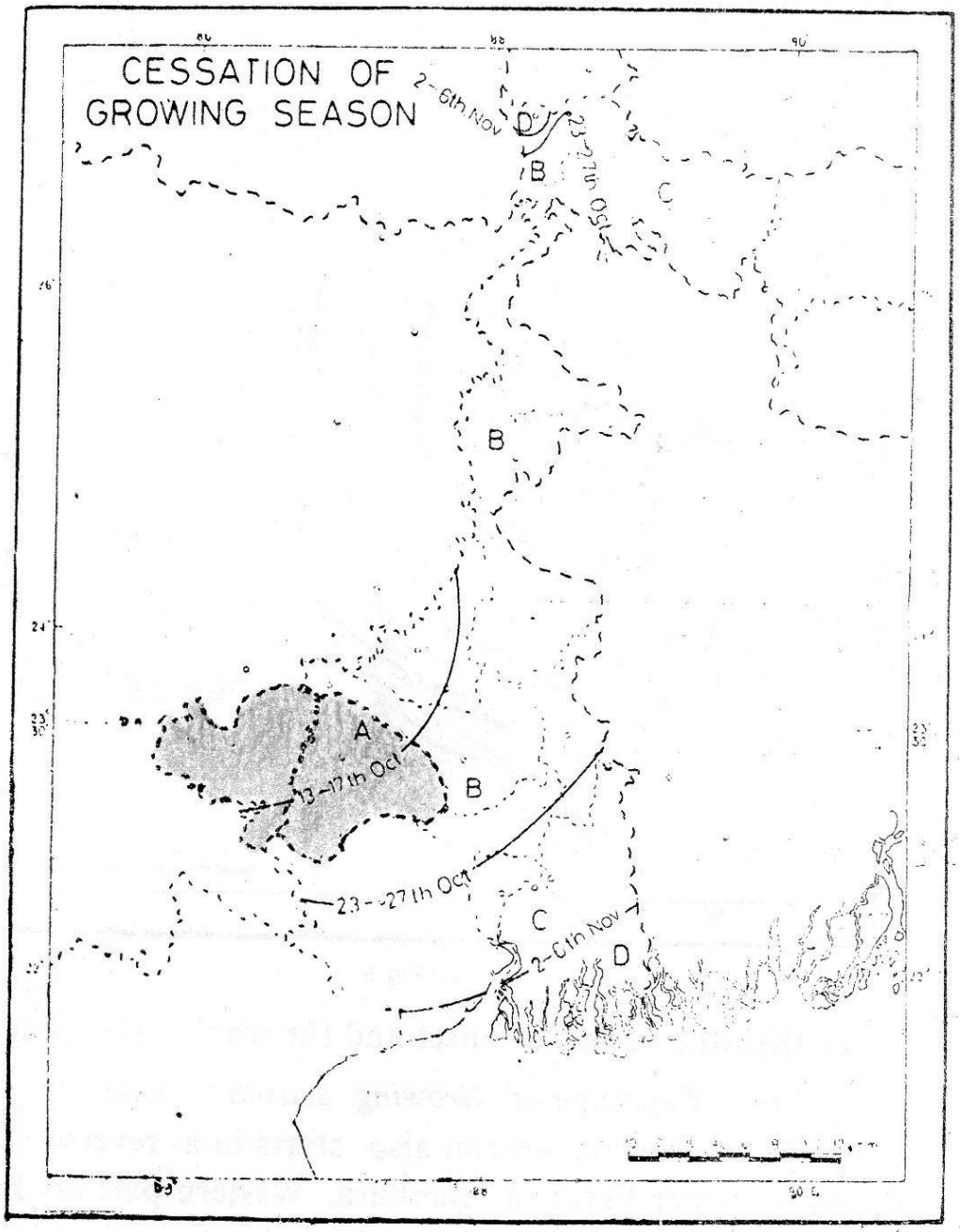


Fig: 31

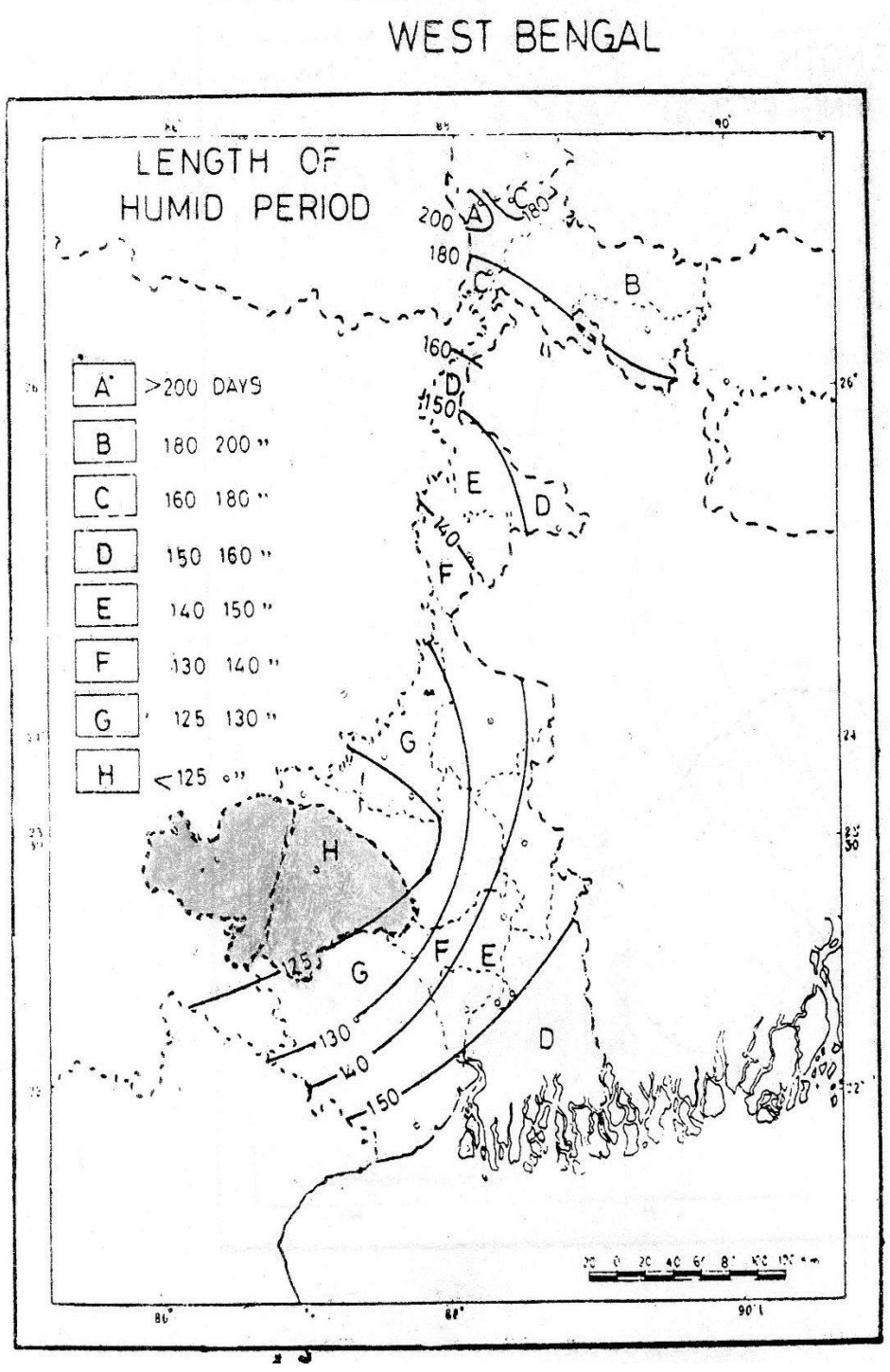

WEST BENGAL
LENGTH OF
HUMID PERIOD
A >200 DAYS
B 180 200 "
C 160 180 "
D 150 160 "
E 140 150 "
F 130 140 "
G 125 130 "
H <125 "
200
180
160
150
140
130
125
A
B
C
D
E
F
G
H

Fig: 32

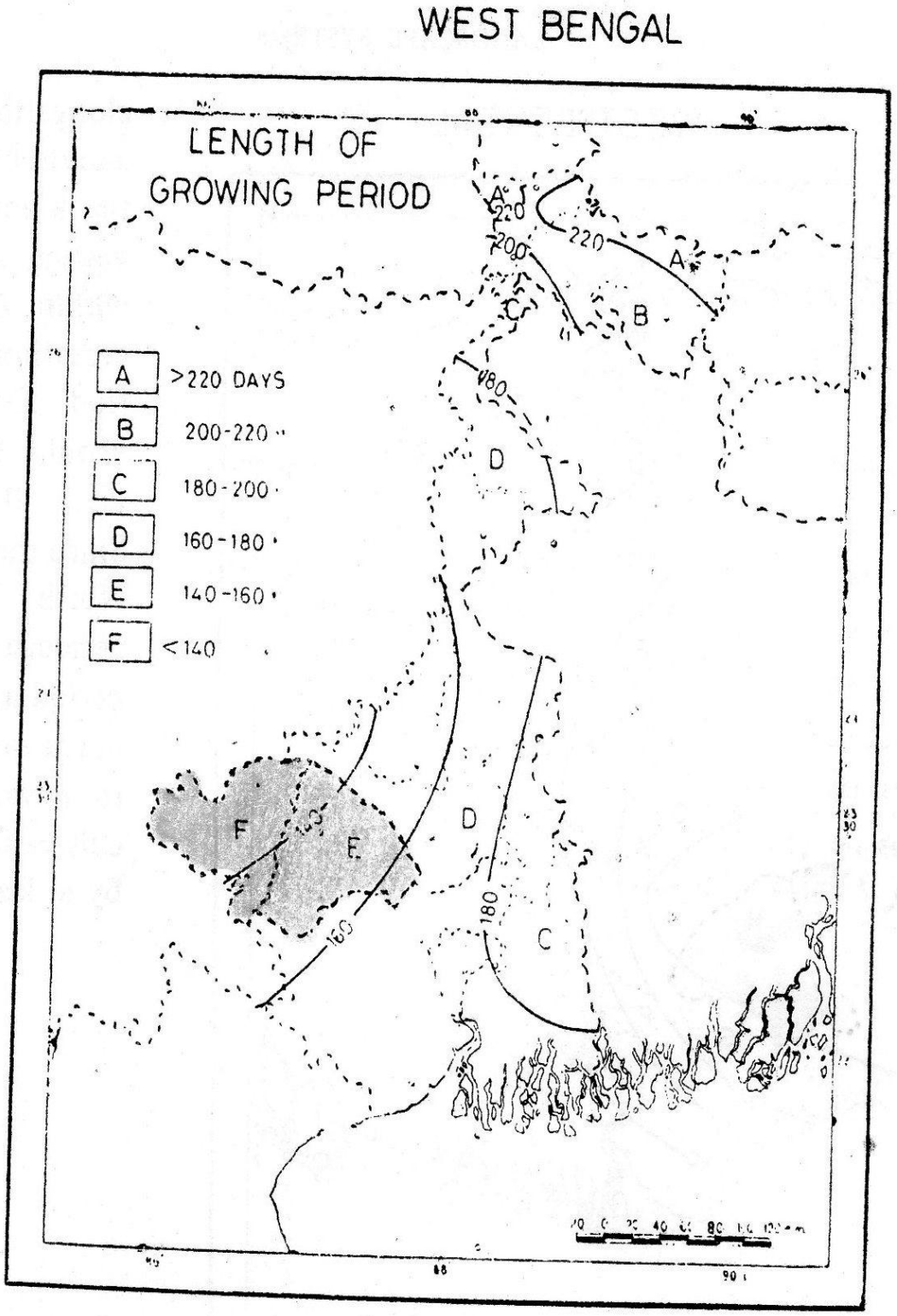

WEST BENGAL
LENGTH OF
GROWING PERIOD
A >220 DAYS
B 200-220 "
C 180-200 "
D 160-180 "
E 140-160 "
F <140 "
220
200
180
160
A
B
C
D
E
F

Fig: 33

IV. At least 60% assured rainfall values should be utilized for agricultural or crop planning in place of mean rainfall because its reliability is much less compared to the 60% assured rainfall values.

Table - 25

Mean Rainfall (MR) and Assured Rainfall (AR%) Values (mm) of Bankura and Purulia

Stations			Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
BANKURA	MR		15.1	24.4	27.4	33.9	82.4	233.1	313.9	303.3	216.2	98.1	15.2	3.3
	AR	50%	3.6	15.5	17.5	21.1	68.8	190.8	303.5	285.8	190.6	80.5	1.0	0.0
		60%	1.8	9.4	9.4	17.5	57.8	171.7	272.4	252.8	176.0	61.7	0.0	0.0
		70%	0.0	3.8	3.8	10.2	44.2	154.2	239.0	240.0	152.7	51.6	0.0	0.0

Stations			Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
PURULIA	MR		16.9	28.2	23.6	26.8	58.1	208.3	310.1	321.1	239.2	88.9	17.6	3.4
	AR	50%	10.2	15.0	9.9	21.2	49.0	180.1	297.4	286.8	218.5	63.5	0.8	0.0
		60%	4.0	10.7	6.4	16.0	40.1	158.8	283.7	271.2	203.5	58.0	0.0	0.0
		70%	0.4	8.5	2.8	9.8	33.2	142.8	264.6	258.6	158.8	38.8	0.0	0.0

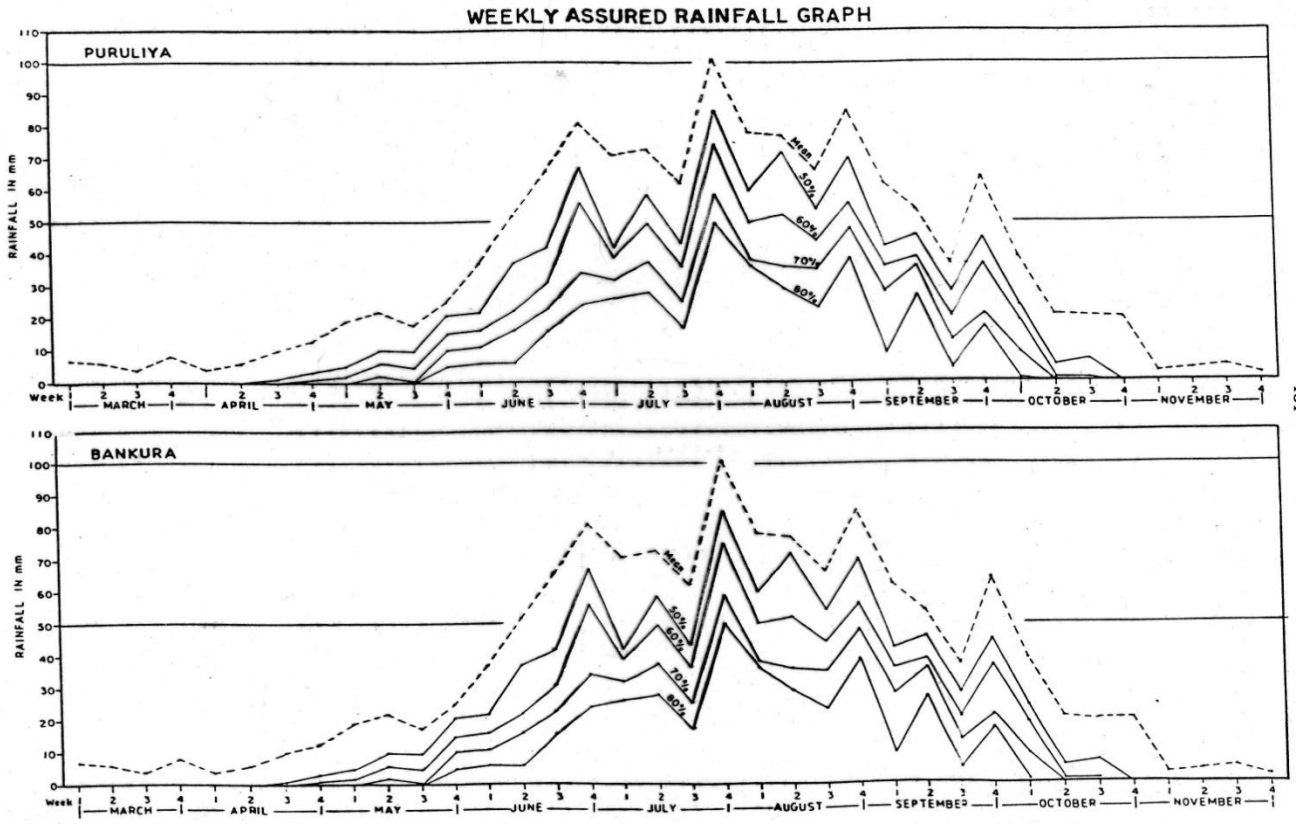


Fig: 34

Table - 26

Stations	Month		March				April			
	Date		1 to 7	8 to 14	15 to 21	22 to 31	1 to 7	8 to 14	15 to 21	22 to 30
	Week No.		M1	M2	M3	M4	A1	A2	A3	A4
	Continuous Week No.		9	10	11	12	13	14	15	16
BANKURA	MR		6.9	6.2	4.3	8.0	4.4	6.0	10.1	13.2
	AR	50%	0.0	0.0	0.0	0.5	0.0	0.0	1.0	2.7
		60%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
		70%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PURULIA	MR		5.9	5.2	4.2	7.8	4.9	6.0	6.1	9.0
	AR	50%	0.0	0.0	0.0	0.3	0.0	0.4	0.1	1.8
		60%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		70%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Stations	Month		May				JUNE			
	Date		1 to 7	8 to 14	15 to 21	22 to 31	1 to 7	8 to 14	15 to 21	22 to 30
	Week No.		M1	M2	M3	M4	J1	J2	J3	J4
	Continuous Week No.		17	18	19	20	21	22	23	24
BANKURA	MR		19.3	21.6	18.4	25.3	36.7	52.0	65.8	80.7
	AR	50%	5.3	9.9	10.2	20.6	21.6	36.6	42.2	67.1
		60%	1.8	5.6	4.8	14.5	15.6	21.8	30.5	56.4
		70%	0.0	2.0	0.5	9.9	11.2	15.6	22.8	34.4
PURULIA	MR		11.6	15.4	11.9	19.0	31.5	47.9	53.2	79.7
	AR	50%	1.5	7.6	4.1	14.0	22.1	42.6	37	69.3
		60%	0.0	3.0	0.8	9.1	10.9	22.2	29.2	48.5
		70%	0.0	0.8	0.0	4.8	6.9	6.2	21.1	38.8

