REQUEST FOR PROJECT/PROGRAMME FUNDING FROM 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
Email: secretariat@adaptation-fund.org

DATE OF RECEIPT:
ADAPTATION FUND PROJECT/PROGRAMME ID:
(For Adaptation Fund Board Secretariat Use Only)

PROJECT/PROGRAMME PROPOSAL

PART I: PROJECT/PROGRAMME INFORMATION

PROJECT/PROGRAMME CATEGORY:	REGULAR
COUNTRY/IES:	INDIA
SECTOR/S:	AGRICULTURE
TITLE OF PROJECT/PROGRAMME:	CONCEPT NOTE ON CLIMATE PROOFING OF WATERSHED DEVELOPMENT PROJECTS IN THE STATES OF TAMIL NADU AND RAJASTHAN
TYPE OF IMPLEMENTING ENTITY:	NATIONAL IMPLEMENTING ENTITY
IMPLEMENTING ENTITY:	NABARD
EXECUTING ENTITY/IES:	NGOS AS PIES
AMOUNT OF FINANCING REQUESTED:	US $ 1.097 MILLION (IN U.S DOLLARS EQUIVALENT) excluding NIE cost

Project / Programme Background and Context:

Provide brief information on the problem the proposed project/programme is aiming to solve. Outline relevant climate change scenarios according to best available scientific information. Outline the economic social, development and environmental context in which the project/programme would operate.

1.1 Problem Context:

1.1.1 Introduction:

Rainfed areas, in particular, having complex cropping systems operating under fragile ecological conditions, constitute about 60 % of net cultivated area (140 mha) of India. Poverty levels and high population density are other important factors that increase the vulnerability of Indian agricultural system to climate change. . For this proposal, two Indian states Tamil Nadu in South-west and Rajasthan in North-west where the state level climate change action plans under the National Action Plan of Climate Change [1]have been prepared and adaptation to climate change in agriculture has been accorded as priority.

Multiple stresses on natural resources such as soil erosion, degradation of irrigated lands (clearly visible in Tamil Nadu), degradation of pastures, water pollution (Rajasthan suffers from this problem) and overexploitation of forest stocks contribute to low resilience in the Indian farming systems. Since most of the agricultural production takes place in rural heartlands by engaging people from the marginalized sections of the society, the coping capacity of the farmers during climatic extremities are limited in these areas

Tamil Nadu, a southern state of India, has 6 per cent of the national population, but has only 4 per cent of land area and 3 per cent of water resources of the country. Tamil Nadu is one of the water starved States, where the per capita availability of water resources is 900 cubic meters per year as compared to all India average of 2,200 cubic meters. The annual average rainfall for the state is around 921.50 mm (48% during north-east monsoon, 35% during south-west monsoon, 14% during summer and 3% during winter). The Gross Cropped Area which was 6.226 million Ha (including area under Horticulture crops) during 2001-02 has come down to 5.753 million hectors during 2010-11. Of this, 3.348 million hectares (58%) are under irrigated condition and 2.405 million Hectors (42%) are rain-fed. The net cultivable area which was 5.172 million hectors during 2001-02 has come down to 4.954 million ha during 2010-11. As against the net cropped area of 4.954 million hectares, 2.912 million hectares (59 per cent) is irrigated through different sources. In the absence of perennial rivers, rainfall is the only source of water in the state and that too inconsistent due to vagaries of monsoon. There is an urgent need for replenishing the ground water aquifer with each and every drop of rain water to ward-off impending severe water scarcity and for sustainable development. Rain water harvesting and run off management structures such as check dams, percolation ponds, farm ponds, Water Absorption Trenches (WATs), recharge shafts etc. are

[1] *India's National Action Plan on Climate Change serves as the basis of adaptation and mitigation framework for the country. There are 8 Missions which are expected to guide the Indian response to climate change adaptation and mitigation in near future.* ***(http://pmindia.gov.in/climate_change_english.pdf)***

required to be constructed in order to improve the moisture regime of the watershed for increased land use).

In **Rajasthan**, wastelands cover almost 30 per cent of the total geographical area, with pasture lands as the major land use. As a result, the extent of net area cultivated is about 44 per cent of the total area of the state, which is slightly lower than the national average of 45 per cent. The water scarcity and fluctuations in rainfall across agro-climatic regions are the major constraints for further expansion of area under cultivation. It also points to the necessity of switching from a water-intensive to a less water-consuming cropping pattern. This is important in determining household income and thus access to food. Rajasthan is below the all-India average in agricultural productivity.
Erratic and low rainfall with varying intensity and uneven distribution of heavy intensity rainfall in short spell characterizes this area. In addition, the steep slopes with sandy soils make livelihoods of small and marginal farmers from natural resources a very challenging task. A major portion of rainfall goes off as runoff, which also takes the top layer of soil away from the fields. The water tables in general are very deep and are declining further on account of overdraft. Combination of all these factors makes agriculture a very difficult proposition in the region. Hence, the central focus of this project is on works related to water and soil conservation and watershed development

1.1.2 Agriculture Development and Poverty Context

The number of poor people in India, according to the country's Eleventh National Development Plan, amounts to more than 300 million. With almost one third of the country's population of more than 1.1 billion continues to live below the poverty line, and a large proportion of poor people live in rural areas, poverty remains a chronic condition for almost 30 per cent of India's rural population. The incidence of rural poverty has declined somewhat over the past three decades as a result of rural to urban migration. On the map of poverty in India, the poorest areas are in parts of Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar, Jharkhand, Orissa, Chhattisgarh and West Bengal. Large numbers of India's poorest people live in the country's semi-arid tropical region. Many districts of Tamil Nadu fall in this category. In this area water shortage and recurrent droughts impede the transformation of agriculture that the green revolution has achieved elsewhere.

Economy of Tamil Nadu

Economy of the state is agrarian. The rural poverty situation in the state could be attributed largely to agricultural development, and to changes in the rural population, rural development and poverty alleviation measures in rural areas. Needless to state that availability and access to food stands as a major common factor determining the incidence of poverty. About 7.83 million people in rural Tamil Nadu live below the poverty line (below 12 USD/month per capita).

Table 1: Changes in Area under Food and Non-Food Crops in Tamil Nadu

Year	Area in 000 hectors			Growth Rate in Percent		
	FG Crops	NFG Crops	GC Area	FG Crops	NFG Crops	GC Area
1960-61	5651	1752	7403	-	-	-
1970-71	5196	2188	7384	-0.81	2.49	-0.03
1980-81	4109	2360	6470	-2.09	0.79	-1.24
1990-91	3901	2731	6632	-0.51	1.57	0.25

2000-01	3633	2884	6517	-0.69	0.56	-0.17
2008-09	3191	2633	5824	-1.22	-0.87	-1.06
Note: FG-Food Grains, NFG-Non-Food Grains, GC-Gross Cropped **Source:** Computed from season and crop reports, Tamil Nadu (Various Years)						

The figure above shows the steady decline in food grains affecting the food security. The decline in agriculture is largely linked to high climate variability and water scarcity in the region. Therefore the state government has been attempting several measures to see how the water can be conserved and agriculture be made resilient promoting the watersheds.

Economy of Rajasthan

The long-term trend rate of growth during 1980-2006 is estimated at little below 6 per cent. The trend growth rate during decades ending 1991 and 2001 is estimated at 6.5 per cent and 6.1 per cent respectively. It has marginally slowed down to 5.1 per cent during 2000-06.While for the entire period 1980-06, the primary sector shows a trend growth of 3.9per cent; for the period 1980-97 the sector grew at 4.9 per cent and for the period 1996-2006, the growth was reduced to an insignificant 1.8 per cent. Agriculture sector growth was a dismal 1.1per cent during this period. The secondary and tertiary sectors together grew at 7.2 per cent annually during 1980-2006; at 7.25 per cent during 1980-98 and 5.4 per cent during 1997-2006.The slowdown in the non-agricultural sectors in the latter period could be partly attributed to demand constraint due to a slowdown in agriculture. Therefore the vulnerability of the state is much more due to climate change and resultant loss in food security and livelihood.

Major Adaptation Challenges:

Detailed climate analysis were carried out in proposed regions of Tamil Nadu and Rajasthan based on the climatic data for the past 30 to 40 years. Further future climate change scenario was developed under standard projection models. On the basis of this analysis major adaptation challenges in the project locations have been identified and are summarized below:.

Tamil Nadu:

- Gradual increasing trend for maximum and minimum temperature and resultant increase in evapotranspiration (ET) as well as potential evapotranspiration (PET). The increase in the maximum and minimum temperatures is expected to be 3.6 and 4.06 Deg. Cen, respectively towards the end of century.
- Decrease in the rainfall from the current level during the near future (up to 2030)
- Reduction in the yield of maize and ground-nut which are the major crops in the region mainly due to increase in both maximum and minimum temperature as well as variation in rainfall in addition to shortening of growing period. The yields are expected to go down by 60 % by the end of the century if no proper adaptation measures are taken up.

Rajasthan:

- Gradual increasing trend for maximum and minimum temperature with the projected increase of 4^0 C and 4.8^0 C, respectively towards the end of century.

- Increase in temperature would reduce the crop duration and result in reduced crop yield.
- Delayed onset of monsoon in most of the years.
- Statistically significant increasing trend for monsoon rainfall.

A detailed account of analysis on current climate and future climate projections are given in the subsequent paragraphs.

1.2 Analysis of current climate/Baseline Analysis

For the purpose of climate analysis and to devise a scale up strategy the data on climate variables like daily rainfall maximum and minimum temperatures of the pilot project areas (Appiyampatty and Poosaripatti watersheds of TamilNadu and Rawarpura and Anjeni watersheds of Rajasthan was taken, The proposed 20 watersheds falls in the adjoining regions of the existing pilots and they exhibit similar climate variabilities. Upon approval of the concept note detailed climate analysis of the project area will be taken up.

1.2.1 Rainfall

Tamil Nadu

The study region receives an annual average rainfall of 692 mm. Annual rainfall recorded from 1969 – 2005 is presented in the figure 2 that shows high inter annual variability over a period of 37 years. The annual rainfall ranged from 68.7 mm to 1358.9 mm with a standard deviation of 252.5 mm and Coefficient of Variation (CV) of 36.4 %. This indicates that receiving annual average rainfall of 692 mm is highly uncertain and in most of the years, annual rainfall oscillated between 440 to 994 mm . In the recent past, most of the years had lesser than average rainfall.

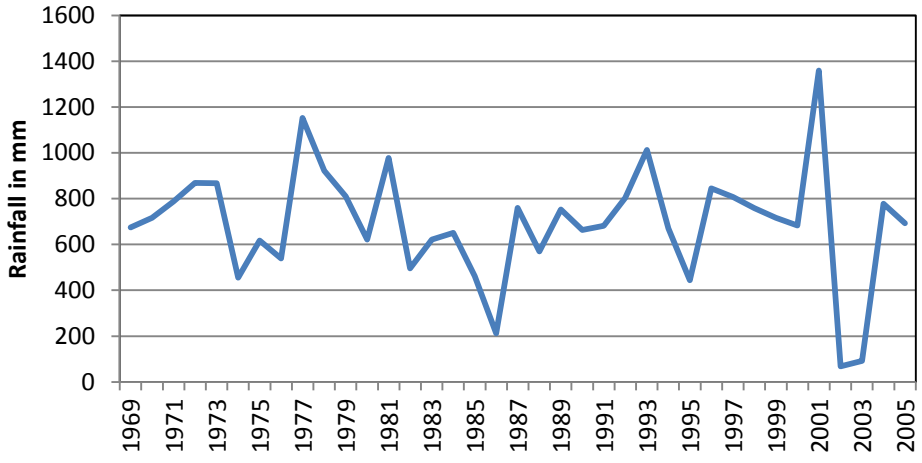


Figure 1: Annual Rainfall (1969 - 2005)

Annual Rainfall deviation from the long period average (LPA) of 692 mm is presented in the figure 2. Based on the India Meteorological Department (IMD) classification, if the rainfall received in that particular year is within ± 19% of the LPA, that year is called as a normal rainfall year, <-19% to -59% of the LPA is deficit rainfall year, <-59% of LPA is grouped

under scanty rainfall year. On the other hand, if the rainfall is >+19% to +59% of LPA, it is excess rain fall year and >+59% LPA is termed as wet year.

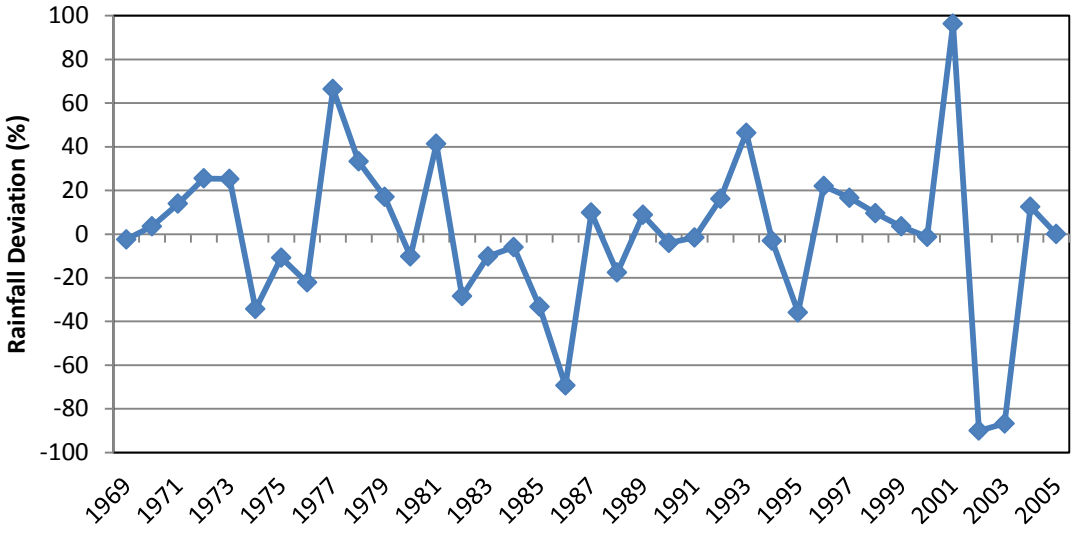


Figure 2: Annual Rainfall deviation from Normal

Out of 37 years of rainfall considered for the analysis, 20 years had normal rainfall, 8 years had excess rainfall and 9 years had deficit rainfall (Figure 3). Consecutive drought years are also quite common which would impact not only agriculture but also the water availability in the region (both agriculture and non-agriculture including domestic purposes).Almost once in every 5 years, there was a severe consecutive drought for a period of 2-3 years. Worst drought hit in the area during1973-75, 1985–86, 1995 and then again during 2002-2004.

The entire year has been divided into following 4 major seasons (Attri and Ajit Thyagi, 2010):

i. Cold Weather Period(CWP) /Winter: January – February
ii. Hot Weather Period (HWP) / Summer: March – May
iii. South West Monsoon (SWM): June – September
iv. North East Monsoon (NEM): October – December

Distribution of mean rainfall during different months of a year is presented in Figure 3.