Stations	Month		JULY				AUGUST			
	Date		1 to 7	8 to 14	15 to 21	22 to 31	1 to 7	8 to 14	15 to 21	22 to 31
	Week No.		J1	J2	J3	J4	A1	A2	A3	A4
	Continuous Week No.		25	26	27	28	29	30	31	32
BANKURA	MR		70.8	73.2	61.5	100.8	78.3	76.9	66.4	84.5
	AR	50%	42.2	59.4	42.7	84.8	59.6	71.9	54.1	69.9
		60%	39.3	50.0	36.1	74.9	49.8	51.6	44.2	55.6
		70%	32.0	37.8	25.4	59.4	37.6	36.2	34.6	48.0
PURULIA	MR		63.1	70.7	66.7	102.7	84.8	80.4	67.0	88.4
	AR	50%	57.8	60.7	52.8	84.3	70.4	64.5	65.5	81.3
		60%	42.2	54.0	42.2	74.7	55.4	53.6	45.5	67.3
		70%	33.0	39.6	37.3	60.2	44.5	47.5	35.3	52.9

Stations	Month		SEPTEMBER				OCTOBER			
	Date		1 to 7	8 to 14	15 to 21	22 to 30	1 to 7	8 to 14	15 to 21	22 to 31
	Week No.		S1	S2	S3	S4	O1	O2	O3	O4
	Continuous Week No.		33	34	35	36	37	38	39	40
BANKURA	MR		62.1	53.9	37.3	63.8	39.4	21.4	19.6	19.9
	AR	50%	42.4	46.0	27.7	45.2	23.6	5.1	6.9	0.0
		60%	36.2	38.8	20.1	37.2	19.1	1.3	1.0	0.0
		70%	28.5	36.1	12.5	20.4	9.1	0.0	0.0	0.0
PURULIA	MR		68.7	66.0	39.3	66.3	39.1	22.0	15.8	14.1
	AR	50%	51.1	58.2	21.6	46.2	25.4	5.6	1.0	0.0
		60%	41.7	46.4	15.2	37.9	15.8	1.8	0.0	0.0
		70%	26.9	34.3	11.7	25.4	5.4	0.0	0.0	0.0

Stations	Month		NOVEMBER			
	Date		1 to 7	8 to 14	15 to 21	22 to 30
	Week No.		N1	N2	N3	N4
	Continuous Week No.		41	42	43	44
BANKURA	MR		2.5	3.6	4.6	2.0
	AR	50%	0.0	0.0	0.0	0.0
		60%	0.0	0.0	0.0	0.0
		70%	0.0	0.0	0.0	0.0
PURULIA	MR		4.3	5.8	3.9	2.4
	AR	50%	0.0	0.0	0.0	0.0
		60%	0.0	0.0	0.0	0.0
		70%	0.0	0.0	0.0	0.0

V. More stress should be given on the cultivation of horticultural crops. Possibilities for cultivation of various orchard and horticultural crops as well as flowers should be explored.

vi. Recent climate adaptation involves rescheduling of crop calendar and crop combination of three main agriculture seasons utilizing.

a) **Normal weather requirement of crops and varieties cultivated here cat different stages of growth.**
b) **Actual weather data (average of last 10-15 years) with a view to synchronize the crop need and actual weather.**

vii. **Prospect of alternative crop and variety are also to be examined where the existing crop and variety is misfit environmentally and economically.**

viii. **Changes in the cropping pattern and cropping sequence if necessary in each season if climate variability needs it.**

ix. **Appropriate agro techniques are to be adopted and applied to cope with climate variability.**

X. **Providing weather data / weather information input everyday to the farmers directly through media / local media to guide them for taking suitable decisions in every stage of agricultural operation and farm / crop management including plant protection for best climate variability adaptation.**

xi. **More integration between the farmers and agriculture experts and extension workers is necessary.**

xii. **Proper understanding interpretation and judicious use of short, medium and long range weather forecast for agricultural crop planning and day to day farm management.**

xiii. **Cultivation of cotton during kharif may be tried in the areas which usually remain fallow.**

B) <u>Climate change adaptation</u>:-

I. **Crop planning, variety selection and re-scheduling of crop calendar to be done, keeping in view the long term changes of weather elements.**

II. **Research and extension in agriculture should have a vision to evolve and introduce new crops and varieties whenever and wherever the situation demands in view of the changing trend.**

III. **Close monitoring of weather elements and their effect on standing crops with a view to evolve and adopt appropriate agro-techniques and agronomic manipulation to bring the situation under control to the maximum possible extent.**

IV. **Regular crop weather advisory to the farmers at the block / sub-division level through local media utilizing sub-divisions or block level weather and crop data. The service is to be rendered by the agricultural officers and extension workers of the above level. The State Agriculture Directorate is capable to do that if motivated and organized.**

V. **Water conservation measures to be adopted at all levels with the ultimate aim of minimizing wastage and maximizing irrigation efficiency, specially by conservation and storing rain water.**

VI. **Cultivation of relatively more water consuming crops and varieties like Boro Paddy are to be availed and replaced by less water requiring crops viz. wheat, pulses and oilseeds specially in the scarcity areas and during deficit periods.**

VII. **For drought affected periods and areas separate sets of location specific adaptation strategies are to be evolved and adopted.**

VIII. **Change in the land use pattern, wherever necessary.**

IX. **Proper land shaping to be done in many areas.**

X. **For each incidence of probable abnormal behavior of weather location specific, crop-specific and time specific contingency plan to be prepared beforehand so that action can be initiated at the very outset.**

XI. **Awareness among the farming community and common man about the nature and extent of weather change with possible causes and impact to be generated.**

Source of Meteorological Data:-

i. **Agricultural Meteorology Division, Directorate of Agriculture Govt. of West Bengal.**
ii. **India Meteorological Department, Govt. of India.**

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ANNEXURE-II

BASELINE SURVEY - EXECUTIVE SUMMARY

1.0 PREAMBLE

Based on the PRA conducted by Development Research Communication and services Centre(DRCSC), the following areas of concerns relating to climate change have been identified as 'community perspective of climate change and associated vulnerability':

- Rainfall is Intermittently scanty and is declining further, especially during last 5-6 years
- Temperature, both maximum and minimum, rising
- Agriculture is mainly rain-fed. Soil is poor in nutrient content.
- The forest cover is vanishing gradually. The collected food items are no longer grown in the forest. This zone is dominated by tribal, who are generally more dependent on non-timber forest products (NTFT).
- Lack of fodder and degradation of grazing land.

Wells are gating dried quickly during summer

Before launching the Project with full vigour, DRCSC have decided to conduct a BASE LINE SURVEY of a few residents of a few selected villages in the districts of Bankura and Purila to know the actual ground situation.

The job of conducting the Base Line Study has been entrusted to Economic Information Technology , Kolkata.

2.0 The objectives of the study are as follows:

- Individual / Household Level -prepare a profile of the 'socio-agricultural-economic-vulnerability to climate change' profile of the households.
- Community level: Through the conduct of group discussions with residences of the villages, gate an overall picture of 'community perspective of climate change an associated vulnerability '.
  Compare this knowledge with the results of PRA conducted by DRCSC given in para 1.5 in the last sections.

3.0 Methodology

It was, ex-ante, decided to cover the following blocks and G.Ps (Gram Panchayats) in the above two districts

Sl. No.	Districts	Name of the Block to be covered	Names of G.Ps to be covered
1	Bankura	Chatna	1. Gpshergram
			2. Jhuka
2.	Purulia	Kashipur	1. Rangamati Ranjandi
			2. Agardi Chitra
			3. Soinathali

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It was, ex-ante, decided by DRCSC that 18 villages in Bankura and 22 villages in Purulia (as named by them) were to be covered. Brake up of these 40 villages are given below:

Sl. No.	District	Block	GP	Number of villages to be covered
1.	Bankura	Chatna	1. Goshergram	7
		Do	2. Jhunka	15
		Sub total		22
2.	Purulia	Kashipur	1. Rangamati Ranjandi	5
		Do	2. Agardi Chitra	9
		Do	3. Sonathali	4
		Subtotal		18
		Grand Total		40

The total number of households in these villages (total) are :

Bankura (2GPs)	4200
Purulia (3GPs)	2375
Total	6575

Allocation of the sample size of 500 was done in proportion to the number of households in each village. Accordingly, the following total number of households were selected:

Bankura	315
Purulia	187
Total	502

We have used Systematic random sampling for the study

Method of data collection – Personal Interview Method.
Survey Instrument - A well designed Households Questionnaire developed by DRCSC was used to elicit the required information from the selected households. Copy of the Questionnaire is annexed as Annexure-1
A total of 15 Field staff were deployed

Supervisors – 5
Field Investigators-10

Training Programme – A 2-day training programme in Kolkata to acquaint the field staff with the objective of the project, methodology being used, and survey instrument.
Dr.A.K.Roy, Chief Executive, Economic Information Technology, Kolkata acted as the Main Faculty member.
Shri Sujit Mitra Coordinator, DRCSC clarified the issues and problems raised.
Data Entry – Data Entry was done by using CSPRO Software.
Tabulation was done using SPSS-15

For the Qualitative Study , the following methodology was used

Key informants interview was conducted by Dr. A.K. Roy Chef Executive, Economic Information Technology, Kolkata with the following officials/KIs:

1. Shri Sahdev Murmu – Farmer and social Activist
2. Shri Prasanta Mandal-DRCSC,

A Group Discussion was organized on 02.05.2014 in one of the selected villages (comprising people from the neighbouring selected villages).

A total of 41 individuals (females-19 and males-22) attended the meeting and took part in the deliberations. The age of the participants ranged between 13 and 75 years.

A copy of the names (together with their age, Occupation and signature) is given in Annexre-3.
In the meeting, the following officials of Economic Information Technology, Kolkata were present:

1. Dr. A.K.Roy Chief Executive
2. Shri B.K.Mazumder, Senior Executive

4.0 RESULTS (BANKURA)

The total number of households surveyed in the study in Bankura district is 315.

The average household size works out to 5.68.

The sex ratio varies from 778 (for age group 0-6 years) to 993 (for age group 51-70 years). Sex ratio , especially for the age group 0-6 years, is really a cause for concern.

Percentage of earning members for the two age-groups (19-30 and 31-50 years) are 64and 80 respectively .
Sex-wise percentages of education (literates) works out to 58 for females and 73 for males with a total of 66

Among 304 households (who have school going children ,) 167 households (58percent) have school going children while this percentage for female children is 45 percent.
Seventy five percent of children are studying either in primary class or in middle class.
There are 24 households having 'College going children'.

Six households have 'dropout children'. Reasons for drop-out mentioned are "not interested" (33 percent), "got married" (17 percent), "illness" (17 percent) wtc.

Half of the six drop-out children are presently 'doing nothing'. One each is working as 'Labour' or engaged in 'cooking' or 'household work'

No household has 'Annapurna' ration cards while 10-48 percent of households have 'Antyoday' cards. 46 persons having 'ration cards' belong to BPL.

Most of households (56 percent) have to travel a distance of more than 1km. to their ration shops.
About half of the households (48 percent) have categorized the services of ration shops as 'fair , bad or very bad'.

First three ranked occupations are:

Rank	**Primary**	**Secondary**
I	Labour(51 percent)	Labour (40 percent)
II	Farming (33 percent)	Self Employment (19.48 percent)
III	Service (5 percent)	MGNREGS (19.12 percent)

As far as type of houses in which the households are living, most of them (72 percent) have 'Permanent katcha structured houses' . Only 19 percent of the households stay in pucca houses .
Only 7 households (2.22 percent) have received 'Government assistance' for building houses. Most of the households (57 percent) received 'Rs. 30.000'. The average amount received works out to Rs. 36333/-

Out of 315 households surveyed, 288 households (91.43 percent) belong to 'No TOILET' category.
There –fourth of the households (76 Percent) are 'using permanent toilet'.

Only 1household has 'recorded government assistance' for constructing toilets. They had received Rs. 2000/-

Half of the households (49.84 percent) use 'Electricity' as the sources of lighting followed by 'Kerosene' (29 percent). Around 21 percent of the households were covered by Rajiv Gandhi Electrification programme

'General chullah/traditional chullah' is the most Important chullah /cooking stove used by households (94 percent):

Wood is the maximum use fuel (54 percent) of the respondents

The first three ranked sources of drinking water are (1) Tube well (84%), (2) Tape water (9%) and Well (7%)

Out of 315 households, 116 households (37 percent) have faced 'scarcity of drinking water

Out of 315 households, 63 households (20 percent) are 'pattadars' (55 registered and 8 not registered) while 53 households (17 percents) are 'bargadars' (41 registered and 12 not registered). Only one household has 'Forest PLOT'

Medium high and upland constitute the maximum of the type of land of the households.

The major crops grown are:

Kharif	-	Paddy
Rabi	-	Mustard
	-	Vegetable
	-	Potato
Pre-Kharif	-	Vegetable

157 households (50 percent) had sold some of their crops

The major places of sales are 'taken from home' and 'outside the village to the market'

Majority of farmers (276 out of 315-88 percent) use chemical fertilizers. They generally use DAP, Urea, 10:26:26. Organic manures are being used by 230 households (73 percent). Use rate of organic manure works out to 29 kg/ bigha or 87 kg/acre.

The average annual income per household works out to Rs. 72,768/- i.e. monthly average income of Rs. 6064/-.

The average monthly expenses of households is observed to be Rs. 4946/-.

The average monthly expenses of households of Rs.4946 /- is well within the average monthly income of households of Rs.6064/-.

The first five ranked durables /assets with the households are listed below:

Rank	Durables /Assets	Number of households (percentages)
I	Sickle	308(98)
II	Spade	307(97)
III	Pick-axe	285(90)
IV	Cycle	284(90)
V	Mobile	257(82)

Out of 315 households, the total number of households who have reported 'any diseases between BAISAKH -CHAITRA in 1420 is 270 (86 percent).

The first 3 ranked diseases (in terms of number of households reporting that disease) are:

Rank	Disease	Number of Households
I	Fever	45 (13 percent)
II	Couch and cold	29 (8 percent)
III	Fever & cold	25 (7 percent)

The first 3 ranked responses are tabulated below:

Rank	Period Response	Number of Households
I	Chaitra	51
II	Falgun	38
III	Magh	38

The average per household expenditure works out to Rs. 2107/-

Out of a total of 315 households, 85 households (27 percent) have said that they had faced scarcity of food.

Only 22 households (7 percent) have faced cattle feed scarcity.

A total of 66 households (21 percent) had said that they needed to work outside to meet shortages.

A total of 98 members (77 Male members 21 female members) worked outside.

The number of days worked by majority of the households outside is '50-99' days (45 percent) followed by '20-49' days (15 percent)

Majority of the households (64 percent) had worked as ' daily labour'

The average amount earned works out as Rs. 9729/-.

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Most of the households (85 percent) saved 'Less than Rs. 50/-' a month:

Most of the households (88 percent) have saved money in 'Banks'

114 households (36 percent) have taken loans. Out of 114 , 68 households (60 percent) had taken loans for "agriculture" followed by 25 households (22 percent) who had taken loans for " health/ illness"

More than half (166) of the households (53 percent) have some form of insurance. Sixty Eight percent have taken insurance on "Health Insurance "followed by "Life Insurance "Thirty One percent.

The WEIGHTED AVERAGE OF DEPENDENCE on natural resources works out to

Sl.No.	**Resource on which dependent**	**Weighted average of dependence**
1	Food	39.23
2	Fuel	74.71
3	Cattle feed	54.52
4	Income	17.45
5	Other	57.5

"FUEL" stands out as the MOST important item on which largest percentage of households with the highest weighted average of dependents depend on natural resources.

278 households out of a total of 313 had (88 percent) communication with Gram Panchyat

Out of 313 households, 212 households (67 percent) do participate in Gram Sabha meetings.

Number of households who received any Government scheme /Yojona works out to 161 (51 percent)

Only 12 households (3.81 percent) have expressed some specific skills

Effect of climate change for last four years have been

Quantum of rainfall - Normal or more – 56 percent
Rainy season - In time – 28 percent
-
-
-
-
Cold - Normal or more – 64 percent
-
Winter season - In time – 33 percent

- Before time – 18 percent

Summer	-	In time – 27 percent
	-	Before time – 21 percent
	-	
	-	
	-	
Temperature in summer	-	Normal or more – 69 percent
Lighting	-	"Normal or more" – 55 percent
	-	
Fogging	-	In time – 23 percent
	-	Before time – 17 percent
	-	
	-	
	-	
Fog	-	"Normal or more" – 58 percent
	-	
Storm	-	"Normal or more" – 51 percent
	-	
Hailstorm	-	"Normal or more" –38 percent
		Less – 37 percent
	-	
Cloudy sky	-	Normal or more" –48 percent
		Less – 29 percent
	-	
Drought	-	- one –fourth (24 percent of the respondents said that there had been a drought in 2010

During last three years, following have been effects of natural disasters:

2013	-	Around 13 percent of the total households lost about 40 percent of 'quantity of products'.
	-	Around 1 acre of land could not be cultivated.
2012	-	Around 30 percent of all households faced 'damage of quality of products' at an average rate of 30 percent.
	-	Around 1.33 acres of land could not be cultivated.
2011	-	Around 6 acres of land could not be cultivated.

QUALITATIVE STUDY

Salient points arising out of the key Informants' Interviews and Group Discussions are presented below:

GENERAL	❖ Onset of KALBISAKHI is getting delayed every year affecting the expected climate with its own effect on weather. This year, KALBAISAKHI has not come till date. ❖ Earlier all the 6(six) seasons (GRISHA, BARSHA, SARAT, HEMANTA, SEET, BASANTA) was clearly useable and discernable. Now, there seems to be the following three seasons: 1. GRISHA (Summer) 2. BARSHA (Monsoon) 3. SEET (Winter) ❖ Duration of summer is getting prolonged every year (in last 5-6 Years).
RAINFALL	❖ Major problem is 'UNCERTAINITY'. It is very difficult for farmers (specially) to anticipate the rains by Calendar days /months (which earlier they could do). Earlier, for each seed variety, the farmers knew the dates of sowing, transplanting etc. Now, this has become a 'Total Guessing game' affecting output. ❖ Frequency distribution of quantum rain over the rainfall period has undergone major changes. Earlier ASHAR (mid- June, July) and SRABAN (mid –July to August) would get the maximum rains. Now, it is unpredictable. You may get good rains in BHADRA (mid –August to September) or even in ASWIN (mid-September to October). ❖ Quantum of rain in a particular period also has undergone changes. Some periods get unusually hearing rains (when is unpredictable) While some periods get scanty rains. Quantum of rain, in most cases, is either more or less than expected/ desired.
FOG	❖ Both total time period and intensity of fog have increased creating lot of damage to different Crops (mainly vegetables). ❖ We have never seen or even heard of 'fog in summer'. Now, it is becoming a reality.
WIND	❖ Earlier, one could anticipate the wind (both timing and velocity –roughly) along with its ferocity. Now, it has become 'sudden. It is also not possible to anticipate the intensity which has also gone up.
LIGHTNING	❖ Periodicity has gone up much more in last 3-4 Years. ❖ Earlier, one would not hear about death / accidents due to lightening (may be one or two in one-two years). Now, one hears a number of cases of death in an area every year.
TEMPERATURE	❖ Summer temperature and duration has gone up in last 5-6 years. ❖ Winter period has shortened. ❖ During winter, we may have a few days of extreme cold followed by a few days of 'very little Cold' followed again by 'very cold' etc.

AGRICULTURE	❖ Major crops in this area is Paddy. Most households, who produce paddy, do not sell paddy. Those who want to sell their paddy; they wait for the next cop of paddy. If there is a good weather etc. and they expect good yield of paddy, then only they sell their paddy. ❖ Vegetables are produced mainly sales. ❖ Farmers have adopted/ introduced a new technological innovation after the DRCSC has started funding here (viz. water harvesting, choice of verities for different zone).
HEALTH	❖ Climate changes and its unpredictability have bought new type of illness/ aggravated the old types by sudden increase / decrease in temperature, weather etc. ❖ Incidence of Cancer has gone up. ❖ Climate changes are not only affecting health of human beings, it is also adversely affecting health of livestock (viz. chicken etc.)

The deliberations of both KIIs and Group Discussion seem to confirm 'the area of concern relating to climate change' based on the PRA conducted by DRCSC (ref. Para 1.5).

5.0 RESULTS (PURULIA)

The total number of households covered in the study in Purulia in 187

- Average size of a household is 5.56
- Percentage of members in the household able to work is 67.76
- Percentage of earning members in the household is 48.70
- Percentage of members holding MGNREGA job card in the household is 43.60
- Percentage of literate persons in the household is 68.93

There are 210 school going children (105 each -50 percent each are males & Females).

Higher the class, lessor is the number of children in that class.

Per household dropout rate works out to 2.67 percent varying between 1.07 percent for males to 1.60 percent for females

Major reasons for 'drop out' for boys (2) is 'In attentive in study'. For the three girls who have dropped out, reasons for each of them is (Table 26):

X

- Illness - 1
- Not interested - 1
- School too far - 1

For the 2 boys who have dropped out, one of them is doing 'nothing' while the other is doing the work of a 'labourer'. For 3 girls, 2 are doing 'nothing' while the 3rd is doing 'household work

Households having BPL ration card constitute 57 percent.

Majority of households (78 percent) have 'Labour' as the main occupation followed by 'Self employed'(13 percent). Month-wise 'labour occupation' varies from6.21 percent in Chaitra to 9.86 percent in shravan.

MGNREGA is the major 'Secondary occupation' (49 percent) followed by 'Labour' (37 percent).

Most of the households (82 percent) have 'permanent structured katcha' houses.

Four (4) households have received Government assistance for construction of houses

Average amount received –Rs. 34,000/-

Most of the households (176 out of 187-94 percent) have 'No toilet'.

Three households have received Government assistance for construction of toilets

Average amount received=Rs.6, 700/-

'Wood' is the main fuel used (96 percent of all households)

"Tube well" is the most use source of drinking water (94 %) while pond is the main source of water for other household purposes (58%)

Scarcity of drinking water has been faced by 48 (26 percent) of the households. Average month of scarcity of water faced is 2.15 (90 percent of 48 households faced water scarcity between 2-3 months). During the scarcity months, the households had to travel an average distance of 0.70 km.

Scarcity of water for domestic animals have also been faced by 26 households.

'Stain through a cloth' is the most important method for purification of drinking water used by 4(57 percent) households.

The number of households growing vegetable etc. in orchards in different seasons is 49

Average value of production in different seasons from orchards is Rs 431.21/-

Major source of water for orchards is “Pond”

“Pond” is also the major source of water for agriculture followed by “River water”.

Paddy and vegetables are the dominant crops.

For field crops, the average cost of cultivation works out to Rs 8575.29 per acre of which 52 percent is contributed by “ Labour”

Of the 164 of the households (88 percent of the total number of households of 187) have sold some or other crops grown by them

Paddy is the main crop sold by 54 percent of the households followed by vegetables (43 percent)

Average distance where households sell their crops work out to 4.5 kms.

Most of the sales are done ‘from home’ (40 out of 89-45 percent) followed by ‘outside the village’ (34 percent).

Fertilizer use (kg/acre) for paddy has been observed as:

Chemical fertilizers	-	11.26
Organic manure	-	121.69

Households owning trees around dwelling area are:

- Fruits and other trees used as food - 118 households(63.10 percent)
- Trees of other uses - 105 households(56.15 percent)

Average monthly income of all households works out to Rs. 5784/-.

The households who are engaged in daily labour constitute the highest percentage (31) as far as monthly income is concerned followed by those who are engaged in ‘agriculture’ (20 percent).

‘Food’ is the biggest contributor(36 percent) of household to the total kitty of ‘average monthly expenditure’ followed by ‘expenses on agriculture’ (12 percent)

The average monthly expenditure of Rs. 4507.44 is much below the average month income of households of Rs.5783.97.

First five ranked assets with the households are:

Rank	Asset	Number of Households
I	Spade	184 (98 percent)
II	Sickle	184 (98percent)
III	Pick-axe	181 (97 percent)
IV	Cycle	176 (94 percent)
V	Mobiles	156 (83 percent)

Almost 90 percent (167) of the total households have reported that their households had suffered from any disease during Baisak –Chaitra 1420.

The first three ranked months/period are (1) Chaitra (18%) (2) Magh (15%) and (3) Falgun (9%)

The most prevalent disease among households is " Fever" (14 percent) followed by Diarrhoea (9 percent)

The first five ranked sources of treatment are:

Rank	Source of treatment	Number of household	Percentage
I	Quack	64	30
II	Govt. Hospital	52	24
III	Private Doctor	32	15
IV	BPHC	14	6
V	Private Hospital	10	5
	Others	43	20
Total		215	100

Scarcity of food has been felt by 30 households (16 percent).
Average days of scarcity felt by these 30 households is 77.4.

Most of the households depend upon 'SHOP' to tide over the scarcity period.

Scarcity of cattle feed had been felt by only 3 households (4 percent).

Little more than one-forth (25.67 percent) of the households had to go out for employment.

Total number of members who had gone out for employment was 48 consisting of 43 males and 5 females.

One-fourth of the members had earned 'Rs. 25,000 and above'

SHG is the main source of community savings use by 26 households. Most of them (92 percent) saved " less than Rs 50" monthly.

Bank is the main source of savings for most of the individuals (69 percent)

There are two major purposes for which loan been taken:

- Agriculture -31 (48 percent)
- Health/Illness-23 (35 percent)

Mortgages had to be mainly for loan for agriculture.

Out of 187 households, 129 households (69 percent) have some from of insurance.

Most of the households have 'Health Insurance

Percentage of dependence on natural resources is the highest (94 percent) for "fuel"

Next to fuel, major dependence of households on natural resources is for 'Cattle feed' (60 percent). Even for 'food' 14households are dependent for 50 percent of their food.

Most of the households (155 out of 187- 83 percent) had linkages with their gram panchayat .

Majority of the households (122 out of 187-65 percent) participated in gramsabha.

177 households (95 percent) are included (beneficiaries of any Government Projects/schemes.

The first three ranked sectors from where households have received maximum benefits from Government Projects are:

Rank	Sector	Percentage of households benefitting
I	Education	54.01
II	Social Security	19.25
III	Health	9.63

A total of 129 households (69 percent) are members of some Government Yojana.

Only 5 households had reported having any specific skills- 3 for 'Matir kaj', 1 each for 'Rajmistri' and 'Veterinary'.

As per households, effect of climate changes are

	Effect	**Percentage of households**
➢ Quantum of rainfall	1. Normal/Same	10.02
	2. More	21.31
➢ **Rainy season**	1. In time	16.91
	2. After time	16.11
➢ **Cold**	1. Normal/Same	10.18
	2. More	26.52
➢ **Winter session**	1. In time	12.98
	2. After time	17.79
➢ **Summer**	1. Before time	23.24
	2. In time	15.71
	Effect	**Percentage of households**
➢ **Temperature**	1. More	38.46
	2. Normal/Same	6.73
➢ **Lightning**	1. More	25.00
	2. Less	13.78
➢ **Fogging**	1. After time	16.51
	2. In time	10.66

➢ **Fog**	1. More	23.32
	2. Less	16.75
➢ **Storm**	1. More	22.92
	2. Less	18.11

➢ **Hail Storm**	1. Less	26.20
	2. More	13.86
	Effect	**Percentage of households**
➢ **Cloudy Sky**	1. Less	19.63
	2. More	18.27

- Drought- a total of 180 households have reported that they had been affected by Drought. One Household reported that the 'Drought' was more than earlier.

'Climate Change Effects' had been 'more in the following cases':

- Quantum of rain fall
- Cold
- Temperature
- Lightning
- Fog
- Storm
- Health Storm
- Cloudy sky

Annexure-III

Participatory Vulnerability & Capacity Assessments (PVCA)

Introduction

West Bengal is a multi-hazard state covering a range of agro ecological zones from hilly track at Darjeeling to deltaic zone at Sundarban and the Gangetic belt in Eastern part to the drought prone Plateau region in West.

The multi-hazard events due to vagarious nature of climatic behavior affect almost the entire state and eventually affected severely and make the inhabitants more and more vulnerable. Apparently, the climate change impact vary strongly in their extent and form around the state, resulting in a wide variation in vulnerability depending on different agro-climatic location, people's perception, their adaptive capacity and opportunity, socio-economic conditions, environmental factors, political (Local, State , National and International) motivations etc.

The present study (PVCA) emphasize on to understand the climate change impact on rural livelihood, associated risks and vulnerability of local communities inhabited in drought prone Plateau region, in particular, Chhatna and Kashipur block of Bankura and Purulua district respectively.

The emphasis has also been given to understand how the communities perceive the 'felt' change and how they mitigate the situation at local level; and what else can be taken to strengthen the capacity.

Finally, the findings of the study will help and strengthen the capacity of the communities to plan, make decisions, and to take action towards improving their own situation.

Objectives

The primary objectives of the PVCA study is to

- identify the hazards and categorize those according to its impact on livelihood
- identify the key vulnerabilities of the communities.
- understand how community members perceive risks and threats to their lives and livelihoods
- analyze the resources (capacities) and opportunities available to them to tackle or minimize these risks
- help the community develop a climate resilient action plan

PVCA - Study Area

Jhunjka and Ghoshergram Gram Panchayat of Chhatna block under Bunkura district and Sonathali Gram panchayat of Kashipur block under Purulia district.

Two mouzas (Besora and Gopalpur) from Jhunjka Gram panchayat, and one mouza (Enari) from Ghoshergram Gram panchayat have been selected for study purpose while in Purulia five mouzas (Lara, Jagannathdih, Balarampur and Jamkiri) from Sonathali GP.

Methodology

Based on participatory approach involves collection of primary data as well as secondary. The primary data are exclusively retrieved by using several PVCA tools and focus group discussion. The secondary data are collected from DRCSC, Kashipur and Chhatna block office. Besides, data/pictures from various websites have been incorporated to supplement the present study.

Why PVCA ?

Participatory Vulnerability Capacity Assessment (PVCA) is a hazard-risk-reduction tool kit used in designing livelihoods or poverty-reduction projects. It is an initial and essential exercise for any poverty alleviation programme and considered as a 'bench mark survey' before project initiation.

This tool kit (a set of different tools) helps both community members and project implementing personnel to collect, analyze and systematize information about the vulnerability of a community in a structured way and enable them to conduct their own analysis and to design their action plan and act accordingly towards improving their livelihood.

Brief Profile of Study Area

The study area belongs to the Eastern Plateau region of Bankura and Purulia district and considered as one of the most poorest livelihood zone, inhabited mostly by scheduled tribe (31% in Bankura & 47% in Purulia) and scheduled caste (14% in Bankura & 40% in Purulia). Out of 328 HHs in Bankura, 148 HHs (45%) belongs to below poverty level (BPL) and 40 HHs (12 %) are landless. Livelihood mainly depends on daily wage (51%). If there is no work, *'dadan'* (loan from 'mahajan' with high interest rate) is the only means to survive. A good percentage (18%) of household are forced to migrate twice a year (during transplanting and harvesting period) outside the district for at least 2 to 8 weeks.