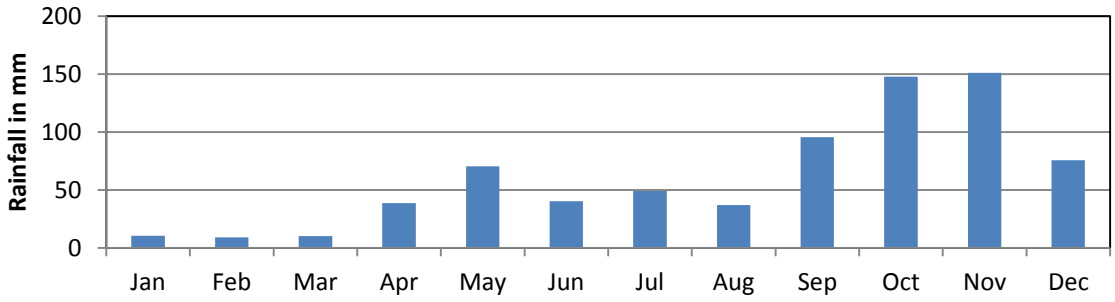


Figure 3: Normal monthly rainfall distribution

The region receives uni-modal rainfall with its major peak during NEM. There is also considerable amount of rainfall during pre-monsoon (summer) and SWM seasons (Historical monthly rainfall data is given in Annexure 2). Major rain-fed crop season falls between Septembers to December. Peak rainfall is received in the month of November followed by October.

The amount of rainfall received in the study region during the four seasons over a period of 37 years from 1969 – 2005 is presented in Figure 4.

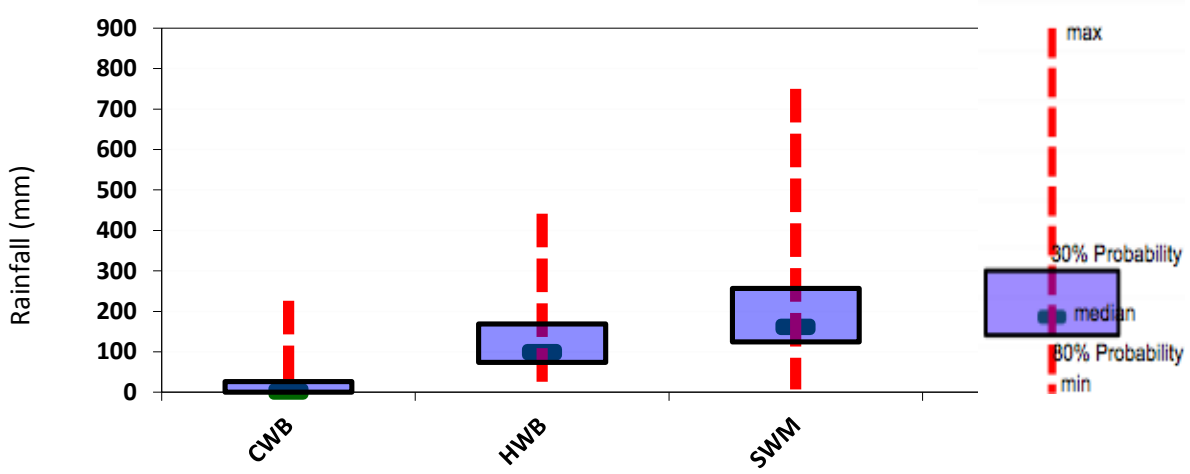


Figure 4: Rainfall distribution in different seasons (1969-2005)

Among the four different seasons, maximum amount of rainfall with high dependability is received in NEM season. NEM and SWM seasons have a mean rainfall of 374 and 222 mm respectively. From the above graph, it is clear that even with high probability (80%), the quantum of rainfall expected in NEM season is close to 300 mm which indicates that rain-fed cropping with less climatic risk is possible only during NEM in the selected watershed.

Rainfall received during the SWM and NEM are presented as a bar chart. To takeout the year to year variability and to study the trend, a five year moving average line was drawn (figure 5).

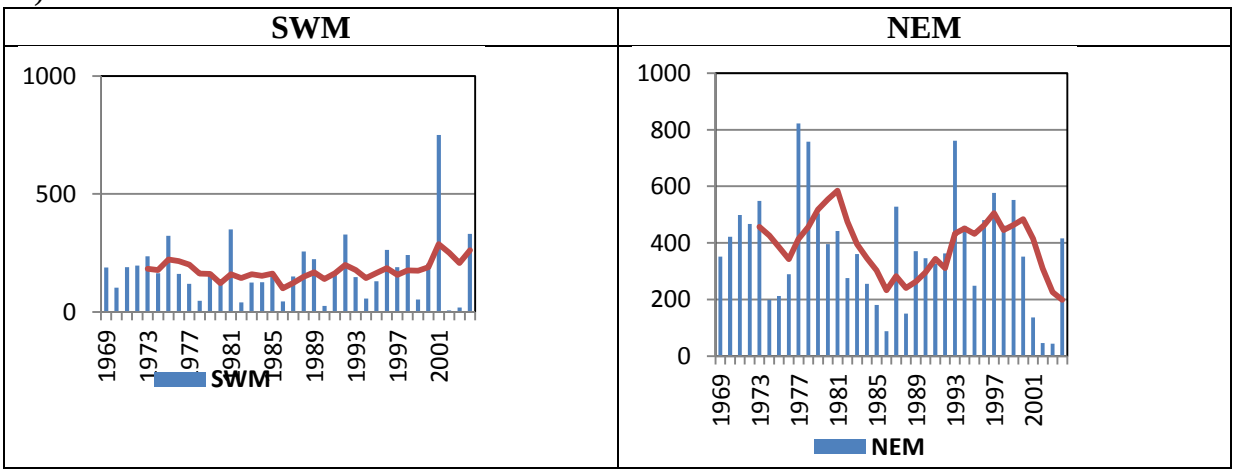
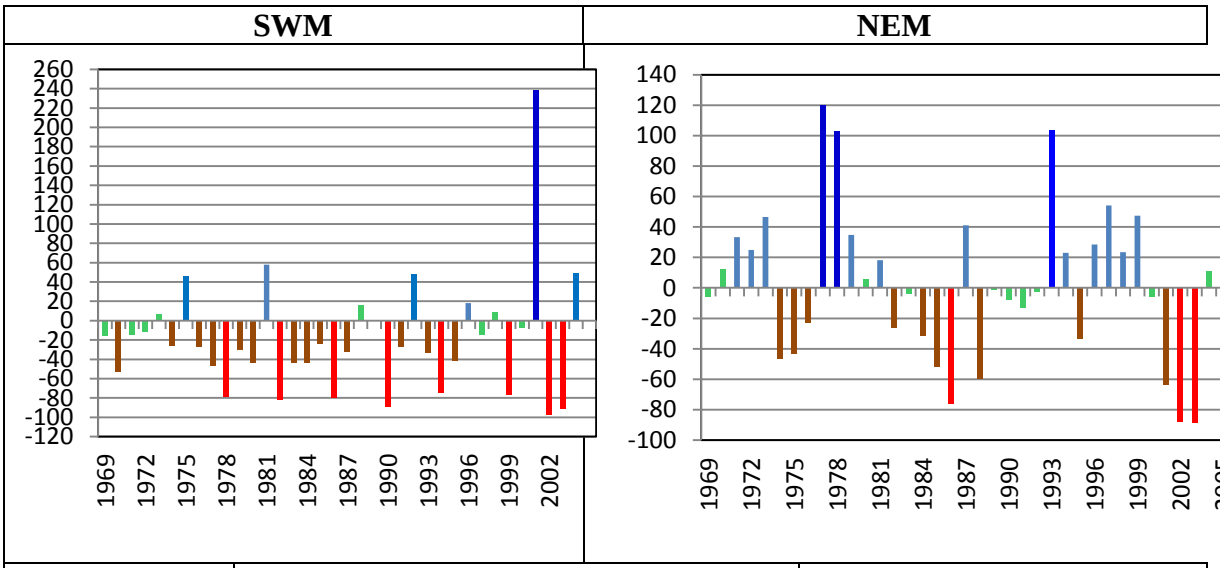


Figure 5: Five years moving average of Rainfall in SWM&NEM (1969-2004)

Moving average of SWM clearly indicates that the quantum of rainfall received during the SWM is slightly increasing over time. In the case of NEM, clear periods of increasing and decreasing trends are noticed. In other words, more than average rainfall is received for consecutive three to four years during the Northeast monsoon, followed by lesser than average rainfall for three to four years.Rainfall deviation from the normal during SWM and NEM is presented in Figure-6.



	SWM	NEM
Normal	1969,1971, 1972, 1988, 1989, 1997, 1998, 2000	1969,1980,1983, 1989,1990,1991,1992,2000,2004
Wet	1975,1981, 1992,1996,2004	1971, 1972, 1973, 1979,1981, 1987, 1994, 1996,1997, 1998,1999
Excess	2001	1977,1978, 1993
Deficient	1974, 1976, 1977, 1979, 1980, 1983, 1984, 1985, 1987, 1991, 1993, 1995	1974, 1975, 1976, 1982, 1984, 1985,1988
Scanty	1978,1982,1986,1990,1994,1999,2002, 03	1986, 2002, 2003

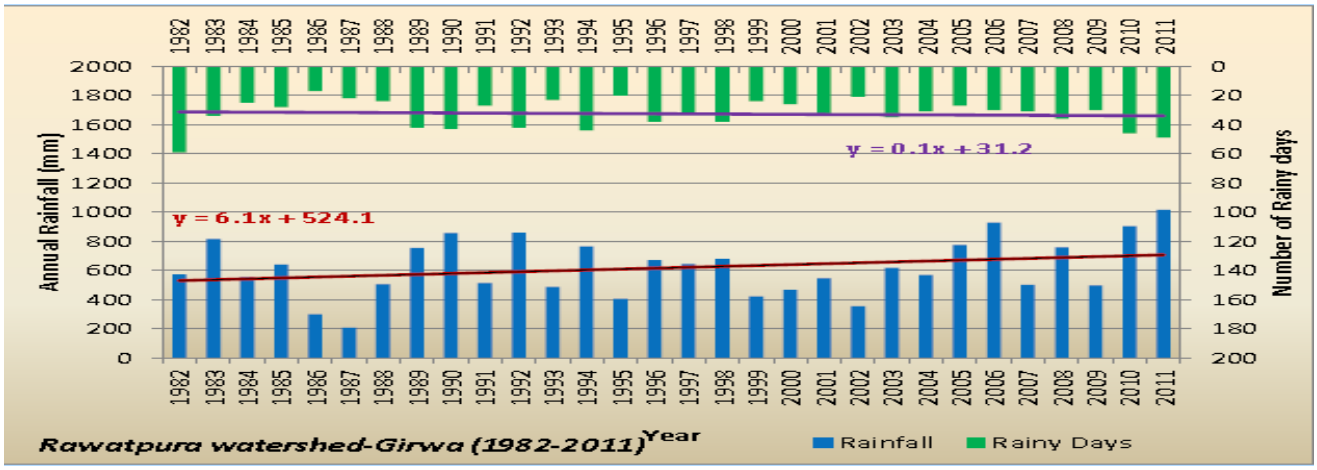
Figure 6: Rainfall Deviation (% from the Normal) in SWM&NEM (1969 – 2005)

Among the 37 years, 14 years received either normal / above normal / excess rainfall during the southwest monsoon. 12years recorded deficit rainfall and 8 years had scanty rainfall. In the absolute terms, only during 9 years, the SWM received more than average rainfall. This indicates that cropping during SWM is highly risky and hence the amount of rainfall received may be properly stored in the soil for utilizing it in the NEM season crop. In contrast, during NEM, among the 37 years, 9 years had normal rainfall and 14 years had excess rainfall and10 years received either deficit (7 years) or scanty rainfall (3 years).From 1981 -1990, the study region experienced heavy drought. In the near future time to mid-century, the frequency of occurrence of deficit and scanty rainfall is expected to increase, and hence, water conservation measures and protective irrigation are essential to ensure good yields during NEM.

Rajasthan

The rainfall pattern for two watersheds have been given in the figure below

Figure 7 Rainfall pattern (observed annual rainfall and rainy days) Girwa Watershed (1982-11)



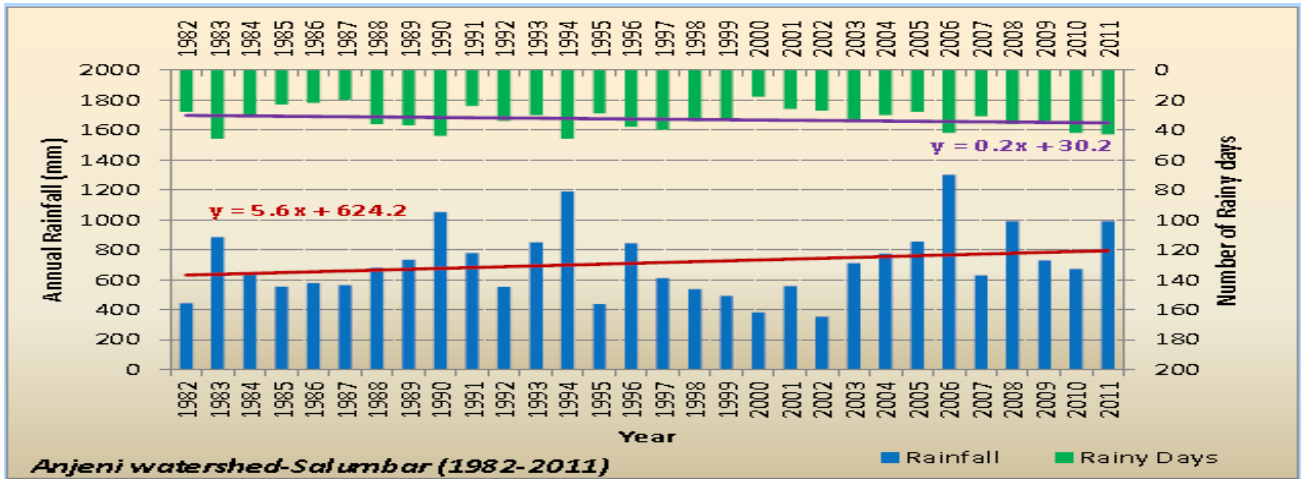
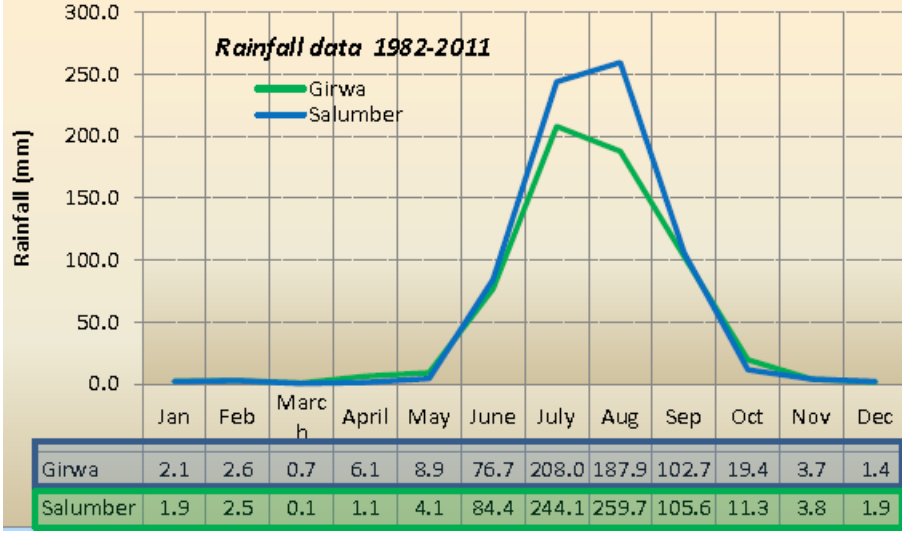


Figure 8 Rainfall pattern (observed annual rainfall and rainy days) Salumbar Watershed (1982-11)

Monthly and seasonal variations of rainfall have been presented for both the watersheds in the below:

Season	Statistics	Salumbar (1983-2011)		Girwa (1983-2011)	
		Value	Contribution to Annual Rainfall (%)	Value	Contribution to Annual Rainfall (%)
Annual	Average (mm)	711		620	
	Range - Average (mm)	352-1299		206-1015	
Winter (JF)	Average (mm)	4	0.6	5	1
	Range - Average (mm)	0-40		0-40	
Pre Monsoon (MAM)	Average (mm)	5	0.7	16	3
	Range - Average (mm)	0-49		0-56	
Monsoon (JJAS)	Average (mm)	694	97	575	93
	Range - Average (mm)	333-1297		165-992	
Post Monsoon (OND)	Average (mm)	17	2.4	25	4
	Range - Average (mm)	0-78		0-162	
Annual	Inter-annual variation (%)	32		32	
Winter (JF)	Inter-annual variation (%)	218		196	
Pre Monsoon (MAM)	Inter-annual variation (%)	207		112	
Monsoon (JJAS)	Inter-annual variation (%)	33		34	
Post Monsoon (OND)	Inter-annual variation (%)	132		160	

Figure 9 Rain fall analysis for Girwa and Salumbar Watersheds



	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Girwa	2.1	2.6	0.7	6.1	8.9	76.7	208.0	187.9	102.7	19.4	3.7	1.4
Salumber	1.9	2.5	0.1	1.1	4.1	84.4	244.1	259.7	105.6	11.3	3.8	1.9

Figure 10 Characteristics of observed mean monthly for Girwa and Salumbar

From the table and Figure above it can be seen that the mean south-west monsoon (June, July, August and September) rainfall contributes the maximum to annual rainfall amounting to 93% and 97% respectively for Girwa and Salumbar stations (reference weather stations)for the period 1983-2011. Contribution of post-monsoon (October, November and December) rainfall in annual rainfall is 4% and 2.4% respectively for Girwa and Salumbar stations. Pre-monsoon (March, April and May) rainfall and winter rainfall (January, February) contribution for these stations is insignificant. Thus the coefficient of variation (inter annual variation in rainfall) percentage is very high during winter, pre-monsoon and post monsoon seasons due to higher variability in rainfall during these months while CV is least during June, July, August and September as rainfall variability is least during these months, as is also evident from the Range-CV given across the seasons.