The scenario of Purulia is more or less same. Most of the households (60%) belong to BPL category and 50% migrated HHs. Primary occupation is daily wage labor (50%). Though landless family is comparatively less (4%), but most of the landholding HHs have lands of *'baid', 'dungri'* and '*tanr'* category which are usually uncultivable rocky upland.

Drought is an inherent characteristic of this Plateau region. Annual precipitation ranging from 1100 mm to 1400 mm. Distribution is uncertain. Erratic behavior of rain results severe soil erosion. Temperature varies maximum 45 °C to minimum 10 °C normally. Land is undulated rocky and unfertile covered with thin forest. Soil is red and latté rite based, texture generally sandy loam to sandy. Soil reaction ranges from acidic in ridges and near neutral in valleys.

Overall, the area with its high risk, harsh environment, compounded with poor infrastructural facility, social inequity is predominantly inhabited by vulnerable rural communities, especially, landless daily wage labors.

Agricultural operation is based mainly on mono cropped *Aman* paddy. It is solely rain-fed. Chemical intensive farming is common among farmers who can afford it. Agricultural guidance is usually dictated by fertilizers/pesticides dealers or retailers.

Use of organic plant nutrients like farm-yard manure, compost is very little. Preparation of compost is unscientific. Few household have started vermi composting. They are supported and guided by DRCSC.

In case of paddy, high yielding variety (HYV) is very common than folk rice. The variety *Lal Swarna*, and *Lalat* are widespread. Most of the indigenous varieties are extinct from the locality which is reflected in venn diagram. Few traditional paddy varieties are reintroduced by DRCSC, Purulia.

Very few patches are grown 2nd crop with mustard and winter vegetables (hybrid) by better off farmers. Lifting water from nearby water sources is experienced by the study team.

Hybrid varieties, in case of vegetables, grabs over *'desi'* (indigenous). The traditional practice of seed multiplication and preservation is very rare. Farmers are totally depended on markets which are not reliable. Growing of vegetables in homestead area is rarely found, that too in unorganized way.

The farmers are not aware of 'crop rotation'. Very little knowledge regarding mixed, inter or relay cropping. System of rice intensification has not yet been introduced which would optimize the production with fewer inputs, specially, irrigation (using 40 per cent less water than conventional methods resulting less Methane - a green house gas, emission).

Fallow land: Found in most study villages usually kept idle and uncared resulting severe soil erosion. Fodder crops can be grown on such fallow and make it a grazing land. Depending on topography, soil and water conservation measures should be taken. It will prevent soil erosion and thus enhancing soil moisture retention capacity and recharging of ground water. Plantation of food, fodder, fuel and medicinal plant species would be additional income sources for better livelihood.

Water-bodies: Ponds, tanks or *'happas'* are found in study area. Few are excavated/ re-excavated under MGNREGS. In most cases, the pond banks are undressed. After digging, soils are hipped and scattered. Proper management practice would able to fetch good return through an integrated approach.

People are ignorant about common property resources (CPRs) like roadsides, school premises, holy places, '*Solo-aana pukur'* (ponds owned by whole village), river banks or vested lands which can be turn into productive. Access to CPRs by poor and marginal groups must be assured. Plantation of appropriate (indigenous species) crop varieties would not only be an alternative income source but also an approach to carbon reduction credits.

'Social forestry' as seen in the locality is absolutely based on plantation of '*Sonajhuri*' and Eucalyptus trees which gradually destroys the ecosystem. Neither any herbs nor shrubs can grow under these trees. No fauna is really found in 'social forest'. It is really funny to believe a forest having one or two plant species; and that too, claimed as 'social forest'!

Apart from crop husbandry, livestock raring prevails in the farming system. Small livestock like poultry birds, goatary, piggery is very common in dry zone. Cow and buffalo are

usually maintained by comparatively better off households. Availability of fodder is crucial in this harsh environment.

Demography (Bankura)

Table 1 **Social Classes**

Sl.No.	Mouza (JL.no.)	Total HHs	Social class				Literacy %	
			ST	SC	OBC	General	Male	Female
1	Besora (56)	207	35	26	119	27	69	51
2	Gopalpur (59)	35	35	0	0	0	25	17
3	Ennari (57)	86	31	20	22	13	47	35
	Total (%)	328	101 (31%)	46 (14%)	141 (43%)	40 (12%)	-	-

Table 2 **Economic Classes**

Sl. No.	Mouza	HHs	BPL	APL	Land less	Migrated HHs	Primary occupation (%)		
							Cultivator	Daily Lab.	Artisan /Business/ Service / others
1	Besora	207	76	131	21	28	50	40	10
2	Gopalpur	35	31	4	4	3	10	90	-
3	Enari (Ghosherg ram GP)	86	41	45	15	27	35	60	5
	Total	328	148 (45%)	180 (55%)	40 (12%)	58 (18%)	42	51	7

Demography (Purulia)

Table 3 **Social Classes**

Sl.No.	Mouza (JL. No.)	Total HHs	Social class				Literacy %	
			ST	SC	OBC	General	Male	Female
1	Lara (206)	525	189	278	57	1	70	60
2	Jibanpur (143)	74	72	0	0	2	70	60
3	Jagannathdih	172	114	17	30	11	65	35

	(134)							
4	Balarampur(136)	22	22	0	0	0	60	40
5	Jamkiri (137)	174	60	89	0	25	60	40
	Total	967	457 (47%)	384 (40%)	87 (9%)	39 (4%)		

Table 4 **Economic Classes**

Sl. No.	Mouza	HHs	BPL	APL	Landless	Migrated HHs	Primary Occupation (%)		
							Cultivator	Daily Lab	Artisan / Business Service / Others
1	Lara	525	375	150	22	250	60	30	10
2	Jibanpur	74	9	65	5	60	70	25	5
3	Jagannathdih	172	63	109	8	65	60	25	15
4	Balarampur	22	21	1	0	10	50	50	-
5	Jamkiri	174	115	59	7	100	40	50	10
		967	583 (60 %)	384 (40 %)	42 (4%)	485 (50%)			

Infrastructural facility (Bankura study area – Source DRCSC, Bankura)

District HQ is at Bankura 13 km away from block HQ at Chhatna. Distance from Chhatna to Gram panchayat office is 12km connected with pucca road while village connectivity mostly of fair weather. Few hamlets are in remote places thus accessibility during monsoon is painful.

Housing conditions are of different types ranging *jhupri* to pucca building. Most of the inhabitants have poor shelter. These are, generally mud-house thatched with straw or plant-waste.

Education: Two primary school, one middle school and one higher secondary found.

ICDS: Four ICDS centers exist.

Bank/ Co-operative: No such facility is found. On emergency, loan is available from money-lender (*'mahajan'*) with high interest rate.

Club: There are 5 village clubs, out of which only one is registered.

SHG/SGSY: All together nine groups exist.

Post Office: One Post office is at Besora.

Market: Regular market is at Khorbona and Jhatipahari. Weekly village market/ *hut* at Ghoshergram.

Amenities

Potable water: Eight tube-wells and six dug-wells. These are the main source of drinking water. During summer, crisis of water is acute as water level goes down. In Beriathol village tube-wells are not used for drinking purpose due to Fluoride contamination. They have to depend on dug-well.
Fuel: Most of the households use dry-leaves (Sonajhuri leaves), fire-woods and farm-waste for cooking purpose. Before monsoon these materials are collected and stored. Normally this job is assigned to women. Very few households in Besora village use LPG. Bio gas plants are in working which mostly supported by DRCSC.

Electricity: Most of the villages have the facility.

Infrastructural facilities (Purulia study area – Source DRCSC, Purulia)

Distance from district HQ to block HQ is 35 km and Gram panchayat office to block office is about 17 km. connected with pucca road. Village connectivity mostly by fair weather road.

Housing conditions are of different types ranging *jhupri* to pucca building.

Education: One SSK, eight primary schools, one middle school and one madhyamik.

ICDS: 16 - centers.

Bank/ Co-operative: One Co-operative Bank & One Gramin Bank at Sonathali

Club: There are 2 village clubs.

SHG: Eight SHG.

Post Office: Post office at Sonathali and at Lara.

Market: Daily market at Lara and Sonathali. Weekly village market at Kroshjhuri, Lara & Sonathali

Amenities

Potable water: 33 tube-wells and 70 dug-wells.
Fuel: Most of the households use fire-woods and few households use bio gas. Few HHs are using smokeless woven supported by DRCSC.

Electricity: Most of the villages have the facility.

PVCA Field Exercise, Findings and Analysis

Location of PVCA

Village: Beriathol Mouza: Besora GP: Jhunjka Block: Chhatna

Prior to start the exercise the study team, acted as facilitator, explained the objectives, and procedure of the PVCA exercise. It is also clarified that how PVCA helps in identifying the climatic

hazards they usually face over the year and analyzing its variability factors, impact on their livelihood, self vulnerability assessment as well as capacity and finally helps in designing appropriate coping mechanism to secure a better livelihood.

1. **Hazard Ranking**
   Village: Beriathol, Block: Chhatna

Hazards as villagers perceived: Five different climatic events have been marked as hazard which causes significant adverse impact on livelihood sustaining for different occupational groups. It includes – 'DROUGHT', 'UNCERTAINTY of RAIN', 'THUNDER STORM', 'HEAT WAVE' and 'FOG'. When the villagers were asked to rank those according to its adverse impact on livelihood, the villagers precisely expressed their views through pair ranking.

Hazards ranking: Comparing drought with other climate events DROUGHT causes maximum damage. In fact, except last year (2013), drought is an inherent characteristic of this region. Similar to drought, 'HEAT WAVE' affects considerably, though the magnitude of damage is less. The villagers believe that the seed beds and crops wilt due to heat wave. 'UNCERTAINTY of RAIN' is considered as hazard next to 'heat wave'. The respondents expressed that 'uncertainty of rain' results severe crop damage. For an example, they mentioned that delayed monsoon or 'uncertainty of rain' results late transplanting. Moreover, they added, during panicle initiation or flowering stage, seizing of rain causes total crop failure. Finally they consider 'DROUGHT' as one of the most hazardous climatic event and ranked it 1st. Next to drought 'HEAT WAVE' got 2nd and least damage by 'FOG' got 5th position.

Table 5 **Hazards Ranking**

	Drought	**Uncertainty of rain**	**Thunder storm**	**Heat wave**	**Fog**	**Rank**
Drought	X	Drought	Drought	Drought	Drought	**1**
Uncertainty of rain	X	X	Uncertainty of rain	Heat wave	Uncertainty of rain	**3**
Thunder storm	X	X	X	Heat wave	Thunder storm	**4**
Heat wave	X	X	X	X	Heat wave	**2**
Fog	X	X	X	X	X	**5**
Score	**4**	**2**	**1**	**3**	**0**	

2. **Time Line on Climate Change**
   Village: Beiathol, Block: Chhatna

This exercise helps in looking behind in the context of climate change and its respective impact on rural livelihood. It's a tool for critically review the past events (climatic) with respective consequences and thereby stimulates thinking to step forward towards judicial management practice.

The 'time line' reflects a period of last 20 years starting form current year (May 2014).

The chart depicts that during last winter mustard and potato crops were spoiled by foggy weather which causes food crisis. Though in 2013, on set of monsoon was in time but heavy shower during harvesting time spoiled the ripen crops.

2008 to 2012 - was the drought years. Most of the *'Aman'* fields were kept fallow. Fodder crisis was acute. People were forced to sell the cattle. Acute food crisis in every household. Even, yield from lowland (Bohal) was not as expected. Crisis of potable water due to depletion of ground water.

In 2003, hailstorm severely affected both field crops and shelters. Roof tiles were badly cracked and Brocken.

1994, 1998, 1999 and 2001 was also affected either by drought or uncertainty of rain. Consequence was miserable. Delayed monsoon caused late planting, hindering crop growth, more diseases and pest attack, depletion of ground water etc etc. Over all the communities were in acute crisis period.

The chart (shown below) reveals that drought and uncertainty of rain is very common since last few years. They consider it as one of the most damaging climatic events affects their livelihood.

Time line

Year	Events	Impact on Livelihood
1994	Drought	* Severe crop damage * Food insecurity * Depletion of ground water
1998	Abnormality of rain	* Delayed transplanting * Precipitation during harvesting.
1999	Drought	* Crop lands kept fallow * Food crisis
2001	Drought/	* Depletion of ground water. * Scarcity of potable water.
	Hailstorm	* Winter crops damaged * Roof tiles cracked/destroyed
2003	Abnormality of rain	* Crops damaged severely
2008	Drought	* Failed to cultivate / Late planting – poor yield
2009	Heat wave	* Dehydration/Less work ability. Disposal of livestock
2011	Drought/ Abnormality of rain	* Paddy field kept fallow. Starvation / half meal
2012	Abnormality of rain	* Poor yield.
2013	Abnormality of rain	* Crop damage
May 2014	Abnormality of rain/Fog	* Crop damage specially winter crops * Food crisis

3. **Climate Variability Factors**
   Village – Beriathol, Block: Chhatna

The climate variability factors and its magnitude assessed by the villagers reveal that factor like 'incidence of high intensity rain fall' is decreasing but total of precipitation are occurred in fewer days which indicates erratic rain. This climatic change makes the farmers to alter their cultivation practice. Due to shortening the ploughing time (i.e. land preparation), the labor is becoming very scarce resulting higher labor-cost.

'Dry spell during monsoon' is prolonged which affects paddy growers resulting chaffy grain, less tiller number, excessive weeds damage etc. More labor is needed for weeding.

Number of 'incidence of storm' is increased and it appears like *'Ghurnijhar'* (like Tornado) which damages trees and houses. Storm damages paddy flowers during autumn. The 'Kalbaisakhi' is very uncommon since last few years. The villagers presume that in future it will vanish.

'Variation of Seasonal temperature' is significantly noticed by the villagers. They confidently expressed that summer period is now prolonged. Three seasons instead of six are now noticeable. Seasonal cropping pattern has changed dramatically.

'Incidence of drought / Uncertainty of rain' are very common. Magnitude of damage and its frequency is increasing. Impact on livelihood is miserable. Transplanting on upland is uncertain. Hunger / half meal period is extended. Farmers cannot depend on agriculture for livelihood sustaining.

'Incidence of hailstorm' is moderate. In fact entire locality is not affected by hailstorm. Where it happen the growing crops is damaged. Roof tiles are cracked.

'Incidence of thunder storm' - Increased and happens throughout the year. Impact - 20 casualties in this locality during last 5 years. Death of cattle.

'Incidence of fog' – Foggy days are increased. Common in every season. Premature flowers and fruits are falling. Cough and cold is common. Pox disease found in livestock.

Table 6 **Climate Variability Factors**

Village – Beriathol, Block: Chhatna

Sl, no.	Climate Variability factors	Magnitude	Impact on livelihood
1	Incidence of high intensity rainfall	Decreased (Qnty. of rainfall same within shorter span)	• Changing the cultivation practice. Entire job has to finish within a short period. • Paddy sapling are spoiled. • Labour crisis due to high demand (Short period) –expensive.
2	Dry spell during monsoon	Prolonged (more than 10 days)	• Chaffy grain – Less yield- number of effective tillers reduced • Excessive weeds in paddy field – more

			weeding – more cost.
3	Incidence of storm	Increased (like Tornado)	• Damage of trees and houses • *'Kalbaishakhi'* (Storm-cloud during 'Baishakh') is very rare. • Storm during autumn spoils paddy flowers.
4	Variation of Seasonal temperature.	Summer period prolonged	• 3 seasons can be noticed instead of 6 • Seasonal cropping pattern is gradually changing
5	Incidence of drought / Uncertainty of rain	Increased/ unpredictable	• Transplanting on upland is uncertain • Food crisis • Farmers cannot depend on agriculture for livelihood sustaining
6	Incidence of hailstorm	Moderate (not at entire area)	• Growing crops severely affected • Damage of roof (tile)
7	Incidence of thunder storm	Increased and happens throughout the year.	• 20 casualties in this locality during last 5 years. • Death of cattle is very common
8	Incidence of fog	Increasing	• Seen in most season. Cough and cold / headache is very • Pre-matured flower and fruits falling, spoiled • Pox disease found in livestock (Goat and lamb)

4. Climate Trend Analysis

Village – Beriathol, Block: Chhatna

'Climate trend analysis' helps the community in critically analyzing the present and thereby assists in emerging a climate resilient action plan.