Monsoon rainfall analysis is done for the two stations as more than 90% of the rainfall occurs in the monsoon season. The rainfall is classified as excess, normal deficient or scanty based on the departure of the rainfall from the long period average rainfall (LPA). Based on the India Meteorological Department (IMD) classification, if the rainfall received in that particular year is within + or -19% of the LPA, that year is called as a normal rainfall year, <-19% to -59% of the LPA is deficient rainfall year, <-59% of LPA is grouped under scanty rainfall year. On the other hand, if the rainfall is >+19% to +59% of LPA, it is excess rain fall year and >+59% LPA is termed as wet year. The rainfall for the two stations has been classified and Figure below shows the frequency of excess, normal, deficient and scanty rainfall years.

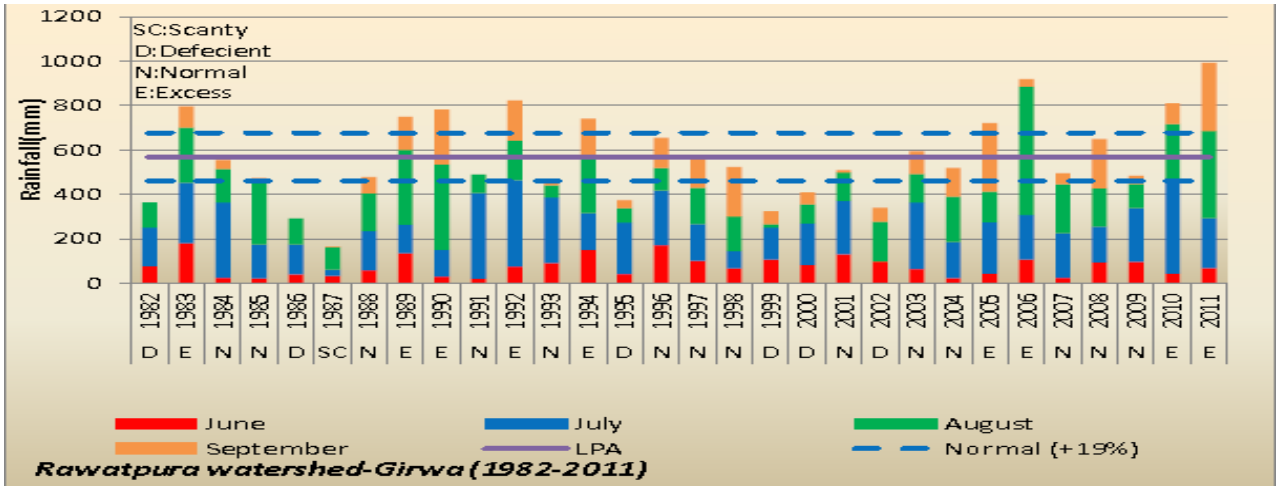


Figure 11 Seasonal analysis of rainfall: Girwa watershed

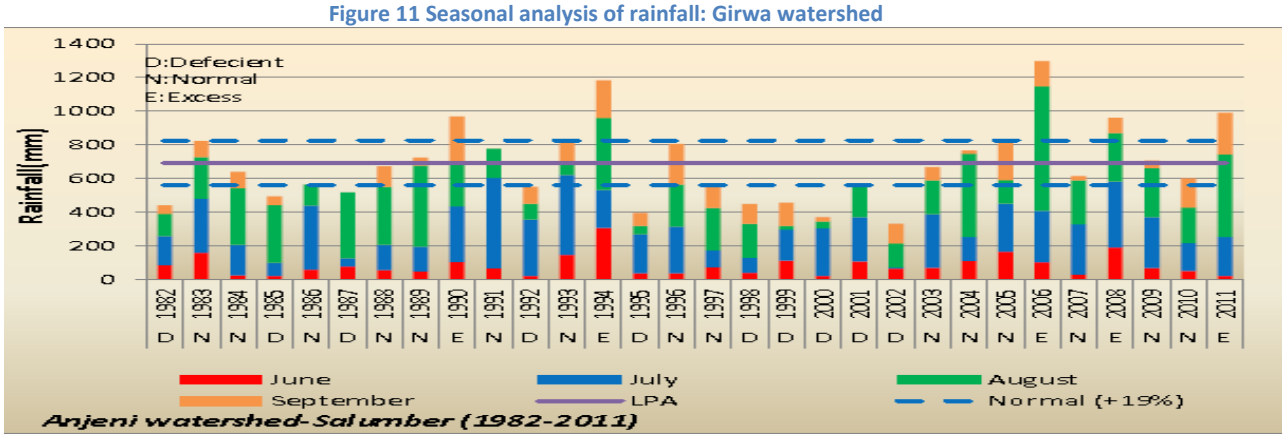


Figure 12 Seasonal analysis of Salumber watershed

1.2.2 Extreme Weather Events and Impact

Drought is a period of dry weather that originates from deficiency of precipitation over an extended period of time. This deficiency results in water or soil moisture shortage for crop production. Drought is a normal, recurrent feature of climate, is usually considered relative to some long-term average condition of shortage of precipitation compared to evapo-transpiration. The effects of drought became apparent with a longer duration, because more and more moisture–related activities are affected. Non irrigated crop lands are most susceptible to moisture shortages. Rangeland and irrigated agricultural lands do not feel the effect of drought as quickly as the non -irrigated, cultivated acreage, but their yields can also be greatly reduced due to drought. Reductions in yield due to moisture shortages are often aggravated by wind induced soil erosion.

Tamil Nadu

In the study area, cropping season in the drylands that depends on rainfall for its crop production starts in the month of September. Normally, onset of growing period starts with receipt of 20 mm or more rainfall in 2 – 3 days time. Length of growing period (LGP) is defined as the period during which the availability of moisture in the root zone of a crop is adequate to meet the water needs. Because the amount and distribution of rainfall varies considerably from year to year, so does the effective growing period. The LGP also depends on the type of soil interacting with the given quantity on rainfall. In areas receiving rainfall for two months, the LGP may be 70 days in the coarse textured soil (60 days rainy period +

10 days growth period supported from stored soil moisture) or 90 days in soils of clay or heavy textures soils. Similarly in areas with 5 rainy months, the growing season vary from 180 to 210 days depending upon soil texture and moisture holding capacity. Short period of water stress during LGP is known as dry spell. Depending upon the stage of occurrence and length of dry spell, the impact on growth and yield of the crop vary.

Major drought that occurred in the study region along with rainfall deviation, LGP and its impact on maize yield are presented in Fig. 8.

Table 2: Impact of Drought on Length of Growing Period (LGP) and Maize Yield

Year	Rainfall deviation in LGP	LGP (days)	Dry Spell in weeks	Maize yield kg / ha
2003	- 90.4	67	7	0
2002	- 89.6	82	7	0
1986	- 73.8	59	5	0
2001	- 63.9	79	5	35
1995	- 46.4	59	3	0
1988	- 44.0	96	6	212
1982	-33.0	91	4	567
1985	-28.2	75	5	55
1990	-22.2	48	2	0
1984	-21.5	83	4	64
1983	-18.1	72	7	48

Rajasthan

Extreme rainfall analysis

In Rawatpura watershed-during the period of 1982-2011rainfall events with $2.5 < R \leq 64.4$ mm was maximum in the period 1990-1999. The amount of rainfall received during this period was also higher. In the recent decades (2000-2009), number of events of rainfall with $64.4 < R \leq 124.4$ mm/day was maximum. In 30 years, there were 27 events in this category with most of them occurring in the monsoon months.

Over 30 years, there were 4 events with more than 124.4 mm of rainfall in one day. All 4 occurred during monsoon season (JUNE-JULY-AUGUST-SEPTEMBER months). The 4 events occurred in years 1983, 1992, 2006 and 2011. Maximum rainfall of 170 mm/d was recorded on 30 June, 1983.

In Anjeni watershed- during the period of982-2011rainfall events with $2.5 < R \leq 64.4$ mm was maximum in the period 1990-1999. The quantum of rainfall received was also higher during this period. In the recent decades (2000-2009), number of events of rainfall with $64.4 < R \leq 124.4$ mm/day was maximum. In 30 years, there were 51 events in this category with all of them occurring in the monsoon months.

Over 30 years, there were 13 events with more than 124.4 mm of rainfall in one day. All 13 occurred during monsoon season (JUNE-JULY-AUGUST-SEPTEMBER months). The 13 events occurred in years 1988, 1991, 1993, 1994, 2005, 2006, 2008 and 2011 with the maximum occurring in 1994. Maximum rainfall of 180 mm/d was recorded on 27 July, 2008.

Frequency of occurrence of rainfall with more than 124.4 mm/day and 64.4-124.4 mm/day is increasing in the decade 2000-2009 compared to the past decades which might have

implications on soil erosion. Depending upon the stage of the crop in which the excess rainfall event has occurred, crop yield may have been affected. Figure 19 gives the frequency of rainfall events for the two stations.

1.2.3 Setting in of seasons

Onset of seasons has impact on moisture regime, cultivation, crop productivity and food security.

Tamil Nadu

For this analysis, 31 years of data from 1977 to 2007 was considered. The date of receipt of sowing rain was considered as start of growing season. Normally, onset of growing period starts with receipt of 20 mm or more rainfall in 2 – 3 days time. There were 13 years during which the onset of growing period started in September 1stfortnight (2006, 2005,2004,1997,1996,1989,1988,1985,1981,1979, 2000, 1991, 1978), 13 years with September 2nd fortnight (2002, 2001, 1994, 1992, 1987, 1986, 1984, 1982, 1980, 1977, 2003, 1998, 1993) and 4 years with October 1stfortnight (1999, 1995, 2007, 1990).For each category of onset of growing period, length of growing period (LGP), number of wet sell weeks and dry spell weeks were worked out). Length of growing period was computed by assessing period between the rainfall onset of growing period and withdrawal of rainy season plus the days supported by soil moisture. Number of days for which available soil moisture would support for crop and growth at the end of the growing period depends upon the type of the soil, its moisture holding capacity, quantum of rainfall received during the end of the rainy season and the evapo-transpiration demand of the crop (Fig. 4).

From the table, it is clear that early onset (September 1st fortnight) is advantageous as it has mean LGP of 100 days (14.3 weeks). Within the LGP, only 3.54 weeks had dry spells and the rest of the weeks had either normal or above normal rainfall. Early onset proves to have less risk for crop production. Normal onset of growing season for the study region is September 2nd fortnight. It showed an average LGP of 81 days with 3.85 weeks of risky period. Delayed onset of growing period is risky as the LGP got reduced to 73 days and within that there were 3.25 weeks of dry-spells. Hence, when there were only 7 comfortable weeks for crop production, a definite impact on crop production occurred.

Table 3: Average LPG, Wet and Dry Spell Weeks with Different onset Categories

Onset fortnight (FN)	LGP in days	No. ofwetspell weeks	No. of dry spell weeks	No. of normal weeks
September 1stFN	100 days	6.08	3.54	4.66
September 2ndFN	81 days	3.38	3.85	4.34
October 1stFN	73 days	4.50	3.25	2.45

It was clear that whether it is early/ normal /late onset of growing season, the cessation happens towards the end of December, hence, the choice of crop can be based on the onset of growing period. If the onset is late, it is better to choose either pulses or other short duration crops.

Rajasthan

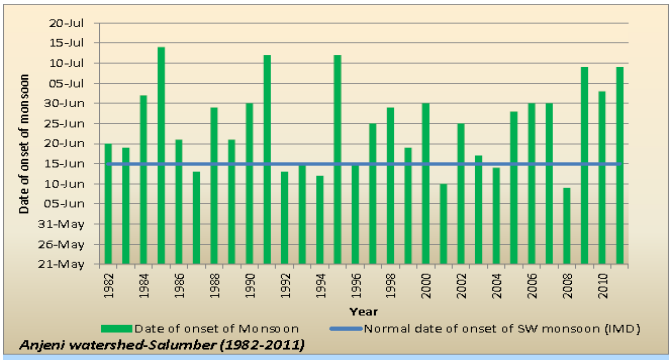


Figure 13 Onset of Monsoon: Girwa

The figures below show that in both the watersheds the onset of monsoon is delayed most of the time and farmers had to stagger the sowing date.

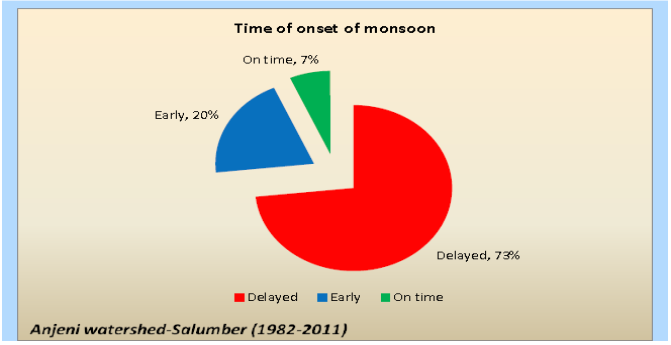


Figure 14 Onset of Monsoon Salumber watershed

1.2.4 Temperature

Increase in mean temperature would reduce the crop duration and thereby decrease the time available for the plants to photosynthesis and accumulate the food material into the sink (grain). Increase in daytime temperature will have greater influence on rate of photosynthesis / respiration related gas exchanges (Crafurd and Peacock, 1993). Moreover, it would also increase the crop water requirement by increasing the rate of evapo-transpiration. If the day temperatures exceed 32 - 35°C during the flowering phase, it will have impact on pollination and grain setting. Increase in night time temperature will have larger impact on yield of the crops as the photosynthates accumulated during the day time hours will be wasted during night hours as a result of increased respiration rate. Production of annual crops will be affected by the increase in mean temperature of 2 – 4° C expected towards the end of the century (Cynthia Rosenwig and Daniel Hillel, 2004). In future warmer climate, time of planting has to be adjusted in such a way that the flowering phase do not coincide with the hot days, to ensure better yields.