Villagers' comments are shown in table below -

Table 7 **Climate Trend Analysis**

Village – Beriathol, Block: Chhatna

Sl, no.	Indicators	Villagers' comments	Effects as community perceived
1	Average day temperature during Summer	Increased / Fluctuating	• Human disease (cough and cold) increased • Wilting of field crops /trees • Skin disease
2	Average day temperature during Winter	Day temperature rises Cold pinching not as earlier	• Winter period shorten • Quality of molasses (from date palm) is falling.
3	Winter period	Reduced	• Wheat cultivation considerably reduced.
4	Summer period	Increasing	• Temperature rises and continues from Middle of Magh (February) to Ashar (Middle of July).
5	Seasonal diversity	Reduced 6 Seasons reduced to 3	• 3 seasons are noticeable. Among all Summer is more scorching.
6	Bio diversity	Reduced	• Plant species like Piyal, Bankhejur, Bainchi, Mahua, Saal, Kusum, Vela, Kendu, Amlaki, Bahera, Haritaki are extinct. • Animal species like Hural, Nekre, Kheksiyal, Corui, Finge, Gosap, Darash are no more.
7.	Diseases	Increasing	• Diseases both for human and livestock are increasing.

5. Seasonal Livelihood Analysis

Village- Beriathol, Block: Chhatna

The poor and marginalized rural people are reluctant to sustain their livelihood on a single approach, they have to depend on multiple activities which may includes crop based activity,

livestock raring, fisheries, collection of NTFP (Non timber forest produce), handcraft, small business on daily wage within or outside village. The 'Seasonal livelihood analysis' reflects the same as shown in chart.

The chart depicts that there are thirteen different seasonal activities performed by the communities for their livelihood sustaining ranging from crop based activity to daily wage labor under MGNREGS activity. The chart also specifically highlighted gender wise activities. It reveals that women are involved mostly on livestock raring. Besides, they are doing few additional income generating activities like leaf-plate making, broom making, *'bel mala'* making during their leisure period.

The crop based activity is usually a joint effort. Molasses preparation though done by men, but supported by women family members. Small business, carpentry and meson work is done by men.The livelihood analysis chart has illustrated the specific time period (month) against each activity and broken line indicates poor and unstable attachment (shown below).

Table 8 **Seasonal Livelihood Analysis**

Village – Beriathol, Block: Chhatna

Occupation/Month	**Ap/ Ma**	**Ma /Ju**	**Ju/ Jul**	**Jul/Ag**	**Ag / Se**	**Se/ Oc**	**Oc/ No**	**No/ De**	**De/ Ja**	**Ja/ Fe**	**Fe/ Ma**	**Ma/ Ap**
Crop based activity (Male & female)		←	—	—	→		←	—	→			
Daily wage (male & female)	←	—	—	—	—	—	—	—	—	—	—	→
NGRES (male & female)	←	→									←	→
Livestock (female)	←	—	—	—	—	—	—	—	—	—	—	→
Carpenter (male)	←	→								←	→	
Meson (male)	←	→						→	—	—	—	→
Small business (male)	←	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	→
Molasses (Khejur)							←	—	—	→		
Broom making (female)					←	→						
Molasses (Palm) (male)	←	→										
Mat (Khejur leaves) (female)			←	→	←	→						

Bel mala (female)	←											→
Leaf plate (Saal/Palash) (female)	←	→										

6. Seasonal Calendar on Scarcity

Village: Beriathol, Block: Chhatna

The chart 'Seasonal calendar on scarcity' illustrates the scarcity of basic primary needs for livelihood sustaining over the year [i.e. Baisak (mid April to mid May) to Chaitra (mid March to mid April)].

Food crisis: The chart depicts food crisis continues for 3 months. Peak crisis period during August-September, precisely till harvesting of *'Aman'* paddy.

Fodder crisis: Fodder crisis occurs in two months (Baisakh-Jaistha) due to dry spell. Again the crisis arises during monsoon as because there is very little space for grazing. The area are then under paddy cultivation. The cattle are then confined in rocky upland. Stall feeding which is laborious and expensive for maintaining livestock.

Crisis of drinking water: Scanty of potable water in this drought prone area is very common. During dry season the water table goes down. The crisis lasts for 4 months (Chaitra to Ashar). If monsoon delays the period may extend. More over the area belongs to Fluoride contaminated zone. The Beriathol people are not using tube-well water. They solely depend on dug well. They have to fetch water from distance point which is mostly done by women.

Irrigation water: Similar to drinking water, irrigation is also a major problem. The area is completely based on rain-fed. Since the drought and uncertainty of rain is a common phenomenon, and the water bodies dries up gradually the villagers are in great problem to growing any crops. The acute crisis period is from Pous to Jaistha. The rest 6 months depends on rain. If rain declines, there is no scope of live-saving irrigation.

Job opportunity: No job opportunity during Fulgun to Jhaistha nor with in village nor outside.

Migration : They used to migrate outside village. Usually they migrate in month of Baisakh and Pous- Magh.

7. Venn Diagram

Village: Beriathol, Block: Chhatna

This tool creates lots of interest among participants. When they recall the past, many interesting facts related to plant species were come out. Such as folk rice they cultivated earlier are now extinct from the locality. They can now realize that though the yield potentiality of those varieties are less than varieties grown today, still those varieties have an inherent capacity to drought tolerant and resistant to pest and diseases attacks. Moreover those have tremendous capability to survive against all natural calamities. Finally, the villagers identified few varieties which they wish to reintroduce in their farming system and requested the study team to find out and collect those varieties for promoting widely.

The plant species identified and categorized by the villagers are as follow –

Era	Paddy
Past	Asanlaya, Kalamkathi, Raghusaal, Lathisaal, Jhunur, Bhutmuri, Kashiful, Lakshidaya
Past + Present	Chandrakanta, Masuri
Present	Lal Swarna, Lalat, Gorya-1, Supershymali, IR-36, Puja, 1017, Dudheswar, Lalgutka, B-20
Present + (expected Future)	Lal Swarna, Lalat, Gorya -1, IR-36, Puja, Lalgutka
Expected Future	Gorya-1, Dhiren
Expected Future + Past	Kankrisaal, Raghusaal, Sitasaal, Jhulur, Bhutmuri, Kashiful, Asanlaya
Most Sustainable Zone (Past+Present+Future)	Roghusal, Bhutmuri, Chadrakanta, Puja, Lalgutka, IR-36, Lal Swarna, Lalat, Gorya -1

8. Focus Group Discussion

Village: Beriathol, Block: Chhatna

Interaction with villagers revealed that a drastic change in climate pattern is noticed since last 10 years. The villagers irrespective of gender, expressed that the cultivation practice has significantly changed. For an example, they mentioned, formerly the paddy seeds were usually sown on 'Rohini' a fixed date of 'Jaistha' i.e. 13th and the others related activities were scheduled accordingly. But since last few years (about 10 to 12 years) this schedule is not followed as because of uncertainty of monsoon. Now the onset of monsoon is shifted at least 15 to 20 days ahead. Moreover, they added, the rain is now unpredictable. Seizing of rain during panicle initiation or during flowering stage results severe crop damage. Very often, the entire field crops are attacked and spoiled by 'dhasa' (blast) due to this climate variation. "We are now in great trouble" they concluded.

The number of rainy day has considerably reduced and the intensity is too high which causes soil erosion. The summer span is elongated and the day temperature rises at the same fluctuating while winter shorten. All these climatic behaviors invite so many unwanted consequences like pest and diseases attack to crops, children are suffered from cold and cough and livestock are attacked by unknown diseases.

Since the respondents are of tribal community and mostly forest dwellers, they exposed their observations. They told - "since we the poor tribal community depends mostly on forest, 'hunting' is not only a passion to us, it's a means of livelihood sustaining. We get food by hunting. Now we are not getting food from forest as earlier. The forest is now degraded. We lost our preys. Birds, bats and few small animals are now lost. Few helpful birds like crow, vultures and eagle are rarely found in our locality. Predator birds like owl is about to extinct. Earlier, field crops were protected from rat by owl. Now owl is very uncommon.

Previously the crop sequence was designed in a way so that a continuous flow of food availability is secured. Unfortunately, to-day mono cropped approach is widespread.

To-day, as they told, field bunds ('*ails*') are not covered with grasses which causes fodder crisis.

In the context of coping mechanism, the villagers reacted that in fact "we are in puzzle. No such measures have yet been made by us except digging of *hapa*". But as DRCSC is

working here since last few years, the villagers are quite aware of few mitigation measures. Accordingly, they suggested –

- Harvesting of rain water by excavation and re-excavation of ponds.
- Land shaping considering topography.
- Introduction of short duration paddy variety.
- Re introduction of traditional rice.
- Promoting 'Lutni sarshe' (mustard).
- Re introduction of drought tolerant crops like bajra, jower, kodo, arhar etc.
- Cover crop to protect soil erosion.
- Mixed cropping.
- Use of organic plant food like 'tral saar', vermin compost etc.
- Use of organic pesticides.

PVCA at Purulia

Location : Jhagradih, Mouza : Lara, GP: Sonathali Block: Kashipur

1. **Hazards Ranking**

   Village: Jhagradih, Block: Kashipur

The villagers from five different mouzas of Sonatali GP came and actively involved in the PVCA exercise held at Jhagradih village. All together they identified 10 climatic hazards which they think most influenced their daily life. These are – i) thunder storm ii) uncertainty of rain iii) hail storm iv) less rainfall v) rain with storm vi) fog vii) cloudy weather viii) drought ix) rise of temperature (heat wave) and x) less dew. After listing the hazards, the respondents were asked to rank those by pair ranking method. The table below shows detail of scoring and thereby ranking. It reveals that the 'DROUGHT' affects highest to their livelihood. According to their scoring, the hazards are ranked as follow –

Hazards	Rank
1. Drought	1st (highest impact)
2. Less (insufficient) rainfall	2nd
3. Uncertainty of rain	3rd
4. Rain with storm	4th
5. Fog	5th
6. Hail storm	6th
7. Rise of temperature (heat wave)	7th
8. Thunder storm	8th
9. Cloudy weather and	9th
10. Less dew	10th (least impact)

Table 10 **Hazard Ranking**

Village: Jhagradih, Block: Kashipur

	Thunderstorm	**Uncertainty of rain**	**Hailstorm**	**Less rain fall**	**Rain with storm**	**Fog**	**Cloudy weather**	**Drought**	**Rise of Temp.**	**Less Dew**	**Rank**
Thunder storm	X	Uncertainty of rain	Thunder storm	Less rain fall	Rain with storm	Fog	Cloudy weather	Drought	Rise of Temp.	Thunder storm	**8**
Uncertainty of rain	X	X	Uncertainty of rain	Less rain fall	Uncertainty of rain	Uncertainty of rain	Uncertainty of rain	Drought	Uncertainty of rain	Uncertainty of rain	**3**
Hailstorm	X	X	X	Less rain fall	Hailstorm	Fog	Hailstorm	Drought	Hailstorm	Hailstorm	**6**
Less rainfall	X	X	X	X	Less rainfall	Less rainfall	Less rainfall	Drought	Less rainfall	Less rainfall	**2**
Rain with storm	X	X	X	X	X	Rain with storm	Rain with storm	Drought	Rain with storm	Rain with storm	**4**
Fog	X	X	X	X	X	X	Fog	drought	Fog	Fog	**5**
Cloudy weather	X	X	X	X	X	X	X	Drought	Rise of Temp.	Less Dew	**9**
Drought	X	X	X	X	X	X	X	X	Drought	Drought	**1**
Rise of Temp.	X	X	X	X	X	X	X	X	X	Rise of Temp.	**7**
Less Dew	X	X	X	X	X	X	X	X	X	X	**10**
Score	2	7	4	8	5	5	2	9	3	1	

2. Time Line

Village: Jhagradih, Block: Kashipur

The 'Time line' (shown above) unfolds the past facts related to climate change and its impact on livelihood of rural communities of Purulia study area.

Year wise climatic events and respective impact as community faced are stated below.

Time line

Year	Events	Impact on Livelihood
1994	Less dew	* Hampers winter crop growth * Less yield in winter crops
1995	Flood (Darakeswar river)	* Severe crop damage* Food insecurity * Communication disrupted
1996	Erratic rain	* Soil erosion * Reduced soil fertility
1999 Aman	Delayed & vagarious nature of rain	* Delayed transplanting * Pest & disease attack in paddy * Less vegetation leads fodder crisis * Hinders crop growth resulting poor yield.
2004	Cloudy weather	* Diseases and pest attack in winter crops – less production
2009	Severe drought	* Most of the Aman fields kept fallow * Fodder crisis
	Hailstorm	* Damage of Ravi crops * Damage of shelters
2010 (Kanali) not	Drought (less precipitation)	* Paddy yield from Low (Bohal) and Mid land satisfactory.
2011 lowland	Drought	* 60% of upland kept uncultivated. Even, yield from (Bohal) not as expected. * Crisis of potable water due to depletion of ground water.
May 2014	Fog	* Mustard and potato damaged by 'Jab poka' (Aphids) and 'Dhasa' (Blast disease) respectively. * Children and livestocks suffer from un known diseases.

3. Climate variable Factors

Village: Jhagradih, Block: Kashipur

Climate variability assessment was judged by the communities by identifying few climate variability factors, its magnitude and impacts on their livelihood which is shown in table below.

Table 11 **Climate Variability Assessment**

Village: Jhagradih, Block: Kashipur

Sl, no.	Variability factors	Magnitude	Impact on livelihood
1	Incidence of high intensity rain & vagarious n	Increased/ unpredictable	• Transplanting in time is not possible • Soil erosion results loss of fertile soil/organic matter eventually turn to barren land • Less production • Migration
2	Continuous dry spell during monsoon	Number of incidence increased and duration prolonging gradually	• Growing crops severely affected • Poor or no yield if happens in panicle initiation /flowering stage.
3	Incidence of storm surge	Moderate	• Soil erosion (top soil)
4	Incidence of Drought	Increasing	• Up lands are kept fallow. • Mid lands ('kanali') also suffer from water stress
5	Incidence of hailstorm	Increased	• Damage of roof tiles • Crop damage • Death of cattle
6	Foggy weather	Uncertainty/ density increased (less visibility)	• Disease /pest attack increased in ravi crops. • Crop damage by unknown (new) pest/diseases

7	Variation of Seasonal temperature	6 seasons reduced to 4	• No flowering in Palash • This year (2014) Palash leaf size is significantly larger. • Mango inflorescence are dropped down due to excessive dew • Wheat cultivation is almost withdrawn due to shorten of winter spell and higher temperature.

4. Climate Trend Analysis

Village: Jhagradih, Block: Kashipur

The exercise 'climate variability assessment' helps the communities to analyze the climate trend. The table below reveals the climate trend analysis in details.

Table 12 **Climate Trend Analysis**

Village: Jhagradih, Block: Kashipur

Sl, no.	Indicators	Villagers' comments	Effects as community perceived
1	Day temperature during Summer	Increased	• Work efficiency considerably reduced • Different types of skin disease • Children suffer from Diarrhea, same in case of cattle • Crops wilt
2	Day temperature during Winter	Winter temp. rises and winter period shorten	• Fluctuation of temp. causes diseases • Yield of potato decreased, diseases like 'dhasa' (blast) increases, size of potato reduced. • Wheat cultivation significantly reduced • Number of irrigation, in case of mustard, is now higher than earlier
3	Winter period	Reduced	• Pinching cold as earlier, is very uncommon • Typical winter crops are not grown now

4	Summer period	Increasing	• Difficult to work • Very soon people are becoming tired / exhausted
5	On set / seizing of each Season	Fluctuated/ unpredicted Annual rain fall reduced Day temp. rises while night temp. is reduced	• Cannot differentiate the seasonal variation • Winter crop damage • Unknown diseases both human /livestock
6	Bio diversity	Mahua, Shaal is disappearing. Pial & kend extinct. significantly reduced in fauna like Sasa, kheksiyal	• Reduced NTFPs • Bio diversity lost

5. Seasonal Livelihood Analysis

Village: Jhagradih, Block: Kashipur

'Seasonal livelihood analysis' chart depicts what type of activity / activities is usually done by the poor and marginalized people. The gender wise work division, if any, is precisely clarified in the chart. Over the year, how many months / weeks they engaged in each activity is clearly illustrated by both end arrow line. The table below illustrates in details.