Tamil Nadu

Trend analysis results clearly state that minimum temperatures are increasing at a faster rate compared to maximum temperature. Mean maximum/minimum temperatures recorded during annual, SWM and NEM are 30.49/20.15, 30.40/21.29 and 28.27/19.25°C respectively. Increase in maximum temperature is more during SWM period and the observed rate of increase is 0.9°C over a period of 100 years while it was only 0.5°C during NEM. In the case of minimum temperature, the rate of increase in NEM is observed to be higher (1.2°C) compared to SWM season (1.1° C) during the past century. As the major crop growing season is falling in NEM, the likely trend of higher rate of increase in nocturnal temperature would definitely decline the productivity of many annual crops.

Rajasthan

The PRECIS data on precipitation, maximum and minimum temperature have been analysed for Anjeni and Rawatpura. Both the watersheds have a single weather grid and therefore the analysis hold good for both the watersheds. Summary of the projections are presented in the following paragraphs. Mean maximum temperature is projected to increase by 1.80C and mean minimum temperature by 2.20C towards mid century. The increase in mean maximum temperature is projected to be 3.60C and mean minimum temperature 4.50C towards end century respectively. Increase is projected for average annual rainfall by 3.0% and 12.0% respectively for mid and end century scenarios.

1.3 Future Climate projections

***Development of future climate projections*:** The future climate change scenario was developed using Regional Climate Models (RCM) viz., PRECIS which was developed by Hadley Centre, UK met office that can be used over any part of the globe (PRECIS, 2011). Special Report on Emission Scenario (SRES) - A1B scenario was selected which is likely to happen in South Asia. From the large number of generated output from the models, only maximum temperature, minimum temperature and rainfall were retrieved. Models were run for 129 years from 1971 to 2099.Decadal means of maximum and minimum temperatures were generated to understand the variation more clearly. Decadal mean for maximum and minimum temperatures with its deviation from the base line data (Referred as year 2010) along with expected change in rainfall is presented in Table 4.

Table 4: Expected Decadal Variations in Temperature, Rainfall and CO_2

Year	Exp. max. Temp. (°C)	Deviation	Exp.min. Temp. (°C)	Deviation	Exp.Rainfall (%)	Exp.CO_2 level(ppm)
2010	29.97	0	19.13	0	0	370
2020	30.36	0.39	19.48	0.35	- 5 %	385
2030	30.45	0.48	19.73	0.60	0	420
2040	30.62	0.65	20.12	0.99	+ 5 %	470
2050	30.87	0.90	20.65	1.52	+ 7 %	500
2060	31.33	1.36	21.12	1.99	+ 8 %	520
2070	31.75	1.78	21.59	2.46	+ 8 %	535
2080	32.13	2.16	22.00	2.87	+ 10 %	550
2090	32.75	2.78	22.64	3.51	+ 14 %	565
2100	33.57	3.60	23.19	4.06	+ 15 %	588

The results of the projected climate change over the study region for A1B scenario using PRECIS regional climate models showed a gradual increasing trend for maximum and minimum temperatures. The increase of maximum and minimum temperatures was 3.6°Cand 4.06°C respectively towards the end of the century. As far as rainfall is concerned, the predictions indicate a slight decline (-5%) in near future (2020). During 2030, the rainfall predictions indicate no change from the current condition. Thereafter, rainfall is expected to increase gradually and towards the end of the century, 15 % increase in rainfall is expected.

Impact of Climate Change on Hydrology and Crop Productivity: Tamil Nadu

Impact of changing climate on the hydrological parameters of the selected watershed was assessed using Soil and Water Assessment Tool (SWAT) model (SWAT, 2012). SWAT requires spatially distributed information on elevation, soil, slope, and land use. In addition to this, SWAT requires weather data including rainfall and temperature, crop characteristics and

management practices for predicting the hydrology as well as crop yields in different hydrological response units. A Digital Elevation Map of the study region was derived from a SRTM 30 m elevation dataset. Information on soil was based on the soil map at a scale of 1:50,000 obtained from the Remote Sensing Unit of Tamil Nadu Agricultural University, Coimbatore, India. Land use data was obtained from the open source global land use land cover data (USGS, 2010).

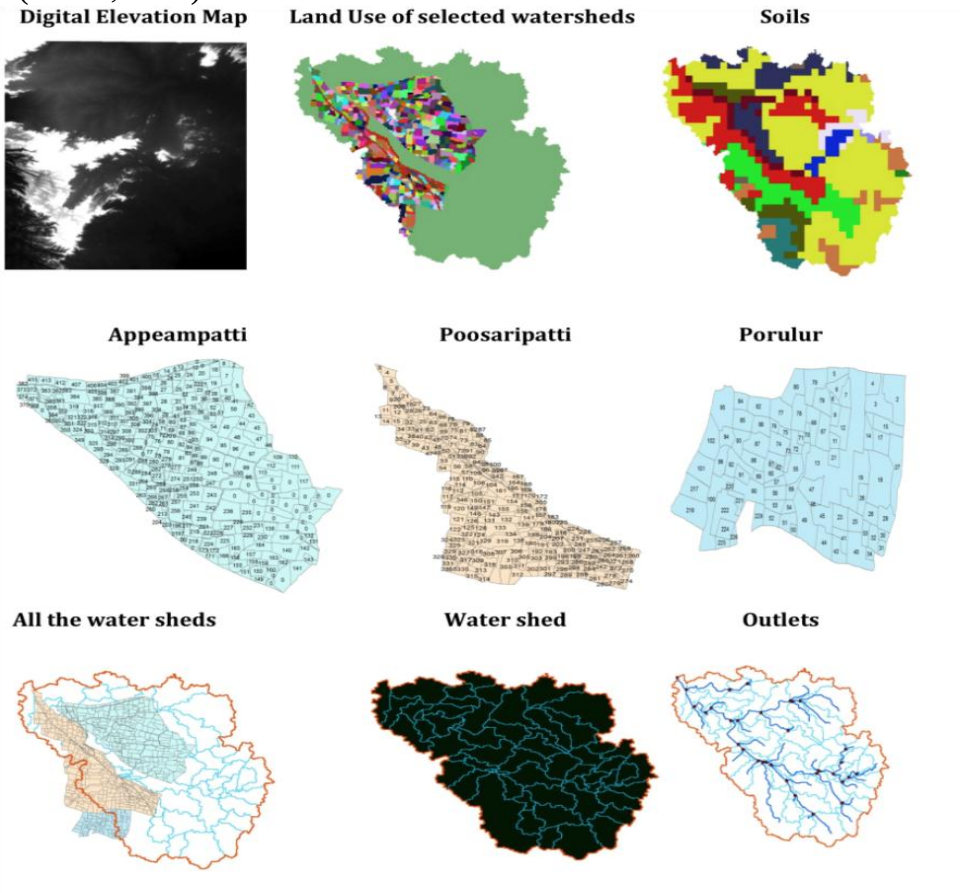


Figure 15: Inputs used for watershed delineation and SWAT Modelling

The SWAT model was continuously run for 130 years and results were averaged out 1971 – 2010 to get the baseline /current climate. Then the values were averaged for subsequent decades to understand hydrology and the results are presented in Table 5.

Table 5: Impact of Climate Change on Hydrological Components

Year	Rain fall (mm)	Surface runoff (mm)	Lateral flow (mm)	Ground water (mm)	Deep aquifer recharge (mm)	Total aquifer recharge	ET (mm)	PET (mm)
Base	778.4	90.87	3.75	259.46	16.20	324.05	314.23	1519.48
2020	749.6	82.88	3.61	247.9	15.47	309.47	310.34	1541.54
2030	778.4	90.87	3.75	259.46	16.20	324.05	314.23	1519.48
2040	817.7	101.3	3.94	274.56	17.12	342.37	322.9	1558.74
2050	832.5	105.5	4.01	280.32	17.47	349.34	325.85	1575.04
2060	840.1	107.42	4.03	282.38	17.60	351.91	328.74	1598.45
2070	840.1	107.17	4.03	281.21	17.53	350.52	330.61	1619.66
2080	856.2	111.6	4.1	287.22	17.89	357.79	334.33	1638.62
2090	887.5	120.5	4.24	298.87	18.59	371.85	341.19	1667.25
2100	895.9	122.52	4.27	300.05	18.67	373.35	346.08	1713.06

Analysis of the data from the above table indicates that rainfall will decrease from the current level during the near future (up to 2030) and again there will be an increasing trend towards the end of the century. Evapo-transpiration (ET) as well as potential evapo-transpiration (PET) demand will increase with the advancement of time. This must be due to the influence of increased temperature on crop water demand (ET) as well as atmospheric water demand (PET). Surface runoff will be highest during the end of the century indicating the possibility of more intense rainfall.

Impact of climate change on crops was assessed using dynamic crop simulation model viz., DSSAT(Decision Support System for Agro-technology Transfer).TheDSSAT modelling system is an advanced physiologically based crop growth simulation model and has been widely applied to understanding the relationship between crops and its environment (Jones *et. al*., 1998).In this study, DSSAT model was employed for assessing the impact of climate change on maize and groundnut productivity and the results are presented in Table-6 and Table-7.

Maize is one of the important cereal crop grown in the study area. It requires 500 to 750 mm of well distributed rainfall throughout the crop growing season. After germination and up to tasseling stage (initiation of male flower), the crop can withstand moisture stress, but requires stress free condition during grain development stage for better grain yields(Fischer *et al.*, 1989).

Temperature and rainfall significantly influences the groundnut production. Temperatures above 35°C inhibit the growth of groundnut crop. Groundnut crop requires 100 mm rainfall during pre-sowing stage for preparatory cultivation, 150 mm for sowing and initial crop growth and 400 – 500 mm for flowering and pod development stages. Both severe drought and water stagnation affects the crop to a greater extent. Flowering, Peg formation and pod development stages are critical with respect to moisture stress (Craufurd and Prasad, 2003).

Table 6: Impact of Climate Change on Maize

Timeline	Maize grain Yield (Kg/ha)	ET (mm)	Water productivity (Yield/ET)	Straw yield (Kg/ha)	Crop Duration (days)
2010	2196	312	7.06	5186	104
2020	1941	312	6.23	5139	101
2030	1925	310	6.4	5021	100
2040	1904	308	6.4	5152	99
2050	1880	350	5.42	5038	95
2060	1813	350	5.52	4971	94
2070	1799	367	4.96	5005	92
2080	1670	366	4.63	4752	89
2090	1570	371	4.29	4526	88
2100	1236	367	3.41	4053	84

Yield of maize has shown a reduction of 107 Kg ha^{-1} $decade^{-1}$ for PRECIS output. This reduction in yield might be mainly due to increase in both maximum and minimum temperatures as well as variation in rainfall in addition to shortening of growing period. The evapo-transpiration increased gradually from 2050 indicating more water requirement under future warmer climate. In contrast, water productivity is decreasing over time which warrants

measures for increasing water use efficiency. Straw yield is also decreasing which would have impact on dry fodder availability to cattle.

Table 7: Impact of Climate Change on Groundnut

Timeline	Pod Yield (Kg/ha)	ET (mm)	Water productivity (Yield/ET)	Haulms yield (kg/ha)	Duration (days)
2010	1576	365	6.14	3886	131
2020	1277	362	5.08	3595	130
2030	1211	361	4.86	3415	129
2040	970	360	3.98	3360	128
2050	779	360	3.27	2995	127
2060	749	358	3.14	2940	127
2070	697	367	2.92	2910	126
2080	674	376	2.82	2870	126
2090	631	378	2.63	2820	126
2100	623	365	2.57	2755	124

Groundnut will be more impacted compared to maize crop due to changing climate. The yields are expected to go down by 60% by the end of the century if no proper adaptation measures are taken up. Much change could not be observed in evapo-transpiration but the water productivity got declined over time (i.e.) the yield produced for every mm of water evaporated got declined. Duration of the crop was reduced by a week towards the end of the century (Table-7).

Impact of Climate Change on Hydrology and Crop Productivity: Rajasthan

The table below shows both rainfall and temperature projection in the study area.

Table 8 Projected rainfall scenario for Anjeni-Rawatpura (Study area of both the watersheds)

IPCC SRES baseline and A1B scenario as simulated by PRECIS for Anjeni-Rawatpura						
Rainfall (mm)						
		JF	MAM	JJAS	OND	Annual
Anjeni-Rawatpura	1970s	19.7	21.4	507.9	42.2	591.3
Anjeni-Rawatpura	2050s	5.7	22.6	542.8	36.4	607.5
Anjeni-Rawatpura	2080s	17.2	34.7	567.3	64.2	683.4
Comparison of projected changes in seasonal and annual rainfall (mm) for IPCC SRES scenario with respect to baseline for Anjeni-Rawatpura **						
Change in rainfall mm (%)						
Change from Baseline to Mid Century		-14 (-71.0)	1.2 (6.0)	35 (7.0)	-5.8 (-14.0)	16.2 (3.0)
Change from Baseline to End Century		-2.5 (-13.0)	13.3 (62.0)	59 (12.0)	22 (52.0)	92 (16.0)

*** Positive change indicates increase in future and negative change indicates decrease in future*

JF - January, February; MAM - March, April, May; JJAS - June, July, August, September; OND - October, November, December

Temperatures play a major role in determining the growth, productivity, and duration of the crop growth. Maximum and Minimum Temperature deviation for each decade has been calculated considering 1961-1990 as the base period as shown in the Table 9. The analysis of the projected climate change over the two watersheds shows a gradual increasing trend for maximum and minimum temperatures as can be seen from the graph. The projected increase

of maximum and minimum temperatures is 4.0°C and 4.8°C respectively towards the end of the century.

Table 9 Temperature projections for Rajasthan (Study area)

Period	Projected annual maximum temperature(°C)	Deviation in maximum temperature (°C)	Projected annual minimum temperature(°C)	Deviation in minimum temperature (°C)
Baseline	31.5	0.0	19	0.0
2011-2020	32.7	1.2	20.2	1.2
2021-2030	33	1.5	20.7	1.7
2031-2040	33.2	1.7	21.1	2.1
2041-2050	33.9	2.4	21.7	2.7
2051-2060	34.4	2.9	22.4	3.4
2061-2070	35.2	3.7	23	4.0
2071-2080	34.6	3.1	23.1	4.1
2081-2090	35.2	3.7	23.5	4.5
2091-2100	35.5	4.0	23.8	4.8

The analysis shows statistically significant increasing trend in the both mean maximum temperature and minimum temperature, thereby increasing the concern for crops and water conservation and climate proofing of the existing watersheds.