6. Seasonal Livelihood Analysis

Village: Jhagradih, Block: Kashipur

Occupation/Month	**Ap/ Ma**	**Ma /Ju**	**Ju/ Jul**	**Jul/Ag**	**Ag / Se**	**Se/ Oc**	**Oc/ Nov**	**No/ De**	**De/ Ja**	**Ja/ Fe**	**Fe/ Ma**	**Ma/ Ap**
Crop based activity (male & female	←	—	—	—	—	—	—	—	—	→		
Meson (male)	←	—	—	—	—	—	—	—	—	—	—	→
Carpenter (male)	←	→		←								
Roof thatching	←									←	—	→

(male)	
Cycle repairing (male)	
Grocery shop (male)	
Molasses (Khejur) (male)	
MGNREGS (male & female)	
Broom making (female)	
Mat (Khejur leaves) (female)	
Leaf plate (Saal/Palash) (female)	
Livestock raring (female)	

7. Seasonal Calendar on Scarcity

Village: Jhagradih, Block: Kashipur

'Seasonal calendar on scarcity' chart prepared by the community reveals that the community is lacking basic requirements of livelihood sustaining.

Food crisis: Starts from Bhadra (August) and continues till paddy harvesting/threshing (i,e. Agrahayan). September-October the peak crisis period. About 60 % of total household belongs to this category. They have to borrow food grain at higher interest rate. During this four months women members are in great pressure.

Fodder crisis: During crop growing period the cattle are not allowed to free grazing. Cattles are then confined in shelter or in rocky upland. Usually, during this period (Sravan to end Kartick) fodder crisis severe.

Crisis of drinking water: About 3 to 4 months (Chaitra to Ashar) acute crisis. Women family members are responsible for this job. Normally, during stress period they have to fetch water from distance water sources.

Fire woods: During rainy season (Sravan to mid Kartick) crisis of fire woods arises. The community has to collect and store their requirements prior to onset of monsoon. The collection of fire wood usually done by women. For better energy efficiency, smokeless 'chulli' has been introduced by DRCSC, Kroshjhuri project, Purulia since last few years. The villagers accepted and use smokeless 'chulli'.

8. Venn Diagram

Village: Jhagradih, Block: Kashipur

This exercise helps in recalling the past in the context of crop varieties that were grown 15 to 20 years back and the crop varieties are growing now. Is there any crop variety fading now gradually or totally disappeared? Why? The Venn diagram impinges in mind to critically analyze its consequences and helps in predicting future, eventually suggests appropriate crop variety compatible to climate resilience farming system.

This tool creates lots of interest among participants. When they recall the past, many interesting facts related to plant species were come out. Such as folk rice they cultivated earlier are now extinct from the locality. They can now realize that though the yield potential of those varieties are less than varieties grown today, still those varieties have an inherent capacity to drought tolerant and resistant to pest and diseases. Moreover those have tremendous capability to survive against all natural calamities. Finally, the villagers identified few varieties which they wish to reintroduce in their farming system and requested the study team to find out and collect those varieties for promoting widely.

The diagram shows that the farmers lost number of folk rice like Manik kalma, Asanlaya, Talmari, Chandrakanta, Kashiful, Baiddhula etc. Lal swarna and Lalat is now wide spread. But both the varieties, as the villagers told, are susceptible to pest and diseases. Moreover, if any climatic stress, the varieties cannot survive. But in case of folk rice, their resistance power is too high. They can survive even in dry spell. Though the yield potentiality of folk rice is less yet it never demands high input cost. The villagers are now too much eager to re introduce those folk rice which now extinct in their farming system.

9. Focus Group Discussion

Village: Jhagradih, Block: Kashipur

An interactive session with participants from 5 mouzas of Sonathali GP was held at village Jhagradih. The participants were mostly from tribal community. The participants, irrespective of male or female, interacted spontaneously to share their experience, views and opinions regarding the dynamics of climate change and the impacts they faced on their livelihood.

The community as commented –

Drought is very frequent in this region. Like drought, inadequate rainfall or uncertainty of rain causes adverse impact on our daily life. We are living in a harsh environment. Geographically our land is undulated terrain. Soil is unfertile. No irrigation facility. All together, this vulnerable zone combined with vulnerable community like us are in great threat to exist. In addition, this climatic trend threats to our future generation.

We have noticed that Day temperature is gradually increasing. Summer spell extended where as winter period is curtailed. Cold is not pinching as previous. This type of climatic pattern creates awful incidence like crop damage to health hazards, loss of flora and fauna eventually imbalance of eco-system.

They suggested few adaptation and mitigation measures to encounter the situation. These includes –

- Harvesting of rain water – excavation and re-excavation of pond/hapas
- Plantation of indigenous plant species.
- Drip irrigation / pitcher irrigation in case of homestead area

- Introduction of drought tolerant crop varieties.
- Introduction of smokeless 'chulli' (oven)
- Use of bio plant nutrients instead of chemical.
- Use of bio pesticides
- Formation of village youth group to protect and preserve natural resources.

Action Plan

The climate resilience action plan for vulnerable communities in drought prone areas of Bankura and Purulia district is carried out with the help of analytical reports emerged though intensive PVCA exercise and frequent interaction with village people irrespective of age, caste and gender. The entire process is based on participatory manner and facilitated by the study team.

In the light of climate change, several issues and challenges need to be prioritized considering the vulnerability and capacity of intended communities and analyzing the local situation, the action plan is designed.

Principally the idea is to allow the climate resilience mechanism in the direction of low emission of green house gases (GHG) or less "carbon intensive" approaches which are eventually responsible for climate change.

Highlighting on two major aspects - the 1st one is "Carbon offset credits" which precisely mean depending on renewable energy and the 2nd one is "Carbon reduction credits" i.e. collection and storage of carbon from our atmosphere through forestation / reforestation.

A. Sustainable Livelihood through Farm Integration

Objectives	Issues identified	Action plan (Climate Resilient Adaptation & Mitigation measures)
Basic requirements for livelihood sustaining - Food security Availability of Fodder Availability of drinking water Availability of fire wood	• Drought – water stress-crop-field kept fallow/ food/ fodder /drinking water crisis. • Uncertainty of rain-delayed planting-crop damage. • Rainy days decreased - erratic rain- soil erosion-poor soil fertility. • Rise of temperature-crops wilt & damage. • Summer prolonged-pest attack/hinders crop growth. • Winter shorten-	✓ Introduction /reintroduction of appropriate crop varieties compatible to farming system. ✓ Adaptive trials on crop and livestock managements. ✓ Trial on SRI (System of Rice Intensification) for low emission of GHG (Methane). ✓ Introduction of mixed cropping/inter cropping and relay cropping (food availability all over the year). ✓ Suitable crop rotation (considering land situation) incorporating at least one legume crop for enhancing soil fertility. ✓ Use of organic plant nutrients for enhancing soil moisture retention capacity. ✓ Recycling of farm waste to nutrient rich plant food. ✓ Practice of mulching (in situ water conservation) ✓ Promoting strategic crop varieties. ✓ Awareness on bio pesticides. How to prepare

	damage winter crops/wheat cultivation decreases. • Foggy weather-pest & diseases- crop damage • Depletion of ground water-water bodies dries up • Convergence of bio-diversity- imbalance of ecosystem • Lack of technical knowledge	and use. ✓ Promoting smokeless 'chulli' (oven) as energy efficiency measure. ✓ Generation / regeneration of grazing land. ✓ Need based training.

B. Soil & Water Conservation

Objectives	Issues identified	Action plan (Climate Resilient Adaptation & Mitigation Measures)
Assured irrigation. Availability of drinking water. Maintaining soil fertility. Recharging of ground water	• Deforestation. • Degradation of forest (natural). • Soil erosion. • Degradation of soil. • Depletion of ground water. • Plantation of inappropriate plant species ('*Sonajhuri*' & Eucalyptus). • Ignorant about natural resources	✓ Identification of micro watershed zone. ✓ Harvesting of rain water. ✓ Earth work as needed (e.g. land shaping, contour bunding , stagger trench, 5% model, 30/40 model etc.). ✓ Check dam using locally available materials (no hitech) ✓ 3-tire plantation of indigenous species (combination of tree , herbs/ shrubs and creepers). ✓ Generation or regeneration of forest with indigenous plant species. Make it a 'food forest' as buffer food stock. ✓ Need based training

C. Access to Common Property Resources (CPRs)

Objectives	Issues identified	Action plan (Climate Resilient Adaptation & Mitigation Measures)
Access to Common Property Resources (CPRs) by poor and	• Ignorance about CPRs • CPRs are kept idle • CPRs are degrading	✓ Identification of CPRs ✓ Group based activity (cultivation of food crops, plantation of indigenous plant species which will provide food, fodder and fire

marginal people.		woods). ✓ Need based training.

D. Alternate Income Source

Objectives	Issues identified	Action plan (Climate Resilient Adaptation & Mitigation Measures)
Provision of alternative income source like - Livestock raring. Handcraft. Small business.	• No job opportunity. • Landless. • Migration.	✓ Technical and financial support for livestock raring. ✓ Fisheries. ✓ Mushroom cultivation. ✓ Lac cultivation on Palash and jujube tree. ✓ Bamboo craft. ✓ Broom making (fromlocally avaiable 'Jurgunda'or 'kharang ghuchi' grasess). ✓ Rope making from *'babui'* grass (particularly in Purulia project). '*Baui'* grass may be grown on fallow lands. ✓ Leaf plate making (from Saal and Palash leaves). ✓ Need based training.

E. Village Resource Management

Objectives	Issues identified	Action plan (Climate Resilient Adaptation & Mitigation Measures)
Identification of village resource both for i) natural & ii) human Conservation and preservation of natural resources Judicial use of natural resources	• Ignorance about village resources. No or less use of village resources. • Misuse and over use of village resources. • Diversified ecosystems are in threat. No resiliency is there.	✓ Identifying and registering the village resources (natural and human) at regular interval at micro level. ✓ Community action to protect and preserve those natural resources. ✓ Ensure judicial use of natural resources and sharing the benefits at equity basis. ✓ Percolating traditional knowledge and wisdom from resource persons (e.g. elderly persons, village doctor, dai, artisan, weather predictor, skilled cultivator etc) to their kin or interested individual. ✓ Need based training.

F. Disaster Proofing

Objectives	Issues identified	Action plan (Climate Resilient Adaptation & Mitigation Measures)

Community Grain Bank Community Seed Bank	• Lack of quality seeds while seedbed is damaged due to climatic hazards • Poor access to credit society • Pressure of money lenders	✓ Establishment of community Grain Banks. ✓ Establishment of community Seed Banks ✓ Formation of savings and credit groups ✓ Need based training.

G. Health and Hygiene

Objectives	Issues identified	Action plan (Climate Resilient Adaptation & Mitigation Measures)
Nutrition awareness Provision of balanced diet. Sense of hygiene.	• No or little awareness about 'nutrition' • Malnutrition • Poor sanitation • Lack of motivation • Lack of infrastructural facilities.	✓ Establishment of 'nutrition garden' at every household to get fresh and toxic free balanced diet. ✓ Nutrition garden at school premises to supplement 'Mid day meal'. ✓ Awareness and motivation camp to use low cost latrine. ✓ Organizing Vaccine / Immunization camp ✓ Linkage with ICDS

H. Institutional Strengthening / Human Resource Development

Objectives	Issues identified	Action plan (Climate Resilient Adaptation & Mitigation Measures)
Empowering/Strengthening village communities.	• Lack of village institution /youth group • Children are not properly looked after • Peoples are not aware of their rights • Harassed and cheated by money lender • Poor or no linkage with local Govt.	✓ Identifying/setting up of Social institute. ✓ Formation of Youth Groups for i) Mother & Child care (linkage with ICDS) ii) Immunization / vaccination camp (linkage with medical team) iii) Regular contact with pachayat iv) Provision of information regarding Govt, schemes/circulars. v) Linkage with Disaster management Dept. ✓ Need based training of Youth Groups.

I. Advocacy and Net Working

Objectives	Issues identified	Action plan

		(Climate Resilient Adaptation & Mitigation Measures)
Linkage with Govt./ Non Govt. Organization & Civil Societies.	• Less exposure to outer world. • Poor or no linkage with local Panchayat / Govt. Depts. • No/ less access to print media.	✓ Conducting village fair/exhibition at village level. ✓ Conducting meeting, seminar etc. with local Panchayat/Govt. Depts./ other agencies at regular interval. ✓ Mass communication through wall writings/posters etc. ✓ Distribution of leaflets/booklets on technical issues. ✓ Disseminating weather reports /forecast well ahead. ✓ Involvement of local media for disseminating the facts (regarding work progress)

Conclusion

The study indicates that the communities are, in all respects, in vulnerable situation. They are quite conscious about climate trend and its impacts on their livelihood. In fact they have very little to combat the situation.

The scientists (IPCC) predicts that during the next decades, billions of people, particularly those in developing countries, will face changes in rainfall patterns that will contribute to severe water shortages or flooding, and rising temperature that will cause shift in cropping pattern and growing seasons.

This changing pattern of climate thus, calls for reviewing the existing coping mechanism for a particular zone and finding out the best possible survival strategies (agricultural) tuned with prevailing farming system. The most important aspect of survival, in particular, agricultural strategy, in Bankura and Purulia, would be to evolve heat resistant varieties of crops and to introduce short duration crops varieties mixed with other drought tolerant crops to minimize risks as well as steady flow of food availability all over the year. Another important aspects would be “the soil and water management” & “weather based crop management” to cope up with the changing climate.

Hence, take it as ‘joint venture’ of a multidisciplinary team and to organize series of awareness campaigns and skill trainings at all levels to ensure a climate adaptive and resilient livelihood of small and marginal farmers of Bankura and Puruli districts of West Bengal.

Annexure-IV

Abbreviation & Acronyms

AIR: All India Radio

ADO: Agriculture Development Officer

BDO: Block Development Officer

CRC: Climate Resource Centre

CBO: Community Based Organization

CPR: Common Property Resources

DRDC: District Rural Development Cell

EMS: Electro Magnetic Spectrum

EWS: Early Warning Systems

GHG: Green House Gas

GDP: Gross Domestic Product

IMD: Indian Meteorological Department

IFS: Integrated Farming System

INCOIS: Indian National Centre for Ocean Information Services

IEC: Information Education Communication

ICT: Information Communication Technology

KKS: Karl Kubel Stifftung

LUP: Land use Plan

LEISA: Low External Input based Sustainable Agriculture

LAMP: Large Adivasi Multipurpose Product

MoEF: Ministry of Environment and Forestry

MSME: Medium and Small Scale Entreprise

NTFP: Non Timber Forest Product

NRM: Natural Resource Management

NSDP: Net State Domestic Product

NDVI: Normalized Difference Vegetation Index

NREGA: National Rural Employment Guarantee Act

NAPCC: National Action Plan for Climate Change

NDMA: National Disaster Management Authority

PAR: Photosythetically Active Radiation

PRA: Participatory Rural Appraisal

P & RD: Panchayat & Rural Development

PSTN: Public Switched Telephone Network

PVCA: Participatory Vulnerability and Capacity Assessments

PRI: Panchayati Raj Institution

RLI: River Lifting Irrigation

SRD: Strengthening of Rural Development

SAPCC: State Action Plan for climate Change

SDMA: State Disaster Management Authority

SRI: System of Rice Intensification

VSAT: Very Small Aperture Terminal

WUMP: Water Use Master Plan

WBREDA: West Bengal Renewable Energy Development Authority

WAT: Water Absorption Trench

WHH: Welt Hunger Hilfe

SOC: Strengthening Soil organic Carbon

MGNREGS: Mahatma Gandhi National Rural Employment Guarantee Scheme aims at enhancing the livelihood security of people in rural areas by guaranteeing hundred days of wage-employment in a financial year to a rural house-hold whose adult members volunteer to do unskilled manual work.

SDSS: Spatial Decision Support System

Gram Panchayat- A Gram or village Panchayat is a statutory body covering one or more villages with an average population varying between 1,000 to 3,000 people, and an average area of about six square miles. It is a body of elected representatives. The number of member varies from 5 to 31, but is 15 on the average the village Panchayat area is generally divided into words, each word returning its representative to the Panchayat.

Gram Sabha: In most of the states, each constituency of the members of the Gram Panchayat is called the Gram Sabha and all the voters of the same constituency are members of this body. In West Bengal it is called *Gram Sansad* (village parliament). Gram Sabha in West Bengal has a different meaning. Here all the voters of the Gram Panchayat as a whole constitute the Gram Sabha.