- statistically significant increasing trend for monsoon rainfall for both the watersheds
- delayed arrival of monsoon in most of the years
- intensity of 1 day maximum rainfall is higher in Salumbar than in Girwa

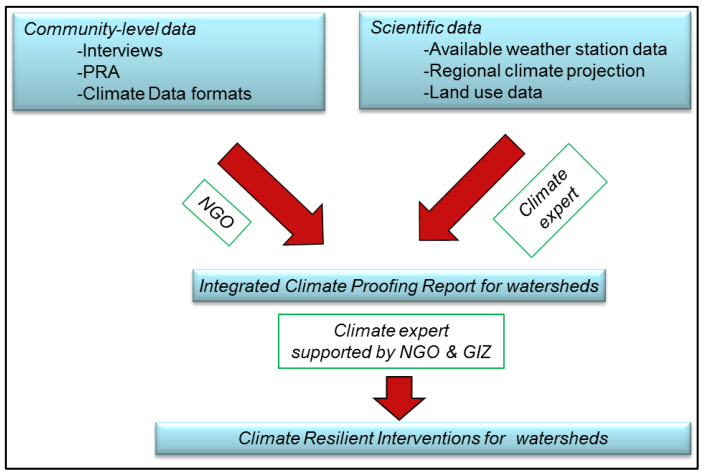
Climate projections on precipitation, maximum and minimum temperature have been analysed for Anjeni and Rawatpura. Projections for future indicate an all-round warming over Anjeni-Rawatpura watershed. Analysis based on the climate scenario data on temperature and rainfall show that:

- Mean maximum temperature is projected to increase by 1.50C and annual minimum temperature by 1.70C towards 2030s. The increase in mean maximum temperature is projected to be 2.40C and annual minimum temperature 2.70C towards 2050s.
- Increase in temperature would reduce the crop duration and result in reduced crop yield, increased demand for ET and PET. Indirect implications may be on the livelihood and migration.
- Under the agro climatic conditions of Rajasthan state normal sowing (around 7th to 20th November) of wheat crop has to be advocated so that the farmers get improved yield. Timely sowing of wheat crop may escape the risk of temperature rise and sterility at flowering stage.
- Adopting to short duration crops, like sorghum or other suitable crop in consultation with local agriculture experts
- Water conservation storage as underground water than surface water should be preferred to reduce the evaporation losses

1.4 Climate Change Adaptation in Watersheds

NABARD has been supporting watershed development programme in 16 states in India under its Watershed Development Fund (WDF). The projects are implemented through state governments, voluntary agencies/corporates for ground level implementation. The programme is governed by principles such as participatory development, transparent fund flow mechanism; ridge to valley approach and intensive training and capacity building. The present programme under implementation aims at improving the living condition of the people in the rainfed areas on watershed basis through various interventions such as soil and water conservation, crop productivity improvement, livelihood activities, etc.

Majority of the projects take up are in resource poor region of the country inhabited by the poor people, who are highly vulnerable to change in climate. The present model although takes care of conservation of resources, it does not address the long term climate adaptation challenges.



Considering the long term impact of climatic variables on agriculture productivity and other livelihoods in these rainfed areas , NABARD with technical and financial support of GiZ has taken up pilot projects on climate change adaptation in rainfed areas viz. "Climate proofing of watersheds in Tamilnadu and Rajasthan" (Two watersheds viz., Appiyampatti, and Poosarapatti in Dindigul district of Tamilnadu and Anjeni and Rawatpura in Udaipur district of Rajasthan).climate proofing. The approach adopted for climate proofing is captured in the figure.

In the aforesaid pilot projects, NABARD funded for the business as usual activities and GiZ provided the technical and financial support for the specific adaptation measures . Out of the total project cost, around 25% was found towards specific adaptation measures which was supported by GIZ.

It is now planned to scale up the programme to a larger rainfed areas in the country so as to have visible impact on the community in building climate change resilience. Towards this end, it is proposed to implement climate change project with the assistance of AFB in about 25,000 ha area comprising of 20 watersheds i.e. 10 each in Tamilnadu and Rajasthan. While NABARD will support the watershed projects as per the current model, assistance is sought from Adaptation Fund Board for the specific adaptation measures. .

1.5 Geographical Coverage of the Programme

Location in Tamil Nadu

The ten selected watersheds cover the water stressed regions of Tamil Nadu. The districts selected are in the South Western cluster viz. Madurai, Dindugal, Krishnagiri and Tirunelveli.

The list of watersheds selected is given in the table below:

S. No.	Name of the watershed	District	Geographical Area in Ha
1	Bettamugilalam	Krishnagiri	2075
2	Chithalai	Madurai	1163
3	Thally kothanur	Krishnagiri	934
4	Saalivaram	Krishnagiri	1247
5	Anjukulipatty	Dindigul	757
6	Chinnapoolampatti	Madurai	1243
7	Peikulam	Madurai	1360
8	Srirampuram -Malvarpatty	Dindigul	1195
9	Ayampallayam	Dindigul	1660
10	Vannikonendal & Kurkulpatti	Tirunelveli	1943
	Total Area (ha)		**13577**

Major soil types present are red sandy soil, red loamy soil and laterite soil. Major crops grown are millets and other cereals, pulses, groundnut, ginger, and cotton. Main source of water for crop production is from underground bore wells and open wells, besides rainfall. Major livestock population in this area is cattle, sheep, and goat.

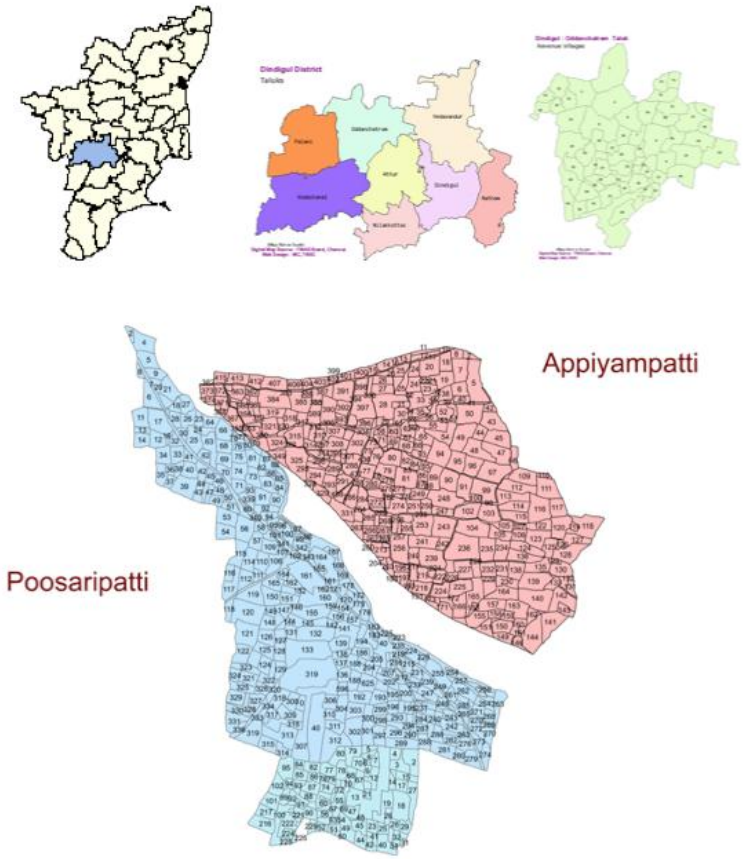


Figure 16: Location of the Appiyampatti and Poosaripatti in Dindigul District

Location in Rajasthan

The ten selected watersheds cover the water stressed south districtes of Bhilwara, Udipur, Chittorgarh, Dungarpur and Jalore . The list of watersheds selected is given in the table below:

S. No.	Name of the watershed	District	Geographical Area in Ha
1	Dhuvala	Bhilwara	1180
2	Nayagaon-I	Jhalawar	1155
3	Nayagaon-II	Jhalawar	1072
4	Balua	Udaipur	1220
5	Vagda	Udaipur	984
6	Jhabla	Udaipur	1358
7	Malvi	Dungarpur	1424
8	Mandli	Udaipur	937
9	Chainpuria	Chittorgarh	1202
10	Khad	Udaipur	1330
	Total Area (ha)		**11862**

Rainfall is low; hence major source of water for irrigation and other uses is groundwater. Recharging of groundwater is crucial to meet the daily water demand, and to meet the irrigation need of the area in Rabi (winter) season.

Mean maximum temperature for for the proposed cluster is 32°C with a range of 31.1°C – 33.4 °C over last 100 years. Major crops grown is maize, guar, sorghum, wheat, mustard, green gram, black gram, minor and millets in the watersheds. Main source of water for crop production is underground water, besides rainfall. Major soil types in the area are sandy loam and red soil.

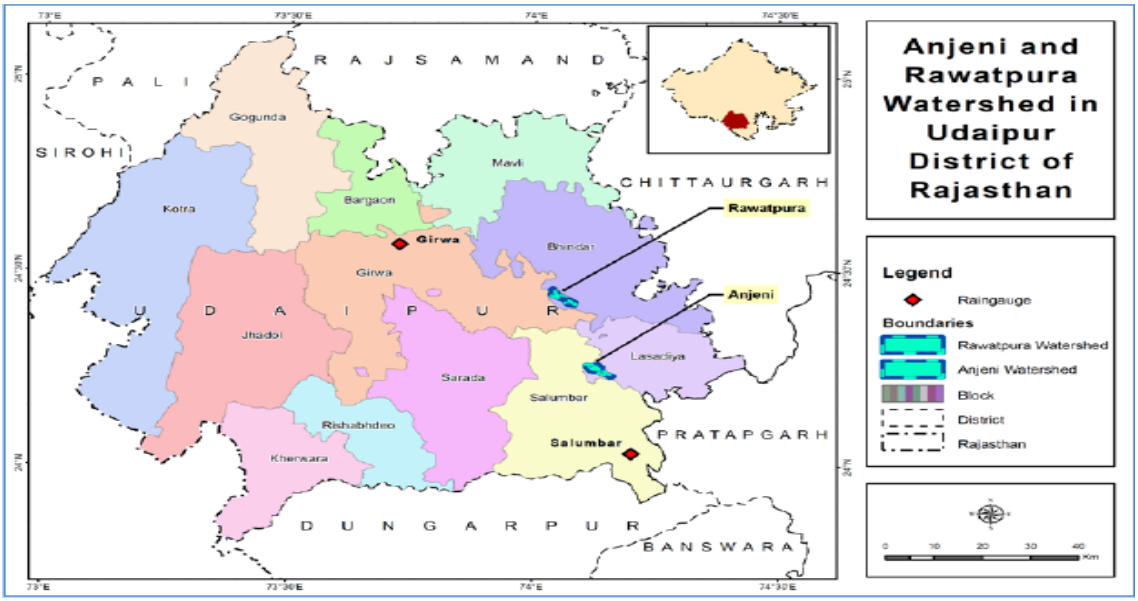


Figure 17Anjeni and Rawatpura Watershed in Udaipur District

1.6 Socio-Economic Context

The socio-economic context in both the states differs. In the pilot projects taken up,stake-holder consultation meetings through PRA exercises were carried-out in both the states to corroborate scientific analysis with community and to identify adaptation priorities and strategies. The experts from stake-holder consultations with farmers in the projects area are given under.

Tamil Nadu

A survey was conducted with 40 farmers each from Poosaripatti and Appiyampattiwatersheds of Thoppampattitaluk in Ottanchathram block of Dindigul district of Tamil Nadu to understand the perceptions of the farmers about climate change and its impact on agricultural productivity in the region and to identification priorities / strategies. Farmers were selected by applying proportionate random sampling and totally 80 respondents were considered for the present study. The survey questionnaire was framed with a view to understand perceptions of the farmers with respect to (a) Changes in rainfall pattern over time, (b) Impact of climate change on water availability, (c) Frequency of occurrence of extreme weather events and their impact on crop production, (d) Socio-economic consequences due to changing climate, and (e) Developing adaptation strategies for overcoming the impacts of climate change.

Interviewing a farmer in Poosaripatti village by NGO members

Drawing timeline in Appiyampatti viallge by NGO with farmers´ participation

PRA tools used in this study are: (a) seasonal calendars,(b) timeline analysis, and (c) hazard mapping. The data collection was also done with a well-structured and pre-tested interview schedule that covered: (a) Awareness on climate change, (b) Changes felt in climate during the past 10 -30years (c) Reasons for water scarcity (d) Impact due to change in rainfall / temperature (e) Livelihood change resulting from climate change (f) Management options to combat climate change (g) Adaptation to climate change.

Rajasthan

To identify community perception with regards to impact of climate change on the local population, participatory approach (PRA, interviews) was followed. In this approach the team tried to gauze community perception through methods like resource map preparation, overlying Hazard/risk map, historical time line, seasonality analysis of events and livelihood actions. Besides semi structured

interviews were undertaken with few key farmers and other persons. A survey was conducted with 11 farmers from Anjeni and 14 farmers from Rawatpura Watersheds of Udaipur district. The survey questionnaire was framed with a view to understand perceptions of the farmers with respect to change in water availability/shortage, changes in rainfall, changes in temperatures, extreme weather events, impact on livelihoods and sensitivity of community, effect on crops, etc

Stake- holder consultation in the proposed project area:

In the proposed project area, series of consultations with farmers and landless persons have been carried out for understanding the problems of degradation of natural resources, low productivity of crops, issues connected with livelihood and to arrive at appropriate treatment measures. On the basis of these information detailed projects report for business as usual activities have been formulated.

During the above consultation climate change related issues affecting the community also have been brought forth. Since detailed climate analysis and focused discussions with the community with reference to climate change scenario have not been undertaken, it is proposed to carry out a detailed community assessment through PRAs, FDGs etc. along with climate analysis by an Expert, upon approval of the concept note

1.7 Project / Programme Objectives:

List the main objectives of the project/programme:
The objective of this program is "to build adaptive capacities of the communities to climate change in the rainfed areas of Tamil Nadu and Rajasthan"

The program will deliver this objective and will have these four outcomes

Outcome 1: Improved soil and water regime for better crop productivity and resultant increase of income of farmers.

Outcome 2: Increased adaptation to climate change through climate resilient farming system approach and diversification of livelihoods;

Outcome 3: Integration of risk mitigation products like weather advisory/insurance and other financial products for the farmers

Outcome 4: Creation of knowledge management system for climate change adaptation in rainfed areas

1.8 Project / Programme Components and Financing:

Fill in the table presenting the relationships among project/programme components, activities, expected concrete outputs, and the corresponding budgets. If necessary, please refer to the attached instructions for a detailed description of each term.

For the case of a programme, individual components are likely to refer to specific sub-sets of stakeholders, regions and/or sectors that can be addressed through a set of well defined interventions / projects.

Table 10: Project / Programme Components

PROJECT/PROGRAMME COMPONENTS	EXPECTED CONCRETE OUTPUTS	EXPECTED OUTCOMES	AMOUNT# (USD $ MILLION)
1. Improvement of soil and water regime for better crop productivity	1.1 Area treatment measures like summer ploughing, well recharge / catch pit, percolation tank, sunken pond, that help recharge the ground water which may be used for supplemental irrigation for the rabi crop.	Increased and extended water availability through the efficient soil and water conservation techniques	0.2
2. Climate Resilient farming system approach and diversification of livelihoods	2.1 Introduction of drought resistant and temperature tolerant High Yielding Varieties (HYV), use of alternate crops (e.g. minor millets, fodder sorghum etc), intercrops, trap crops and alternate fodder crops; 2.2 Introduction of agri-horticulture and agro-forestry as a diversification strategy 2.3 Integrated farming system with a mix of crops and livestock (goat, sheep, dairy and poultry) 2.4 Introduction of energy efficient devices, and provision of quality drinking water. 2.5 Soil Fertility Management (i.e. with the use of organic fertilizers like vermi-compost) to enhance soil organic carbon that would increase water holding capacity; 2.6 Introduction of micro-irrigation & fertigation that enhances water use efficiency and controls soil erosion	Increased adaptation to climate change through cropping system change, crop diversification and integrated farming system approach	0.61
3. Integration of risk mitigation and other financial products	3.1 Livestock and weather based crop insurance 3.2 ICT integration to provide farmers with crop weather	Integration of risk mitigation products like crop and livestock insurance and	0.09

PROJECT/PROGRAMME COMPONENTS	EXPECTED CONCRETE OUTPUTS	EXPECTED OUTCOMES	AMOUNT# (USD $ MILLION)
	advisory and agri-extension advisory	other financial products for the farmers	
4. Creation of knowledge management system for climate change adaptation in rainfed areas	4.1 Development of operational manual on climate change adaptation in rainfed areas on watershed basis. 4.2 Policy briefs for mainstreaming the concept of climate change adaptation in rainfed areas on watershed basis. 4.3 Experience sharing of the lessons learnt through exposure visits, workshops, audio- visual tools (short films), etc.	Dissemination of lessons learnt and knowledge acquired to policy makers, planners and other stake-holders.	0.13
6. Project/Programme Execution cost			0.07
7. Total Project/Programme Cost			1.097
8. Project/programme Cycle Management Fee charged by the Implementing Entity (if applicable)			
Amount of Financing Requested			

 # In the above table, only the total project cost is indicated. Upon approval of concept note by AFB, the detailed costs will be worked out based on the location specific detailed analysis. Item-wise project -wise cost details are indicated in the Annexure 1 (A&B)

1.9 Projected Calendar:

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

MILESTONES	EXPECTED DATES
Preparation and finalisation of the DPR	June 2013
Submission of the DPR to AFB	July 2013
Start of Project/Programme Implementation	November 2013
Mid-term Review	July 2015
Project/Programme Closing	June 2017
Terminal Evaluation	December 2018

PART II: PROJECT / PROGRAMME JUSTIFICATION:

1. 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 watershed programmes in drought prone areas have been going for quite some time in India. Both Tamil Nadu and Rajasthan have been implementing such watershed programmes too. This programme is unique in three ways (a) first time it takes into both lessons of climate variability and change in the pilot location both from de-scaled model and corroborated with community perception survey (b) conduct a gap analysis from standard measures taken to arrest drought incidence (c) models the future climate scenario to factor in sensitivity, exposure as well as mal-adaptation: to design climate proofing measures for the watershed. In this way it is going to enhance the adaptive capacity of the farmers and resilience of the watershed much beyond the usual soil and water conservation focused drought proofing measures and is beyond the business-as-usual practice and can be considered as concrete adaptation. The justifications are elaborated below.

Outcome 1: Improved soil and water regime for better crop productivity and resultant increase of income of farmers.

The analysis in part 1 clearly shows that there is likelihood of more water scarcity and incidence of drought in the coming decades apart from delay in onset of monsoon most of the time. This will significantly reduce crop productivity affect food security and increase poverty. The non-climatic stress will be over grazing, higher bore-well density and indiscriminate ground water extraction. There will be lowering of water table and reduced vegetation cover during climate stressed scenario. Current practice of over dependence on water intensive crops, methods of flood irrigation will enhance the vulnerability further.

The following measures are supposed to enhance water availability in the watersheds and make them climate resilient.

a. Percolation Pond:

It is the shallow depression created at lower portions in a natural and diverted stream course, preferable under gentle sloping stream. Main advantage of percolation pond is improvement in ground water recharge in a scenario where there is increased draft for agriculture and increase in temperature and reducing rainfall. Afforestation on the boundaries of the percolation pond would help in reducing the siltation of the ponds, minimizing evaporation losses and also stabilizes the bunds for a longer period of time.

b. Summer ploughing: From the climate analysis, it could be seen that the quantum of rainfall received during the SWM is slightly increasing over time. To capture the increased amount of rainfall effectively in the soil column, the hard topsoil should be opened up. Ploughing the soil in advance of the start of the monsoon season (Summer ploughing) would

help in opening the hard topsoil, which would lead to increased rate of infiltration besides reducing the soil borne pests, diseases and weeds besides controlling Soil erosion.

c. Sunken pond: High intensity rains falling in a shorter period would lead to higher runoff. Farm pond helps in storing the runoff water locally that can be utilized during critical water need of the crop or for livestock during dry periods.

d. Waste Weir / Diversion Drain : In order to safely dispose off excess runoff during high intensity rainfall events waste weir / diversion drain structures will be constructed at feasible locations.

Specific Activities to implement the measures:

1. Area identification & technical feasibility for percolation pond construction and other recharge structure;
2. Construction of percolation pond/tank in feasible areas within the watershed;
3. Identification of potential farmers for sunken pond & construction;
4. Water harvesting would be ensured through well recharge pit construction with identified farmers.
5. Waste weir / diversion drains to dispose off excess water.

Outcome 2: Increased adaptation to climate change through climate resilient farming system approach and diversification of livelihoods

The programme envisages improving in existing cropping system to reduced dependency on water intensive crops and introduction of hardy varieties apart from introducing farming techniques that are efficient in the water scarce situations.

a. Deep Tillage: Performing tillage operations in the summers below the normal tillage depth to modify adverse physical and chemical properties of the soil is termed as deep tillage. One of the reasons for low yields in the dry lands is the limited amount of moisture available at crop root zone. From the examination of Length of Growing Period (LGP) and the dry spells within the LGP, it could be understood that, whether it is early/ normal /late onset of growing season, the cessation happens towards the end of December and the number of dry spell weeks ranges from 3.25 to 3.85. Under such situation, the LGP can be increased by one week to 10 days, if deep tillage is done as it helps in increasing the rooting depth of the plant. The available moisture to the plant will be increased if the rooting depth is increased and would help in supporting for the crop development for more number of days after the cessation of rainfall. In a situation of increasing intensity of rainfall during SW monsoon deep tillage will help in retention of higher moisture in the root zone for a longer period of time.

b. Agro-forestry: Agro-forestry is a collective name for land use systems and practices in which woody perennials are deliberately integrated with crops and/or animals on the same land management unit

The integration can be either in a spatial mixture or in a temporal sequence. Agro-forestry systems offer and facilitate the framer with the extra earning because it enhances the production ability of the land. Diversification of forest and cultivating crops also reduces resources and labor costs and also minimizes the risks involved in the cultivations of crops. Mix up of long lasting forest crops with annual agricultural income creates big profits on the annual basis too. Agro-forestry system increases the fertility of soil and also helps in preventing soil erosion. Special attention to be given in Rajastahn for forage crops and that grasses that bind the soil.

Some of the trees / shrubs suitable for agro forestry in the study region which are creating favorable micro climate for the crops in addition to minimizing soil erosion are: Acacia Senegal (multi - purpose fodder tree), Acacia tortillis (fuel wood), Albizialebbeck (shade & fodder), Cajanuscajan (leguminous shrub), Pithecellobiumdulce (cut and carry fodder), Sesbaniabispinsoa (leguminous, fixes atmospheric nitrogen), Tamarindusindica (Tamarind), Dalbergiasissoo (cut and carry fodder), Casuarinaequisetifolia (Pole & Fuel wood), Gliricidiasepium (fodder), Sesbaniagrandiflora (leguminous live fence). Agro forestry also helps in sequestering atmospheric carbon dioxide which would become eligible for carbon trading and would pave way for additional income to the farming community.

c. Agro-horticulture:

Growing fruit crops in between the annual crops is known as agri-horticulture. Fruit crops such as amla, pomegranate, guava, sapota, mango, etc. can be grown for more profit in the selected watersheds. It provides better microclimate for the annual crops besides providing off season employment and income to the farm family.

d. Increasing crop productivity / Farm income

- **Use of high yielding and drought tolerant varieties:** High yielding varieties with drought resistant and temperature tolerant character are highly suitable for the selected watershed as it experiences frequent droughts.
- **Need based fertilizer application:** Soil test based and crop requirement based fertilizer application would improve the crops yield besides maintaining the soil health.

- **Growing alternate crops / fodder sorghum during SWM:** Using the quantum of rainfall received during the SWM, minor millet crops like barn yard Millet can be grown which are drought hardy and needs less water. Instead of keeping the land fallow, a fodder sorghum crop can be grown to create fodder reserve for the animals.

- **Inter-cropping / Mixed cropping / Rotational cropping:**

Intercropping is the practice of growing two or more crops in proximity. The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources that would otherwise not be utilized by a single crop. Careful planning is required, taking into account the soil, climate, crops, and varieties.

e. Alternate fodder: The land area available for cultivation is expected to decline in the future years due to socio economic changes that arise out of climate change. Under such context, allocating sizable area of land for fodder production would lead to addition stress on cultivation of food crops. Hence, alternate (conventional and non conventional) fodder crops need to be promoted to meet the challenges in fodder requirement of the future. Azolla can be promoted as alternate fodder which doubles its biomass in 10 days with very less water requirement. It also increases omega fatty acid content in the animal products.

Fully grown Azolla

Azolla Feeding to Cow

f. Integrated farming system: Under changing climatic condition frequent crop failures can happen due to increased frequency of extreme weather events. Growing crops and animal (goat/sheep/dairy/poultry) together helps in increasing the adaptive capacity of the community by raising the productivity, profitability and sustainability of the farm. There is an efficient recycling of by-products from one component to another that leads to environmental safety. Income and employment is generated throughout the year.

g. Soil nutrient management :

As a result of increasing temperature, the crop residue gets easily decomposed and soil organic matter content goes down. Organic matter content in the soil can be improved through application of vermicompost or bio-fertilizers at a frequent interval. Vermicompost is organic manure (bio-fertilizer) produced as the vermin cast by earthworm feeding on biological waste material/ plant residues. This compost is an odorless, clean, organic material containing adequate quantities of N, P, K and several micronutrients essential for plant growth (Bana*et al.*, 1993).

Vermicompost pit

Vermicompost

Sesbania (Green Manure)

Vermicompost is a preferred nutrient source for organic farming. It is eco-friendly, non-toxic, consumes low energy input for composting and is a recycled biological product (Edwards, 1998).Bio-fertilizers such as *Azospirillum* / *Phospobacterum* can also be applied to the soil to increase the availability of nutrients to the plants. Alternatively green manure crops such as *Sesbania* can be grown during the SWM period with minimum rainfall and incorporated into the soil at the age of 40 days when the crop is in peak flowering stage. This will increase the water holding capacity of the soil by increasing organic matter content.

h. Micro irrigation (Drip irrigation / Micro sprinklers): Micro-irrigation refers to low-pressure irrigation systems that spray, mist, sprinkle or drip. Drip irrigation is the targeted application of water directly to the root zone, fertilizer, and chemicals that when used properly can provide great benefits such as: Increased revenue from increased yields (up to 80%), increased revenue from increased quality, decreased water costs, decreased labor costs, decreased energy costs, decreased fertilizer costs, decreased pesticide costs and improved environmental quality. Water use is reduced by 40 – 60 %.

i. Fertigation: Increase in temperature would result in increasing the soil temperature and soil microbial activity, which would lead to quick decomposition and release of green house gases such as Carbon dioxide, Nitrous oxide, and Methane besides reducing the nutrient use efficiency. Application of liquid fertilizer through drip irrigation is popularly known as fertigation. In this method, nutrient use efficiency is increased, cost on fertilizer is reduced and yield of most of the crops are increased.

Specific Activities to implement the measures:

1. Orientation to Farmers on the benefit of Deep Tillage system
2. Field Demonstration of deep tillage methods (demonstration units);
3. Selection & finalisation of species for agro-forestry and forage crops in consultation with farmers (consultation meetings in every watershed villages) and technical feasibility study;
4. Selection & finalisation of species for agri-horticulture in consultation with farmers (consultation meetings in every watershed villages) & Technical feasibility;
5. Technical and Financial Feasibility Assessment for mixed cropping / crop diversification etc.;
6. Promotion of mixed cropping/crop diversification / integrated farming covering
7. Soil treatment through organic means ;
8. Demonstration of micro-irrigation operation system in-situ;
9. Support to farmers for adaptation of micro irrigation system & modern water management practices;

Outcome 3: Integration of risk mitigation products like weather advisory/insurance and other financial products for the farmers

Rural poor have little access to credit. While a wide network of rural finance institutions exist, many of the rural poor remain excluded, due to inefficiencies in the formal finance institutions, high transaction costs, and risks associated with lending to agriculture.

Specifically in agriculture, these cost of administration and basic risks are very high and therefore premiums are excessive for most farmers (hence most agricultural insurance schemes are subsidized).

The project will include risk mitigation products such as crop and livestock insurance thereby reducing vulnerability of the communities.

In addition to the above, there will be a strong ICT component in the project in which tie-up with mobile service providers will ensure timely weather and crop advisories to farmers..

Specific Activities to implement the measures:

1. Performing risk mapping and vulnerability analysis
2. Extensive coverage of crop and livestock through insurance
3. Weather based crop advisory services.

Outcome 4: Creation of knowledge management system for climate change adaptation in rainfed areas

It is proposed to create a strong knowledge management system under the project which would enable large scale dissemination of knowledge and lessons learned to project partners as well as policy makers and planners.

Towards this end, operational manual, policy briefs, audio visual materials, etc. are proposed to be brought out, besides, interactive workshops, exposure visits, etc.
The operational manual will be developed in a participative manner both in English and in local language with illustrations so that the trainers can use it in training the farmers.

Policy brief prepared as part of the knowledge management system will help policy makers to be sensitive to climate change adaptation in rainfed areas on watershed basis and help in mainstreaming such adaptation initiatives in natural resource management projects/programmes. This output will extend over the life time of the project and will highlight the impact of climate change on natural resources and agricultural development in Tamil Nadu and Rajasthan.

Specific Activities to implement the measures:

1. Design workshop for the development of operational manual
2. Developing appropriate knowledge products, including photo stories, presentations and briefing notes, etc. for use in policy advocacy activities aimed at policy makers
3. Conducting exposure visits to the project areas to enable sharing between stakeholders, farmers, and local communities.
4. Producing audio-visual material describing the projects' products and results.
5. Disseminating knowledge products, targeting outlets that are relevant for policy makers
6. Ensuring good media coverage for programme activities.
7. Conducting regular policy advocacy activities throughout the life of the programme, including at relevant national and regional events.

2. Describe how the project / programme provide economic, social and environmental benefits, with particular reference to the most vulnerable communities, and groups within communities, including gender considerations.

The project would be implemented in resource poor rainfed regions of Tamil Nadu and Rajasthan. Community in this region are dependent on agriculture with mostly of single crop in a year due to limited rainfall. Hence, most of these farmers are financially very weak thereby making them vulnerable to the impact of climate change.

The major beneficiaries of the project will be small and marginal farmers (with less than 2 ha of land holding), besides landless labourers and women living in the identified project locations spread over in about 25000 ha.

The equitable distribution of benefits to the eligible beneficiaries out of the project components will be ensured through prioritization of beneficiaries on the basis of appropriate tools such poverty indexing, vulnerability assessment, etc.

The project meets the various sustainability development criteria such as social well being

Table 11: Sustainability Parameters of the Project and Key Benefits

Sustainability criteria	Key benefits	Baseline scenario
Social		
	Agri-horticulture provides Off season employment and income to the farm family and reduces the vulnerability of the poor and also enhances their nutritional security	Reduced agriculture (production) threatens food security in the region.
	The necessary labour for watershed rehabilitation and protection will be from the location itself	Landless labour and marginal farmers migrate from rural areas.
	Since SHG / JLG will be linked to SHG groups where women membership is high gender equity will be maintained.	Gender inequity
Economic		
	Drip irrigation will reduce the cost of production as labour for weed control and reduce water Consumption	Poor water use efficiency and high input cost.
	Intercropping method will produce a greater yield on a given piece of land and enhance the farm income	Mono cropping
	Through fertigation, nutrient use efficiency is increased, cost on fertilizer is reduced and yield of most of the crops are increased.	Indiscriminate use of fertilizers.
Environmental		
	Deep tillage is done as it helps in increasing the rooting depth of the plant. The available moisture to the plant will be increased if the rooting depth is increased and would help in supporting for the crop development for more number of days after the cessation of rainfall.	Poor root penetration and low LGP
	Agro forestry also helps in sequestering atmospheric carbon dioxide and helps in reducing emission and global warming	High level of vulnerability
	Some of the trees / shrubs suitable for agro forestry in the study region which are creating favourable micro climate for the crops in addition to minimizing soil erosion.	Lower water table negatively impacting water quality, increasing soil pollution.
	Production and use of organic manures like vermi-compost reduces use of high cost chemical fertilisers	Indiscriminate use of fertilizers.
Institutional	Creation of community based organisation such as village watershed committee (VWC), SHG, user groups, farmer interest	Low level of awareness on climate change adaptation among watershed

	group oriented towards climate changes adaptation scenario	community.
Financial	Hassel free access to bank credit individually and group basis.	Inadequate credit availability for crop production, investment and livelihood measures
	Coverage of project areas with weather based crop insurance and livestock insurance	Low penetration of insurance products.