Gram Sansad: Each GP member represents a specified geographical area and numbers of voters. This is called Gram Sansad (village parliament)

Panchayat Samiti: A *panchayat samiti* is a local government body at the tehsil or taluka level in India. This body works for the villages of the tehsil or taluka that together are called a Development Block. The panchayat samiti is the link between the gram panchayat and the district administration.

Zilla Parishad: The governing system at district level in Panchayati Raj is known as Zila Parishad

Annexure-V
Consultation on Climate Resilient Food & Livelihood Security
Venue: Bankura District Central Cooperative Bank – Board Room, Bankura
Date: 18th June, 2014

We conducted 5 Consultation meetings, 2 in Purulia and 3 in Bankura to discuss about the activities to be undertaken in respect to climate change. In the Consultations, different stakeholders, the beneficiaries, the Government Officials, Bank coordinators, representatives of other NGOs working in the area were present.

The report below is the brief of the Consultation happened in BDCC- Board Room, Bankura on 18th June 2014.

The meeting was started with the welcome address by Mr. Sourav Ghosh, the representative of DRCSC. Ms. Somjita Chakraborty,the Secretary of DRCSC briefed the purpose of the meeting along with DRCSC's work in Purulia and Bankura. She invited all the participants to interact openly and express their views about the project so that their valuable suggestions can be incorporated in the final DPR.

Dr. S. Bandyopadhyay, DDM NABARD explained the issues of Climate Change, why the weather is changing how it is impacting the life and livelihood. He emphasized o awaring mass about the climate change has become the most important issue now. The crop planning and diversification in the livelihood is the option to bring the stability in the life of rural population. He explained through his presentation that how the cultivable land is shrinking day by day with the erratic rainfall, higher temperature and absence of proper infrastructure in the villages. He also showed with examples that the dependency on chemical fertilisers is ultimately increasing the global warming. When the nature is becoming damaged the food security is getting challenged.

He explained through his research and presentation that harvesting rainwater at village and household level , plantation, proper crop planning, organic fertliser promotion etc will help us to walk towards the resilient livelihood.

After Dr. Bandyopadhyay's presentation Mr. Sujit Mitra, Coordinator of NRM activities, DRCSC presented the proposal. He explained the overall goal, specific objectivities and activities thoroughly. He also presented the models DRCSC has already tried out in other places and showed the pictures of those. He also explained through his presentation that the problems DDM has explained for all over India, the farmers of Purulia and Bankura are facing everyday. He explained how the Geo Informatic appraisal will help to plan for the land and water use. He explained that how the awareness sessions will be carried out and capacity building trainings and handholding will be

organized and how the crop advisory services in local language will help the farmers to have proper crop planning round the year.

After his presentation, Mr. Sagar Bandyopadhyay, Assistant Director of Agriculture (PP), Agriculture Department, appreciated the proposed plan and wish every success in the project. He suggested to access the maps from the MGNREG cell which will help in doing the Geo informatic appraisal for Bankura. He also showed his interest for the crop advisory services. He said that his department would also like to have the service and will also help in this regard in every possible way. At present the department is providing some service of early warning but that is based on the central system and not very area specific and not in terms of crop advisory. Mr. Bandyopdhyay also suggested to use traditional varieties of paddy seeds which have high potential in export. He also suggested to look into the marketing options and processing the produce for marketing.

He appreciated the integrated approach for developing the proposal. He emphasized on the need of micro planning. He said that winter crop is severely damaging due to the shifting of rainfall which was also pointed out by the committee. The pest and disease management in the context of climate change needs also be looked into. The Government of India also has the target to convert 2% of the total cultivable land into organic. He appreciated the effort which has been shown in this proposal in addition to that.

Sri S. Ghosh, Resurce Person, Bangiyo Grameen Bikash bank, requested to explain the methodology of the field extension, which was done again for all. He said that with support from GOI, some agriculture clinics have been opened in the villages. So he requested to supply the crop advisory services to those clinics also.

Sri H.N. Panda, LDM, Bankura said that there is need to discuss the issue of climate change regularly at local district authority level, among the line departments. Proper orientation and regular discussion will help all to ensure the resilience in the livelihood of rural poor people.

The SBI District Cooridnator for Bankura and Purulia, was overwhelmed with the discussion and requested to listen something from the beneficiaries as well. He wanted to their views about the whole issue. He said that they will extend all necessary help to the farmers for taking agricultural loan. He appreciated the concept and the approach of the project.

Sri Mrinal Kanti Mondal, the Deputy Project Director, Agriculture, DRDC said that the department already worked with DRCSC earlier. He appreciated the concept, and requested to converge with Government at every level. He requested NABARD to think about developing one or two more projects along with this to cater the additional issues of marketing, certification etc.

Sri Dipak Ghosh, Ex. District Officer of Khadi Village Industries, emphasized on conserving the nature and use it very cautiously. He said that conservation of traditional local varieties of trees has to be planted more and more. DRCSC should facilitate to increase the awareness and interest among the youth about nature and climate change issues. The diversification in the livelihood is very necessary and tress based livelihood opportunities has to be explored.

Among the beneficiaries, Sri Subodh Hansda explained about the effects he is facing at present due to climate change. He also said that he has been trying out to make organic fertilizer at household level and is in the process of replacing the chemical fertilizer, because he is unable to meet the cost of agriculture now as his crops are not ensured due to the erratic rainfall, shifting rainfall, erratic dryness etc.

The CEO, BDCCB appreciated the concept of participatory development of the project. He appreciated the holistic development and requested further to see the sustainability of the project a little more.
He also said that the issue of marketing has to be thought upon with additional project support.

The Up-Pradhan Sri Bankim Mishra of Chhatna block said that he liked that the project has the scope for awareness and capacity building of the farmers. He also appreciated the handholding approach that has been explained through project presentation. He also appreciated the methodology which has taken by DRCSC to convert the seasonal and permanent fallows into productive. He mentioned specifically that the villagers are getting most benefit out of the activity and there is need to expand it on larger area.
He also said that he believe, the activities proposed in the proposal if can be done at all the levels then it would really help the villagers.

Sri Saradindu Banerjee, the secretary of Gandhi Bichar Parishad, an NGO in Bankura, emphasized to be carefull on the use of the communicative language for crop advisory services. It would be good if the awareness can be given through farmers local language. Gandhi Vichar Parishad has expressed their willing to help in every possible manner as and when required.

The participants list is attached herewith.

The meeting was ended with the vote of thanks.

Participants List

Facilitated by: DRCSC

Supported by: NABARD

CONSULTATION ON CLIMATE RESILIENT FOOD & LIVELIHOOD SECURITY

VENUE: BDCCB BOARD ROOM, BANKURA

DATE: 18TH JUNE, 2014

Sl no	Name	Designation & Department	Contact No	Signature
1	SARADINDU BANERJEE	SECRETARY Gandhi Vichar Parisad	9830048725	[illegible]
2	Priyabrata Gangopadhyay	Dist. Co-ordinator SBI.	8001175435	[illegible]
3	Priyanka Ganguly	B. Tech. (CSE)	8100341332/ 8902362923	[illegible]
4	Sushanta Mandal	Up-Pradhan Jhunjka G. P.	9002014012	Sushanta Mandal
5	Dr. S. BANDYOPADHYAY	DDM NABARD	9434738598	[illegible]
6	Uttam Dhang	Secretary Bankura Bandhan.	9153222503	[illegible]
7	Shyamapada Karmakar	CEO Bankura (Bandhan)	8926908159	[illegible]
8	Chandana Kundu	Assit Secretary Bankura Bandhan NGO	9474047705	C. Kundu.
9	Kousik Biswas.	Project-in-Charge. Pally Unnayan Sanstha, Hirbandh Block.	9474100325	Kousik
10	Harinath Panda	DM Bankura	9609660801	[illegible]
11	Dipak Ghosh	Ex. Dist. officer N.B.K.V.I.B.	9434014914	[illegible] 18/6/
12	S. Ghosh	RP, PDC BDCC Bank	8016099146	[illegible] 18/06/14
13	Kumar Sambhav	Freelance Journalist	9911998304	[illegible]
14	Mrinal Kanti Mandal	Dy PD (Agri) DRDC.	9434422817	[illegible] 18.06.14.

DRCSC

Facilitated by:

Supported by: NABARD

CONSULTATION ON CLIMATE RESILIENT FOOD & LIVELIHOOD SECURITY

VENUE: BDCCB BOARD ROOM, BANKURA

DATE: 18TH JUNE, 2014

Sl no	Name	Designation & Department	Contact No	Signature
1	S. Bandyopadhyay	Asst. D. A (PP) Agri Banker	9434335761	18/6/14
2	Mousumi Mishra	Sevapati Chhatna	9434754858	
3			9434465906	
4	Manik Karak	Manager Mahabona S.K.U.S Ltd	9434392818	
5	Santanu Dasa	D.E.O., P.D.C.C.Ltd	9333595825	
6	SUBIT PAL	Manager (Loans) BDCC Bankura	8016090334	
7	S. THAKUR	CEO Bankura DCCB	8016090330	
8				
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14				

Facilitated by: DRCSC

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CONSULTATION ON CLIMATE RESILIENT FOOD & LIVELIHOOD SECURITY

VENUE: BDCCB BOARD ROOM, BANKURA

DATE: 18TH JUNE, 2014

Sl no	Name	Address	Contact No	Signature
1	Subhod Hansda	Beriathol		Subodh Hansda
2	Bijoy Hembram	Gopalpur		BIJOY HEMBRAM
3	Bimal Tudu	Gopal Pur.		Bimal Tudu.
4	Sibsankar Mondal	[illegible]		শিব শংকর মণ্ডল
5	Sasadhar Hembram	[illegible]		[illegible]
6	Susanta Tudu	Joy nagar		Su Santa tudu
7	Barun Kr Soren	[illegible]		[illegible]
8	Gurupada Mandi	[illegible]		[illegible]
9	Lakhiram Mandi	[illegible]		Lakhmiram Mandi
10	Ukil Kisku	[illegible]		Ukil Kisku
11	Maheswar Kisku	[illegible]		[illegible]
12	Durgadas Mandi	[illegible]		[illegible]
13	Jagat Kr Mondal			Jagat Kumar Mondal
14				

Facilitated by: DRCSC

Supported by: NABARD

CONSULTATION ON CLIMATE RESILIENT FOOD & LIVELIHOOD SECURITY

VENUE: BDCCB BOARD ROOM, BANKURA

DATE: 18TH JUNE, 2014

Sl no	Name	Address	Contact No	Signature
1	Dulal Hansda	Sirpura		Dulal Hansda
2	Srimanta Saren	Yognagar.		Srimanta Saren.
3	Panmati Saren	Beriathol		Panmati Saren
4	Mamata Besara	বেড়িয়াথোল		মমতা বেসরা
5	Padmabati Mandi	হিড় হিড়		পদ্মাবতী মান্ডি
6	Sumitra Murmu	জয়যোল		সুমিত্রা মুর্মু
7	Anjali Besara	[illegible]		অঞ্জলী বেসরা
8	Bahamoni Murmu	[illegible]		বাহামনি মুর্মু
9	Ajoy Mal	যোগীর গ্রাম		অজয় মাল
10	Laxmikanta Murmu	"		লক্ষীকান্ত মুর্মু
11	Sasil Hansda	[illegible]		সুশীল হাঁসদা
12	Kadam Mandi	[illegible]		কদম মান্ডি
13	Rakhe Hari Mandi	~~[illegible]~~ রামসাগর		রাখহরি মান্ডি
14	Jiban Musi	[illegible]		জীবন মুর্মু

Consultation on Climate Resilient, Food & Livelihood Security

Venue:- Community Hall, Kashipur Gram Panvhayet

Date: 20/05/2014

Organised By: DRCSC, Kolkata- 700042

Participant List

Sl. No	Name	Address	Contact No	Signature
		জোড়মোহল		দুলেশ্বরী কিস্কু
		বক্সীবাড়ি		নির্মল টুডু
		তিলাবনী		সুরধনী সরেন
		কেন্দুগড়িয়া		লক্ষী মান্ডি
		খোয়াসা		সত্যবতী সরেন
		[illegible]		জোবা হেম্ব্রম
		কেন্দুগড়িয়া		[illegible]
		কাঁকুরদিহি	8001078897	[illegible]
		জোড়মোহল (কাঁদাপাড়া) [illegible]		[illegible]
		~~সুকদেব মন্ডল~~ [illegible]		সুকদেব মন্ডল

We conducted 5 Consultation meetings, 2 in Purulia and 3 in Bankura to discuss about the activities to be undertaken in respect to climate change. In the Consultations, different stakeholders, the beneficiaries, the Government Officials, Bank coordinators, representatives of other NGOs working in the area were present.

The report below is the brief of the Consultation happened in BDCC- Board Room, Bankura on 18th June 2014.

The meeting was started with the welcome address by Mr. Sourav Ghosh, the representative of DRCSC. Ms. Somjita Chakraborty,the Secretary of DRCSC briefed the purpose of the meeting along with DRCSC's work in Purulia and Bankura. She invited all the participants to interact openly and express their views about the project so that their valuable suggestions can be incorporated in the final DPR.

Dr. S. Bandyopadhyay, DDM NABARD explained the issues of Climate Change, why the weather is changing how it is impacting the life and livelihood. He emphasized o awaring mass about the climate change has become the most important issue now. The crop planning and diversification in the livelihood is the option to bring the stability in the life of rural population. He explained through his presentation that how the cultivable land is shrinking day by day with the erratic rainfall, higher temperature and absence of proper infrastructure in the villages. He also showed with examples that the dependency on chemical fertilisers is ultimately increasing the global warming. When the nature is becoming damaged the food security is getting challenged.

He explained through his research and presentation that harvesting rainwater at village and household level , plantation, proper crop planning, organic fertliser promotion etc will help us to walk towards the resilient livelihood.

After Dr. Bandyopadhyay's presentation Mr. Sujit Mitra, Coordinator of NRM activities, DRCSC presented the proposal. He explained the overall goal, specific objectivities and activities thoroughly. He also presented the models DRCSC has already tried out in other places and showed the pictures of those. He also explained through his presentation that the problems DDM has explained for all over India, the farmers of Purulia and Bankura are facing everyday. He explained how the Geo Informatic appraisal will help to plan for the land and water use. He explained that how the awareness sessions will be carried out and capacity building trainings and handholding will be organized and how the crop advisory services in local language will help the farmers to have proper crop planning round the year.

After his presentation, Mr. Sagar Bandyopadhyay, Assistant Director of Agriculture (PP), Agriculture Department, appreciated the proposed plan and wish every success in the project. He suggested to access the maps from the MGNREG cell which will help in doing the Geo informatic appraisal for Bankura. He also showed his interest for the crop advisory services. He said that his department would also like to have the service and will also help in this regard in every possible way. At present the department is providing some service of early warning but that is based on the central system and not very area specific and not in terms of crop advisory. Mr. Bandyopdhyay also suggested to use traditional varieties of paddy seeds which have high potential in export. He also suggested to look into the marketing options and processing the produce for marketing.

He appreciated the integrated approach for developing the proposal. He emphasized on the need of micro planning. He said that winter crop is severely damaging due to the shifting of rainfall which was also pointed out by the committee. The pest and disease management in the context of climate change needs also be looked into. The Government of India also has the target to convert 2% of the total cultivable land into organic. He appreciated the effort which has been shown in this proposal in addition to that.

Sri S. Ghosh, Resurce Person, Bangiyo Grameen Bikash bank, requested to explain the methodology of the field extension, which was done again for all. He said that with support from GOI, some agriculture clinics have been opened in the villages. So he requested to supply the crop advisory services to those clinics also.

Sri H.N. Panda, LDM, Bankura said that there is need to discuss the issue of climate change regularly at local district authority level, among the line departments. Proper orientation and regular discussion will help all to ensure the resilience in the livelihood of rural poor people.

The SBI District Cooridnator for Bankura and Purulia, was overwhelmed with the discussion and requested to listen something from the beneficiaries as well. He wanted to their views about the whole issue. He said that they will extend all necessary help to the farmers for taking agricultural loan. He appreciated the concept and the approach of the project.

Sri Mrinal Kanti Mondal, the Deputy Project Director, Agriculture, DRDC said that the department already worked with DRCSC earlier. He appreciated the concept, and requested to converge with Government at every level. He requested NABARD to think about developing one or two more projects along with this to cater the additional issues of marketing, certification etc.