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

Water harvesting, supplemental irrigation and agricultural adaptation techniques are all proven to be effective in enhancing resilience to climate change, enhancing agricultural productivity, as well as enhancing the sustainable use of natural resources. Thus the investments have relatively secured results and the fund is proposed to be used for climate resilient technologies. The investments identified have proven or demonstrated cost efficiency in the watershed projects. For instance drip irrigation is expected to reduce cost of cultivation (increased water use efficiency, reduced labour cost in irrigation management, increased productivity) by about 25-30% every year over a period of 8-10 years. Similarly use of organic manures like vermi-compost prepared using locally available biomass will substantially reduce the input cost towards nutrient management in addition to improving the soil structure.

With the onetime investment of laying out of percolation tanks for example in addition to ground water recharge it provides supplemental irrigation water resulting in conversion of more wastelands into cultivation over long period of time.

By undertaking the climate resilient cropping system such as agro-horticulture and agro forestry with identified species, the risks of the farmer to climate aberrations leading to crop loss are mitigated. Also such systems supplement the livelihoods through additional income; for e.g. sourcing of additional income form tree species like neem, pongamia etc. In the livestock front, introduction alternate fodder sources like azolla especially in summer season would reduce the cost of purchase of summer fodder during years of monsoon failure or delayed onset. In order to protect the most important fall back option for the farmers in a year of crop failure, livestock insurance under a subsidised premium scenario will ensure sustained livelihoods.

Mainstreaming of climate proofing with the national watershed development strategies and larger natural resource management policies will protect the government's investments in this front for the long run.

4. 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, sector strategies, national communications, or national adaptation programs of action, or other relevant instruments, where they exist.

India has ratified Kyoto protocol of 1997 and accepted the treaty in August 2002.While ratification demonstrates a commitment to international legislation, the Government of India is also the second largest generator of clean development mechanism projects and the projects apart from reducing emission also contribute a percentage to the adaptation fund. India is eligible to receive funding from the Adaptation Fund as a developing country party to the Kyoto Protocol and is vulnerable to the adverse effects of climate change. The proposed location in India is climatically vulnerable due to its arid and semi-arid environment existing high levels of vulnerability due to concentration of hunger and poverty in the region and high climate variability.

The Government of India is contributing to Climate Change negotiations at the international level and is promoting adaptation and mitigation measures at the national level to the best extent possible. The National Action Plan on Climate Change and the State Action Plans on Climate change further developed recognises the threat of climate change and has identified the agriculture & water sector as heavily affected by the predicted impacts of climate change. In addition, a large proportion of the rural population, particularly the poor, depend on agriculture and livestock for their livelihood. Accordingly, the Government of India has developed a **sustainable agriculture mission** committed to promote and implement all measures that would increase the resilience of agriculture to climate change, focusing on watershed development as a thrust area. The plan mainly aims to support climate adaptation in agriculture through the development of climate-resilient cropping system, expansion of weather insurance mechanisms, and agricultural practices.

Twelfth Five Year Plan lays considerable focus on climate change adaptation in agriculture sector (para 7.85 of 12th FYP document). The plan identified some policy and programmatic interventions which can help farmers and other stakeholders adapt to climate change and reduce the losses. Amongst the key actions for adapting Indian agriculture to climate change are improved land management practices, development of resource conserving technologies, development of crop varieties that can withstand climate-stress, effective risk management through early warning, credit-insurance support to farmers. The proposed concept is in-line with the adaptation strategies contained in the 12th Five Year Plan.

The suggested strategies as per the Second National Communication on Climate Change (May 2012) indicates that "adaptations can be at the level of the individual farmer, society, farm, village, watershed, or at the national level." Some of the possible adaptation options suggested include, agronomic adaptation/ crop adaptation, crop diversification, water harvesting and recycling, awareness creation among farmers, resource conservation technologies, augmenting production and its sustainability and improved risk management through early warning system and crop insurance. As may be seen from the project components that majority of them are aligned to the adaptation options suggested in the Second National Communication on Climate Change

Integrated Watershed Management Programme (IWMP) launched during 2009-10, is being implemented as per Common Guidelines for Watershed Development Projects 2008. The main objectives of the IWMP are to restore the ecological balance by harnessing, conserving and developing degraded natural resources such as soil, vegetative

cover and water. The outcomes are prevention of soil erosion, regeneration of natural vegetation, rain water harvesting and recharging of the ground water table. This enables multi-cropping and the introduction of diverse agro-based activities, which help to provide sustainable livelihoods to the people residing in the watershed area.

Success of climate change adaptation in rainfed areas on watershed basis with fund support from AFB could be upscaled in the on-going massive programme under implementation by Govt. of India.

5. Describe how the project / programme meets relevant national technical standards, where applicable, such as standards for environmental assessment, building codes, etc.

Relevant national technical standards that relate to proposed project activities are as under

i. Watershed Manual by Central Research Institute for Dryland Agriculture (CRIDA)- Design specifications for various soil and water conservation structures such as farm pond, percolation pond, broad bed and furrow system as recommended in the manual will be adopted in the project areas.
ii. Handbook of Agriculture by Indian Council of Agriculture Research (ICAR) - project components like deep tillage, summer ploughing, application of tank silt, soil nutrient management, micro- irrigation, design of climate resilient cropping pattern and integrated farming systems, will be implemented as per the standards contained in the ICAR publication.
iii. Handbook of Horticulture by Indian Council of Agriculture Research (ICAR) - specifications with respect to agro-forestry, agro-horticulture, etc, will be as per the standards laid down in the above handbook.
iv. Relevant Standard Schedule of Rates (SSR) of respective state / region as approved by State Government – cost norms for various treatment measures will be as per the SSR.
v. Guideline on crop insurance by Ministry of Agriculture , Govt. of India : The prescriptions with regard to premium, compensation, etc., for crop insurance will be followed as per guideline on an annual basis.
vi. The following Land Tenancy Acts of respective State Governments provides for lease of agriculture land to tenants. However, these Acts do not come in the way of the implementation of adaptation and watershed measures proposed under the project.
    a. Tamil Nadu Cultivating Tenants Protection Act, 1955 – tenural rights are assigned to the cultivating tenants based on tenancy agreement entered with land lord in the prescribed form. Names of the tenant farmers are recorded in the revenue records along with the name of land lord. The state government also enacted Rent Relief Act 1990, providing relief to the cultivating tenants in the event of natural calamities.
    b. Land Tenancy Act Rajanthan : provision for long term tenure/ lease period upto 30 years.

There will be detailed scanning of the policy environment to ensure that the proposed strategies/interventions will be in line with the national technical standards. This will ensure that there is, enough social and environmental safeguards before the project is launched.

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

The major adaptation projects / programmes under implementation in the states of Tamil Nadu and Rajasthan were present climate adaptation project is proposed to taken up are given below:

i. Climate proofing of rainfed areas on watershed basis in co-operation with GIZ in Tamil Nadu and Rajasthan : two watershed projects each in both the states are under implementation.
ii. Indo- German Watershed Development Programme (IGWDP) Rajasthan in collaboration with KfW : 32 projects under implementation
iii. Watershed Projects under Watershed Development Fund of NABARD : In Tamil Nadu 154 projects (with State Government collaboration) and in Rajasthan 13 projects are under implementation.
iv. Improving Pasture Management and Livestock rearing by AFPRO / GIZ in Rajasthan
v. Sustainable Livelihoods and Adaptation to Climate Change implemented by World Bank / GEF.
vi. Climate Change Adaptation in Rural Areas of India commissioned by BMZ

The present project area covering 25000 ha has been delineated separately with the consent of the respective State Governments (State Level Nodal Agency). While selecting the project areas it has been ensured that the same is not having other overlapping with any of the on-going climate change adaptation programmes indicated above.
The present project concept has been designed based on the learnings from the Climate proofing of rainfed areas on watershed basis implemented in collaboration with GIZ by NABARD in Tamil Nadu and Rajasthan. As such there are no duplications of projects/ programmes with other funding sources in the proposed project area.

Some of the potential programmes in India with which the current program could build synergy are:

1. National Rural Employment Guarantee Programme

The Mahatma Gandhi National Rural Employment Guarantee Act 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 household whose adult members volunteer to do unskilled manual work.

2. Integrated Watershed Development programme

The Integrated Watershed Development Programme (IWDP) aims to restore ecological balance in a watershed by harnessing, conserving and developing degraded natural resources such as soil, water and vegetative cover and thereby help provide sustainable livelihoods to the local people.

3. **National Rural Livelihood Mission**

   The mission aims at creating efficient and effective institutional platforms of the rural poor enabling them to increase household income through sustainable livelihood enhancement and improved access to financial services.

4. **Joint Forest Management**

   JFM is a framework for creating massive peoples movement through involvement of village committees for the protection, regeneration and development of degraded forest lands.

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

The transfer of knowledge generated through the project is crucial since this will be the first of climate change adaptation project targeting the agricultural sector in both the states that takes into future climate scenario. The knowledge will include adaptation techniques at the farm level, best practices, early warning information through mobiles, sound sustainable agricultural practices, climate indexed insurance, and other policy recommendations and technical guidelines produced by the project.
This can be disseminated in the following ways:

a. Peer learning workshop in both the states
b. Wider dissemination of the operational manual in English and local language of both the states
c. Producing audio visual materials
d. Hosting best practices in the existing national websites on climate change

8. Describe the consultative process, including the list of stakeholders consulted, undertaken during project preparation, with particular reference to vulnerable groups, including gender considerations.

In both project areas one each stakeholder consultation meeting was organised. Concept of climate change adaptation in rainfed area on watershed basis was discussed in the workshop conducted at Chennai & Jaipur . Stake holders participated includes state watershed department, technical institutions like agricultural universities, civil society organisations, bilateral agencies, state department of environment etc Inputs were given by all the stakeholders who participated in the workshop. To understand the climate variability, trends observed already in the proposed area as well as climatic trends expected in the next 30 years were discussed based on learnings from pilot areas.

In the proposed project area, series of consultations with farmers and landless persons have been carried out for understanding the problems of degradation of natural resources, low productivity of crops, issues connected with livelihood and to arrive at appropriate treatment measures. On the basis of these information detailed projects report for business as usual activities have been formulated.

During the above consultation climate change related issues affecting the community also have been brought forth. Since detailed climate analysis and focused discussions with the

community with reference to climate change scenario have not been undertaken, it is proposed to carry out a detailed community assessment through PRAs, FDGs etc along with climate analysis by an Expert, upon approval of the concept note

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

General Baseline Scenario

The traditional soil water conservation measures and farming have been followed in India for rainfed areas based on the current climate scenario. The farmers generally adjust the sowing date for adapting to moisture stress or try sporadic measures to save the crop which result in failure. In most cases they migrate to nearby towns/cities, during years of crop failures keeping the land barren. This completely makes the investment in watershed structures infructuous.

General Justification alternative

The project will support farmers in applying appropriate water management practices to ensuring that agricultural production can withstand the stresses caused by climate change. This includes upgrading of rainfed and irrigated agriculture through applying rainwater harvesting systems and complementary interventions -climate resilient agronomic techniques etc. The programme also envisages crop diversification and diversification of livelihood and risk transfer through insurance as additional measures. These components are not traditionally part of the conventional programme and the assistance is sought for such additionalities for climate change adaptation.

The business approach comprising of soil & water conservation, drainage line treatment, livelihood and agriculture productivity enhancement, etc, will be funded by NABARD out of its resources. The fund support from AFB is sought for additional components having direct relevance to climate change adaptation in project area. The list containing major components and budget thereof to be funded by NABARD and AFB are given under Part III(Para E).

Summary of component-wise baseline scenario and additionality components proposed to be funded under AF is given in the table below:

Component	Baseline (without AF)	Additionality (with AF)
Outcome 1: Improved soil and water regime for better crop productivity and resultant increase of income of farmers.	With increasing impact of climate change on the weather parameters the traditional business as usual treatment measures and livelihood in the watershed will get affected.	The interventions and structures are designed with a climate change consideration, resulting in better adaptation to the short term climate variability and long term climate change. The interventions include, deep tillage, summer ploughing, application of tank silt, percolation pond, farm pond, broad bed and furrow, soil nutrient management, micro irrigation, fertigation.

Outcome 2: Increased adaptation to climate change through climate resilient farming system approach and diversification of livelihoods	An increased risk owing to mono cropping, intensive input application, in efficient water use etc. in the context of increasing evidence of changes in climate variables. This will bring in a scenario of over exploitation of the natural resources.	Climate resilient cropping system with strong elements of diversification leading to sustainable livelihoods for the grass root communities. Agro-forestry, agro-horticulture, drought tolerant varieties, inter-cropping, alternate fodder, integrated farming system, etc.
Outcome3: Integration of risk mitigation products like weather advisory/insurance and other financial products for the farmers	Unpredictable and short term climate variability leading to loss of crop and livestock (e.g. extreme events like drought, late onset of monsoon etc.)Inefficient insurance products with very poor climate considerations in its actuarial calculations and thus poor insurance penetration.	Reduced risk due to improved insurance penetration through weather based crop insurance and general insurance for livestock, weather based crop advisory.
Outcome 4: Creation of knowledge management system for climate change adaptation in rainfed areas	Lack of climate consideration in development planning. Rural livelihood programmes without climate consideration leading to maladaptation during programme implementation.	Mainstreaming climate change adaptation into development planning. Operational manual, peer learning, audio visual tools, policy brief etc.

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

The project takes into account output wise long term sustainability. The traditional watersheds only look at current Soil Water Management (SWM) measures. The climate forecast data obtained by setting up Automatic Weather Station and crop advisory based on the weather data, will be integrated in the design parameters so that the watershed remains resilient in aggravated climate scenario.

The cropping system diversification is not only focused on conventional agronomic practice but also takes into account introduction of hardy varieties and also crop diversification.

The use of risk transfer instruments like weather based crop insurance; livestock insurance etc. will enhance the sustainability by reducing risk and vulnerability. Introduction of non-farm source of livelihood will increase the income and saving of the farmers and reduce indebtedness from high cost sources.

The key benefits against each of the sustainable parameters is indicated in table 11. As may be seen from there the community based institutions will be empowered taking forward the benefits achieved during the project period in a sustainable manner.

PART III: IMPLEMENTATION ARRANGEMENTS

A. Describe the arrangements for project / programme implementation.

.NABARD being the funding entity will be working with PIEs (NGOs) and will oversee the implementation of the additional climate proofing measures under the programme.

The arrangement for project coordination and management is driven by the use of existing institutions and capabilities, as far as possible, whilst making necessary adjustments for building their capacity where needed.

The ground level project implementation will be taken up by NGO partners identified by NABARD as PIEs based on pre-defined selection criteria and supported by a dedicated Project Management Units of the concerned NABARD Regional Offices at the State level. The PMUs will be supported by necessary technical and managerial man power in the fields of NRM, agriculture, engineers, social development and finance. The implementation will be guided by a Steering Committee consisting of Heads of respective NABARD Regional Offices, Development Policy Department of NABARD Head Office, experts in the field and civil society representatives.

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

The department in both states have showed strong interest and commitment for this project as a pilot programme for adaptation to climate change. There are however political, institutional and technical risks associated with the implementation of the project. Some of these risks will be identified during the detailed project design, with a view to minimizing or mitigating them.

Some of the major perceived risks and mitigation strategies are as given under.

Risk	Level	Mitigation strategy
Lack of adequate human capital and skills at implementers level	Low	Sensitization and capacity building at various levels of implementation
Lack of funding support to these additional measures	Low	Exploring possible funding sources such as GEF, AFB, bilateral and multilateral funding sources etc.
Unforeseen events that affect the crops like locust and extreme weather which could not be forecasted.	High	Risk mapping with in the project boundaries using the various climate scenarios to cover all contingencies.
Regulatory risk in case of credit and insurance, common land development etc.	Medium	Mainstreaming of climate change adaptation into the development planning and liaisoning with the regulators
Lack of coordination and consultation among the line project partners	Medium	Information and Knowledge management and periodic stakeholder interactions and feedback.
Implementation delays	Low	Intensive monitoring mechanism and mid-term evaluation missions

C. Describe the monitoring and evaluation arrangements and provide a budgeted M&E plan. Include break-down of how Implementing Entity's fees will be utilized in the supervision of the monitoring and evaluation function.

The project has been designed based on the standard result framework and indicators have been identified. It would introduce a monitoring, evaluation and knowledge management system to facilitate compilation and dissemination of relevant project knowledge about issues, experiences and insights to all stakeholders.

The project would introduce a gender disaggregated system of data collection and reporting for each project component. The system would be designed to capture the rate of implementation against planned targets and objectives, as set out by the project design and reflected in the Annual Work Plans and Budget (AWPBs), and would monitor: (i) the financial information of the proposed project;(ii) the regular and systematic recording and reporting of progress against planned project targets; and (iii) more importantly, the assessment of the impact of project activities on the target group and the environment.

The Monitoring and Evaluation of the project achievements and knowledge management would be the responsibility of the project management units The results-based approach will be adopted, involving regular recording of, and accounting for progress against AWPB targets; and routine, periodic assessments of movement towards beneficiary impact. The same would be achieved through on-site and off-site monitoring by a dedicated team.

D. Include a results framework for the project proposal, including milestones, targets and indicators and sex-disaggregate targets and indicators, as appropriate. The project or programme results framework should align with the goal and impact of the Adaptation Fund and should include at least one of the core outcome indicators from the AF's results framework that are applicable[2].

Table 12: Project Log Frame

Project Description	Measurable Indicators	Means of Verification	Assumptions
Overall Objective			
Improved soil and water regime for better crop productivity and resultant increase of income of farmers	Crop loss due to climate variability reduced by X% for crop type X, Y% for crop type Y & Z% for crop type Z	Annual crop cutting report & crop loss measurement	
	Ground water table increased by X% from the baseline by the end of the project period	Measurement of Ground water table and comparing with baseline	
	Soil-moisture regime increased from the present level of X to Y by Z%	Soil-moisture sensor recorded data of pre during and post project	
	X ha. of area treated through different vegetative and mechanical methods	Reference of reports & physical verification of sites	
	X% of the total cultivated area i.e. Y ha. Of area covered under Crop diversification / mixed cropping	Reference of reports & physical verification of sites, comparative assessment against baseline	
	Loss of water due to flood irrigation / unscientific management of irrigation reduced from the present level of X to Y i.e. by Z%	Measurement of present water utility and comparison with baseline	
	Adaptation of climate resilient	Interaction with farmers, field	

[2] Please refer to the *Project level results framework and baseline guidance* for the Adaptation Fund's results framework and guidance on developing a results framework and establishing a baseline [add link here].

	agricultural practices by X% farmers	verification & document review	
	Insurance coverage of major crops in X% cultivated area in each season by Y% farmers	Insurance document reference, consultation with insurance providers and ensured farmers	
	Accessibility of farmers to weather information and information related to package of practices by crop types	Verification of SMS received by farmers, consultation with farmers & local weather station officials	
Purpose 1			
Increased water availability through the efficient soil water conservation techniques	Annual harvesting of a minimum of X Cubic Litre of rain water in the micro watershed	Measurement of conserved water, reference of annual run-off data	Ground water exploitation remains scientific with recharging of ground water in the adjacent watershed areas
	Run-off water percentage reduced from the present level of X to Y i.e. by Z%	Reference of annually measured run-off data in the watershed	
	Increased soil moisture from the present level of X to Y by the end of the project period	Reference of soil moisture sensor report (annual / periodic)	
Result 1.1			
Improved Soil Water Conservation Measures	100% villages having water harvesting and conservation structures in suitable places	Physical observation, scientific measurement of water level, reference of water conservation report on seasonal basis	Govt. land / private land is available for construction of water harvesting / soil conservation structures / measures
	Installation of X no. of artificial ground water recharging units and recharging of ground water	Ground water measurement, unit observation and report review	
	Soil erosion rate reduced from X to Y i.e. by Z%	Soil erosion rate measurement report	
Activity 1.1.1			
Summer ploughing, sunken pits/ponds			
	A total of X% farmers in the watershed area adapting practices	Discussion with farmers and database review by crop type practices	
	Of the total X% Small and Marginal Farmers, Y% adapting practices	Field visit and interaction with farmers	
	A total of --- No. of sunken pits / ponds covering Y% farmers (X% Small & Marginal Farmers)	Physical verification	
Activity 1.1.2			
Standard water conservation measures like percolation tank, check dams and farm pond	-- no. of percolation tanks constructed covering Y ha.	Physical observation, report review	
	X no. of check dams constructed	Physical observation, report review	
	X ha. of cultivated land covered under protective irrigation	Physical observation, report review	
	X% farmer receive protective irrigation	Physical observation, report review	
	-- farmers (X% farmer) covered under farm ponds	Physical observation, report review	
	-- no. of farm ponds constructed	Physical observation, report review	
	-- field bunds of different cross section	Physical observation, report review	
	-- no. of well recharge pits benefitting approximately all households of the watershed		
	-- sunken ponds constructed for water conservation & protective irrigation		
Purpose 2			
Increased adaptation to climate change through climate resilient farming system approach and diversification of livelihoods	Integrated / Diversified cropping system adopted by X% farmers covering Y% of the cultivated area	Crop field review & interaction with farmers	Existing Government System have required Technical Human Resource and facilitate extension services in a sustained manner, beyond the project personnel
	Minimised crop loss due to climate variability from preset level of X% (average for each crop type) to Y% i.e. by Z% by the end of the project period	Crop report	
Result 2.1			

Climate Resilient Cropping System	100% farmers received agri-extension services and advisory on package of practices by crop type	Interaction with farmers	Farmers willing to make investment of own share to availed project benefits
	VV ha i.e. X% of cultivable area covered under deep tillage	Interaction with farmers, review of crop specific tilling practice report, Interaction with local agri-extension service provider	
	Deep tillage will cover three major crops namely XYZ	Report review & discussion with farmers	
	Disc ploughing covering --- ha. Of cultivable land benefitting X no. of farmers i.e. X% of total farmers		
	-- no. of Integrated farming in X% of cultivated land by Y% farmers	Farm observation	
	In-situ hand holding support to 100% farmers individually or through their organisations	Interaction with farmers	
	X no. of farmers (Y%) trained on climate resilient cropping system	Interaction with farmers	
Activity 2.1.1			
Introduction of drought resistant and temperature tolerant HYV, use of alternate crops (e.g. fodder sorghum), intercrops, trap crops and alternate fodder crops	X% of cultivated area covered under HYV for crop type A, B and C	report review & interaction with farmers	
	Per ha. productivity increased from the present level of X to Y i.e. A% by the end of end of the project period for crop type A, B% for crop type B & C% for crop type C	Crop production report, interaction with farmers	
	X% of the cultivated area covered under alternative crop for present Y crop type	Farm field verification, crop report review & interaction with farmers	
	X% farmer adapt intercropping in Y% cultivated are i.e. average of A ha. per farmer	Farm field verification, crop report review & interaction with farmers	
	-- no. of fodder development covering X ha. Of land	Farm visit & fodder development report	
Activity 2.1.2			
Introduction of agri-horticulture and agro-forestry as a diversification strategy	--nos. of agro-forestry which covers X% of the present cultivated area	Farm field verification, report reference	
	--no. of agro-horticulture covering X% cultivable area & Y% farmers	Farm field verification	
	X% farmer adopt agri-horticulture /agro-forestry in their fields	Farm field verification	
	Income of the farmers increased by X% from agri-horticulture / agro-forestry	Interaction with farmers	
	X% farmers received technical support on crop diversification strategy / mixed cropping	Crop diversification report by agriculture season	
Activity 2.1.3			
Integrated farming system with crops and livestock (goat, sheep, dairy and poultry) with an intelligent mix of by-product recycling	X% farmers adopt integrated farming system in the watershed area	Farm field observation & interaction with farmers	
	Income of the farmers increased by X% from integrated farming system	Interaction with farmers	
	X% farmer received training on integrated farming	Training report	
	X% farmer got exposure on integrated farming system	Exposure report	
Activity 2.1.4			
Soil Nutrient Management (i.e. with the use of vermi-compost) to enhance soil organic carbon that would increase water	Soil treatment covering X cultivated area in an organic manner	Soil test report	

holding capacity; introduction of micro-irrigation, fertigation and cross-seeding that enhances water use efficiency and controls soil erosion			
	-- no. of Vermi compost units for Y ha. of cultivated area	Physical observation of vermi compost tanks	
	X% of farmers, including Y% of small & marginal farmers benefitted from vermi composting and soil treatment	Interaction with farmers	
	Soil moisture regime of the intervention area increased from X to Y	Measurement of soil moisture, report review (periodic report)	
	-- no. of drip irrigation system installed covering X ha. Of land benefitting 365 no. of farmers	Physical observation of installed units	
	--micro sprinkler system installed benefitting Y no. of farmers covering X ha.	Physical observation of installed units	
	X% farmers (Y% Small & marginal farmers) adopt micro irrigation for their crops	Physical observation of micro irrigation & irrigation management practices	
	Micro irrigation saves at least X litters of water per crop in a season	Water conservation report review (irrigation related)	
	Soil erosion control measures reduces present soil erosion rate from X to Y	Report on soil erosion, measurement	
Activity 2.1.5			
Introduction of renewable products and energy efficient devices (e.g. solar cooker, solar lamps, improved cookstoves, etc.	X% families supported with energy efficient devices in the watershed area	Interaction with families / households supported with, database review of supported families	
	X% families adapt energy efficient devices in the watershed area which minimised non-renewable energy consumption	Physical verification & interaction with adapted families	
	40 bio-gas units covering about 40 households in the watershed areas	Physical verification & interaction with adapted families	
Purpose 3			
Integration of risk mitigation products like weather advisory/insurance and other financial products for the farmers	100% farmers covered under weather insurance	Insurance report	Weather insurance products are available with insurance companies & crop insurance covers pulses, oilseeds, maize, cash crops & vegetable crops
	X% farmers covered under crop insurance for Y crop types	Insurance report of insuring company	
	X% families availed supportive livelihoods options in off/non-farm	Interaction with farmers, database review for extended support	
Result 3.1			
Livelihoods Diversification	X% families diversified their present livelihoods options	Interaction with farmers	Convergence model is in place for livelihoods enhancement
	X% farmer have increased annual income from diversified livelihoods by Y% from its present level	Interaction with farmers	
Result 3.2			
Risk Transfer, Weather Insurance, Livestock Insurance, Micro Finance & other innovative Financial Products	X% farmers covered under weather insurance	Insurance report	Insurance services are available to the people in rural areas / watershed area
	Crop insurance coverage of X% farmers for Y% of the total cultivated area in each year	Insurance report	
	Financial loss of farmers due to climate variability linked crop losses minimised by X% for Y% farmers	Interaction with farmers	

Activity 3.2.1		
Livestock Insurance and Agri-Insurance Pilots	X% farmers ensured their livestock	Insurance report, interaction with insurance service providers
	Financial losses incurred due to livestock mortality reduced by X%	Interaction with farmer
Purpose 4		
Creation of knowledge management system for climate change adaptation in rainfed areas	Operational manual developed on climate resilient agricultural practices, based on the learning of the project & used for advocacy	Reference of operational guidelines
Result 4.1		
Development of an operational manual for the mainstreaming climate proofing watersheds to influence policy	One operational manual developed having different learned lession	Reference of operational guidelines
Activity 4.1.1		
Development of operational guideline for climate proofing the watersheds	One operational guidelines developed based on the project learning & utilised for advocacy	Reference of operational guidelines
Activity 4.1.2		
ICT integration and help desk to provide farmers with SMS based weather advisory and agri-extension advisory	Existing State level help desk strengthened to provide weather &agri-extension advisory on regular basis	Call record review of help desk & discussion with help desk officials of Govt.
	All farmers, having cell phone receive weather related information and information on package of practices based on crop type	Review of SMS received by farmers & interaction with farmers
Activity 4.1.3		
Policy brief and workshop for mainstreaming the concept of climate proofing the watersheds	X no. of State level workshops organised as a part of policy advocacy involving Y no. of persons	Workshop minutes, reference document & photographs/video

E. 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.

The total outlay of the project works out to USD 5.54 million of which co-funding by NABARD will be done to the extent of USD 4.43 million, beneficiary contribution by way of voluntary labour will be USD 0.56 million. The balance cost towards climate change adaptation estimated at USD 1.097 million is sought from AFB under the present proposal. This cost is mainly towards four major components viz., improvement is the soil- water regime, climate resilient farming systems, risk mitigation and knowledge management.

Amount (million USD)

Component	Total Cost	Beneficiary Contribution	Fund Support by NABARD	Fund support sought from AFB
Improvement in Soil-Water Regime	2.38	0.34	1.84	0.2
Climate Resilient Farming System	1.21	0.11	0.49	0.61

Risk mitigation	0.09	0.00	0.00	0.09
Knowledge Management	0.13	0.00	0.00	0.13
Others	1.67	0.12	2.09	0.00
Sub total	5.47	0.56	4.43	1.02
Project / Programme execution cost	0.07			0.07
Total Project / Programme cost	5.54			1.097

Component-wise, project area wise cost details are furnished in Annexure 1 (A&B).

The subcomponents under each of the main components to be funded by AFB are as indicated below:

Component	Sub-Components
Improvement in Soil-Water Regime	Waste weir, Diversion drain, disc ploughing, sunken pond, well recharge pits, Stone-pitched thawla (bunds), Gradonis (bench terracing), Bund planting
Climate Resilient Farming System	Plant Seeding in bushes and notches, deep ploughing, Sloping Agricultural Land Technology, Grass seeding, forest species seeding, silvipasture, grassland ecology study, creation of Pasture group and fodder bank, Energy Efficient Systems
Risk mitigation	Installation of Mini Agro-met observatory, Instrumentation, Weather Based Insurance
Knowledge Management	Climate Change Adaptation related manual preparation, peer learning, audio visual tools, short films, etc.

The above costs pertaining to climate change adaptation components were estimated on the basis of the cost details under NABARD-GIZ support projects under implementation. As such this cost may undergo change at the time of DPR preparation based on detailed climate analysis, location specific design requirements and stakeholder consultations..

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

A. RECORD OF ENDORSEMENT ON BEHALF OF THE GOVERNMENT[3] *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:*

(Enter Name, Position, Ministry)	Date*: (Month, day, year)*

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 (……list here…..) and subject to the approval by the Adaptation Fund Board, understands that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.	
Name & Signature Implementing Entity Coordinator	
Date: *(Month, Day, Year)*	Tel. and email:
Project Contact Person:	
Tel. And Email:	

6. Each Party shall designate and communicate to the Secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.