Sri Dipak Ghosh, Ex. District Officer of Khadi Village Industries, emphasized on conserving the nature and use it very cautiously. He said that conservation of traditional local varieties of trees has to be planted more and more. DRCSC should facilitate to increase the awareness and interest among the youth about nature and climate change issues. The diversification in the livelihood is very necessary and tress based livelihood opportunities has to be explored.

Among the beneficiaries, Sri Subodh Hansda explained about the effects he is facing at present due to climate change. He also said that he has been trying out to make organic fertilizer at household level and is in the process of replacing the chemical fertilizer, because he is unable to meet the cost of agriculture now as his crops are not ensured due to the erratic rainfall, shifting rainfall, erratic dryness etc.

The CEO, BDCCB appreciated the concept of participatory development of the project. He appreciated the holistic development and requested further to see the sustainability of the project a little more.
He also said that the issue of marketing has to be thought upon with additional project support.

The Up-Pradhan Sri Bankim Mishra of Chhatna block said that he liked that the project has the scope for awareness and capacity building of the farmers. He also appreciated the handholding approach that has been explained through project presentation. He also appreciated the methodology which has taken by DRCSC to convert the seasonal and permanent fallows into productive. He mentioned specifically that the villagers are getting most benefit out of the activity and there is need to expand it on larger area.
He also said that he believe, the activities proposed in the proposal if can be done at all the levels then it would really help the villagers.

Sri Saradindu Banerjee, the secretary of Gandhi Bichar Parishad, an NGO in Bankura, emphasized to be carefull on the use of the communicative language for crop advisory services. It would be good if the awareness can be given through farmers local language. Gandhi Vichar Parishad has expressed their willing to help in every possible manner as and when required.

The participants list is attached herewith.

The meeting was ended with the vote of thanks.

Annexure-VI - DETAILED BUDGET NOTES

Sl No	Sub Component / OUTPUT	Descriptions	Unit	Unit cost (USD)	Target units	Amount (USD)	Sub Component / Output wise Total (USD)	Component wise Total (USD)
Component 1: Land & Water use master plan (LUP & WUMP)								
1	5 Gram Panchayat -wise Land and Water use Master Plans are prepared	GIS Mapping	Per GIS appraisal	10000	5	50000	54165	**54,165**
		Gram Panchayat level WUMP and LUP	Each Planning	833	5	4165		
Component 2: Reducing climate risks through timely and appropriate weather specific crop/agro-advisory services in local language (Bengali)								
2.1	Automated Weather stations (AWS) at 6 locations (covering 10 sq.km each), 12 manual data collection centres (MDC) for collection of weather information	Installation of AWS and MDC	Numbers	1,020	18	18360	18360	**55,401**
2.2	The expert group comprising of weather expert and agri experts for analyzing the data collected through AWS and MDC and preparing the 5-days crop-weather advisories	Cost of data collection, entry, analysis, linking universities for crop advisories, awareness, follow up etc	Month	581	48	27888	27888	
2.3	A Climate Resource Centre located at the centre of the project area and 40 weather kiosks managed by climate volunteers for collection and dissemination of crop-weather advisories	Establishment CRC – Climate Resource Centre	Numbers	4353	1	4353	9153	
		Establishment of Climate kiosk Centre	Per Kiosk	120	40	4800		
Component 3. Climate resilient technology transfer for enhancing the adaptive capacity of the community								

3.1	Sustainable soil and water conservation measures (e.g. semi-circular bunds, check dams, gully plugs, infiltration ditches and agro forestry plantations) for various ecosystems introduced for improvement of agricultural productivity and environmental sustainability	Step pond	Numbers	13333	40	533320	745,390	**1,877,373**
		Earthwork & Soil & water conservation	Per hectare	200	300	60000		
		Plantation	Per hectare	501.6	250	125400		
		Check Dam	Numbers	6667.5	4	26670		
3.2	Multilevel crop arrangements & integrated farming practices are introduced which improve the total yield, reduce the need for external inputs & seeds as well as improve labour efficiency mainly through popularizing a combination of drought & heat tolerant fieldcrops, fast growing & multipurpose perennials and small livestock & fisheries	Capacity building on group building, natural resource managements and sustainable agriculture techniques	Number of trainings	105.32	253	26646	901813	
		Model integrated farming practices	Numbers	500	100	50000		
		Inputs seeds/ Organic material	Per hectare	175	1000	175000		
		Small bird & animals	Per household	67	2750	184250		
		Micro irrigation facilities (Ditch & Dugwell)	Numbers	285.44	800	228352		
		Lift Irrigation	Numbers	11013	5	55065		
		Production Organic manure (vermicompost pit)	Numbers	83	2000	166000		
		Aquaculture	Per household	33	500	16500		
3.3	Disaster-coping mechanisms e.g. community grain banks, local crop & trees seed banks, fodder banks developed in targeted villages	Community Grain bank	Numbers	500	40	20000	28330	
		Community Seed bank	Numbers	833	5	4165		
		Community Fodder bank	Numbers	833	5	4165		
3.4	Climate resilient appropriate technologies e.g.	Energy efficient ovens	Number	25	2400	60000	201840	

	energy efficient cook stoves, bio-gas, low cost water filters, community based drinking water facility are promoted.	Bio gas	Number	217	250	54250		
		Low cost water filter	Number	17	2500	42500		
		Community based drinking water facility	Number	9018	5	45090		
Component 4: Learning and Knowledge Management								
4.1	Production of technical and financial data analysis on processes to improve the resilience of the livelihood in red and lateritic zones of West Bengal	Technical and Financial paper	Number	666	5	3330	10000	**126,284**
		Policy Paper	Number	6,670	1	6670		
4.2	Improved access to learnings from the project activites to be ensured through short films, dedicated website and other printed materials	Awareness films	per film	833	5	4165	64084	
		Printing materials, Newsletter, Journals, brochure, pamphlet	Lumpsum			7919		
		Website design & regular updation	Month	250	48	12000		
		Farmers Convention	Number	7000	3	21000		
		Mass Awareness Events	Types of Events	475	40	19000		
4.3	Advocacy with National / State / Local Government and others (NGOs, CBOs, International organisations, climate activists/experts) on processes to identify strategies to adapt to climate change in red and lateritic zone	Advocacy films	Number	5,015	2	10030	52200	
		Network meeting with CBOs, Pos & local administration	Number	128	140	17920		
		Local level workshop	Number	1,750	8	14000		
		State level experience sharing workshop	Number	2,000	3	6000		
		National level seminar	Number	4,250	1	4250		
	Total Programme Cost							**2113223**
	Project / Programme Execution Cost (9.5%)							**201163**
	Vehicles	Motor cycles	Number	1250.00	4	5000	5000	

	Office Equipments	Furnitures, Computers and peripherial devices, Teaching & Learning Aids, Machinaries, Storage equipments, Volt etc				8500	8500	
	Operational Cost	Head office and 2 District Offices (rent, electricity, repair & maintenance, stationaries, refreshments, telephone, internet usage, postage, audit fees etc)	Monthly	500	48	24000	24000	
	Travel	Fuel of vehicles and local travel	Months	347.20	48	16666	16666	
	Monitoring and Evaluation	As per detailed plan in DPR				15550	15550	
	Salary and Honararium		Monthly	2738.48	48	131447	131447	
	Total Project / Programme Cost							**2314386**
	Project/Programme Cycle Management							196468
	Amount of Financing Requested							**2510854**

Village Name					
Sl. No.	District	Block	GP	Village	
1	Purulia	Kashipur	Sonathali panchayet :		
				1	Jaganath dih
				2	Jamkiri
				3	Balarampur
				4	Lara
				5	Jibanpur
		Kashipur	Agardi chitra panchyet :		
				6	Seja
				7	Chakadih
				8	Jalumdih
				9	Itamarah
				10	Beldih
				11	Kashidi
				12	Sura
				13	Bangara
		Kashipur	Rangamati Ranjandi :		
				14	Ranjandih
				15	Bodma
				16	Jorethol
				17	Tilabani
				18	Lajhna
2	Bankura	Chhatna	Ghoshergram :		
				19	Khorbona
				20	Dumdumi
				21	Ghosergram
				22	Hanspahari
				23	Shuara bakra
				24	Enari
				25	Bengaoria
			Jhunjhka :		
				26	Majhidih
				27	Hausibad
				28	Kalipur
				29	Shirpuria
				30	Saluni
				31	Jhunjka
				32	Pechashimul
				33	Ethani
				34	Jiurakelai
				35	Joynagar
				36	Dumurkundi
				37	Besara

				38	Kendua
				39	Gopalpur
				40	Bagjura
Total	**2**	**2**	**5**	**40**	

Total 5000 HHs will be covered in the above mentioned villages

Appendix 1

CR2: Please explain for each of the activities under Component 3, whether there is experience of using them in the target area and provide very brief examples highlighting experiences, acceptance by community members and possible problems. For any activities for which there is no local experience in the form that is proposed for the project, please explain why it is believed that the approach would work in the target area, referring to experiences, acceptance by community members and possible problems experienced elsewhere.

The experiences of implementing activities proposed under Component 3 by DRCSC are discussed below:

1 Soil Water Conservation

Initiatives have been taken to control soil erosion by undertaking measures like contour bunds, semi-circular bunds, trenches/pits etc., by DRCSC in one of the projects taken up in Birbhum and Purulia districts in the year 2008.

Impact

1. Hitherto unutilized natural resources (fallows) could be made useful for growing food-fodder-fuel.
2. Soil erosion could be minimized.
3. Many more person days could be created which, in turn, has reduced the trend of seasonal migration.
4. The underground aquifers could be recharged.
5. Soil fertility as well as biodiversity could be enhanced.

2 Rainwater harvesting through pond excavation through community initiative

DRCSC had implemented a project on construction of step pond in Saldiha Village of Purulia district. The pond measuring 180' X 160' X 10' was excavated at a total cost of INR.2,18,800. This project could generate 3,220 man-days for pond excavation and 831 man-days for mixed cropping on the steps, pond banks and field.

The pond bank was utilized for growing different vegetables, pulse crops like pigeon pea and seasonal, semi-perennial, perennial and multi-purpose trees. Fish was grown in the pond for additional income. Water stored in the pond was utilized for irrigating fallows on both sides. Around 7 acres of land adjacent to the pond are being irrigated and farmers even go for the second crop. In the dry season when the level of water in the pond receded, vegetables were grown on the steps of the pond. From the bank on all four sides, trellis were made hanging over the pond for supporting creepers yielding vegetables like pumpkin, bottle gourd, bitter gourd, etc. The benefits/impacts of step pond project are as under:

- Water availability for a minimum of 6 months a year, they are able to grow vegetables for at least 6 months in a year.
- Apart from irrigating the vegetables and fruit tree saplings on the pond bank, it has potentials to irrigate 10 acres of fallow land.

- In 2006, as many as 40 different types of vegetables were cultivated through mixed cropping.
- Hitherto unutilized natural resources (fallows) could be made useful for growing food-fodder-fuel.
- More person days could be created which in turn, could reduce the trend of seasonal migration. It has created man days for not only pond excavation but also for mixed cropping in the fallow land.
- Soil fertility could be enhanced.

The major problems in implementation related to high cost of excavation of pond due to the almost impenetrable rocks, difficulty in mobilizing the tribal people, etc.

3 Multipurpose village woodlots on common lands as a source of food-fodder-fuel

DRCSC had implemented a project on the banks of Mayurakshi Irrigation Canal in Kashiara village in Birbhum district. Under the model, where 20 or more households of landless labourers, artisans etc. live near a road or canal alongside which 5 to 10m wide stretch of barren land is available, discussions were arranged with all household members to assess their needs of firewood, fodder, construction material etc and to draw up a list of the shrub species preferred by them. If members agree to plant trees, shrubs etc and protect them, they are assisted to draw up a 15-20 years lease agreement and get it sanctioned by local village council. DRCSC assists the groups with seeds, training for raising seedlings and some costs of raising saplings & transplanting them. Usually 12-15 varieties of trees & 6-8 types of shrubs are planted along with some seasonal crops in early period to get some short term return. Members ensure protection of the plantation & share the NTFPs harvested. In the long term as 15-20 years old trees will be felled 25% of the sale proceeds will be given to the village council and the rest shared equally among members.

Impact

1. Even though the activities were started only 5-6 years ago, it has contributed positively. More than 50 such groups have come up, with about 1,100 members and altogether about 65 km stretch of land has been planted, with high survival rates.
2. In the initial 2 years each family gets 20-30 kg of pulses. Fodder grasses could be harvested @ about 500 kg / family / year initially and about 600 kg / family / year from year 3 onwards. Firewood yield / family / year have been 100-110 kg / family / year from year 3 and it is increasing gradually. As a result of this, women and children need to spend less time in searching for fodder & firewood.
3. Many groups have become skilled in raising tree seedlings and they are selling seedlings to augment their group fund.
4. The activity has resisted soil erosion to a large extent.
5. The trees have started to provide shelter to many types of birds, pollinating insects, and have reduced soil erosion & storm damage to nearby crop fields. The birds in turn have brought seeds of many trees, medicinal plants etc creating small biodiversity areas.

Three more Panchayats have already adopted this model of community managed multi-species / multipurpose woodlots.

4 Nutrition Garden activity by Women's Groups

Women and sometimes adolescent children are organized into small groups of 12-20. Garden Maps & Seasonal Calendars are prepared for each household to identify present production &

consumption pattern and identify factors that limit productivity, length of growing season etc. DRCSC provides seeds & bio-inputs & arranges trainings, exposure trips etc so that new crops & varieties, cropping patterns, bio-fertilizers & bio-pest repellents, crop-tree or crop-animal/bird combinations is tried out on a small scale by at least 2/3 group members and all the members are encouraged to try out 2-3 techniques / inputs / crops etc. Apart from vegetables / fruits etc group members grow culinary & medicinal herbs, ornamental plants, erosion control plants etc. Group members save seeds and share it with neighboring households also. Group members also discuss preparation of nutritious food, their preservation methods etc.

Impact

1. 160 women's group with 2050 gardeners planted leafy vegetables, vegetables, legumes, roots & tubers, spices & herbs in their gardens. Throughout the year 15-20 varieties of crops can be found in their gardens.]
2. Average garden sizes are 60 to 70m^2 / household and average yield / week varies between 12-14 kg / week during peak period & 7-8 kg during lean period.
3. The skills and knowledge of these groups have enhanced. Their capacity to make decisions and plans has improved. Many group members now actively participate in village development council meetings etc.
4. They are now able to store and exchange seeds of 25-30 vegetables, herbs etc among themselves, which in turn has reduced their dependence on the non replicable hybrid seeds sold in the markets.

5 Mixed cropping with minor millets in permanent fallows

The poor families are organized into groups and motivated to make the unfertile fallows cultivable by adopting soil and water conservation measures like making circular bunds and trenches; growing cover crops, minor millets, oil seeds, pulses and some leafy vegetables; planting drought-tolerant multi-purpose plants and trees; excavating ponds for rainwater harvesting and many more.

Impact

1. Food supply and variety even during severe droughts have increased which has resulted in amelioration of the food and nutrition status of the families.
2. Migration has reduced.
3. Unfertile fallow land could be made cultivable for more than 6 -- 7 months

6 Grain Bank

DRCSC has initially started this experiment in Lahadda village in Birbhum district). This initiative promoted especially among the vulnerable and landless families is not confined to Birbhum district but has also spread its wings to the neighboring districts like East and West Medinipur, Purulia, and 24 Parganas (South) in West Bengal. In the last ten years, DRCSC has catalyzed and supported 225 Grain Banks with 2400 households as members in different districts of West Bengal. Most of the banks have enough grain reserves to last for 60 days. Selection of the members for the grain bank is done after a detailed PRA exercise and food security analysis of each of the household in the village. The economically poorest families in the village are preferred and given the first priority for enrolment as members of the grain bank. During the harvesting season, the group members save a portion of their harvest (usually 50 kg) in the community grain bank. DRCSC gives an equal amount as a matching grant. At the time of scarcity or any disaster, paddy can be borrowed from the bank at a low rate of interest decided by the group. The amount of loan with a small amount of interest is

returned to the bank after the next harvest. The interest goes to increase their stock. It is most interesting to note that more than 80% of the grain banks already established are run by the women's groups.

The above interventions were mainly done with the project support from Christian Aid, KKS & BMZ, DST, in the areas Birbhum, Purulia, Paschim Medinipur, Murshidabad, Malda, South and North 24 Parganas, East Medinipur etc. However, DRCSC does not have first hand experience of implementing climate resilient energy efficient technologies. From the experience of working with the community in the project areas of Bankura and Purulia districts, we do not envisage any problem in acceptance of these interventions also.