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Abstract.

Role of Community in Responding to Climate Change and Water Scarcity in Rural context.

This paper discusses the important issue of chronic water scarcity, resulting from extreme heat in dry regions, threatening both agriculture and household water use and particularly, how communities can activate a system of self-help to address this. The issue is generally relevant for all rain fed areas of India. A holistic analysis of the government effort and the nongovernment organizations (NGOs)is attempted in the paper which gives a variety of micro policy options for reversing the crisis. The role of community is shown to be the crucial factor that will mark feasibility of local solutions for unique local dimensions of the problem. A case study of two villages of West Bengal is presented which have distinct ecological characteristics and hence face unique problems. One village is a tribal village with joint ownership of ponds which are their lifeline for all economic activity. Other than the NGO help, guiding the functions of the Self-help groups, the community is self-sufficient. There is limited government initiative in this village. The other village has communally held ponds but also a government Watershed Project. This village has self-help groupswhich are formed under government initiative. Involvement of the community in the two villages, hence are very different. The main purpose of this paper is to study the impact of communal cooperation or lack of it, on life of the people in the two villages.Good outcomes in reversing somewhat, theconsequence of visible climate change, will be understood in terms of high agricultural production and an account of seasonal migration that has become lesser than the past. It is important to look at the communities' capability to design rules of water governance and practices of water conservation. In the end, a comment on the positive action of the State is recommended. The State has to be proactive in disseminating knowledge to farmers , especially relating to soil health, maintaining surface water bodies and proper modes of irrigation in the changed circumstance of climate change.

Key words: climate change, rain fed agriculture, water governance, Self-help groups, NGOs.

I. Introduction.

In human settlements, there are always areas that are water abundant and areas that face water stress chronically. All developmental effort, therefore is fortified with special strategies for draught prone areas. But the water crisis that is considered here, has close link with the phenomenon of climate change. Climate change is explained as long period systemic change in temperature and rainfall patterns, leading to unexpected environmental impacts. Since 1980's, the phenomenon of climate change has been evidenced, debated and time and again denied.With

1990's adjudged the warmest decade since 1000 years, denials have given way to grave concern. Temperature was predicted to go up from 1.4 to up to 5.8 degrees Celsius by year 2100, giving longer hours of sunlight, hotter heat waves. The attendant hazards include melting of ice cover on mountain peaks (eg. Himalayas) resulting in swelling of perennial rivers and ultimately raising sea levels, threatening submerging of low lying islands, coastal as well as delta areas.

Highly unpredictable occurrence of rain in terms both of time and ferocity accentuate the suffering of people so affected.Large population movements infear of disaster also bringnegative welfare implications.The unprecedented disasters associated with climate change have been experiencedthroughout the last decade (Tsunami, cyclones, cloud bursts, earthquakes etc.) in different parts of world, indifferent magnitudes. I quote one such experience(2013) "The coastal areas are under the surge. The highly populated deltas of Nigeria that are under sea level are at risk of flooding as a result of anticipated sea level rise due to climate change. The 1999 flood incidence in Lagos, Abeokuta, Delta and Edo states of Nigeria respectively recorded many losses while800,000 people were affected by flooding incidentin 14 countries of West Africa in 2007. In 2012, over l8 local Government areas of Anambra State of South easternNigeria were affected by severeflood incident. The seasonal heavy rainfall also exacerbates erosion menace that deteriorates soilquality. Soils are loosened, surface water dried up and wind erosion is predominant. The unsuccessful effort to combat most environmental hazards such as flooding ensuing from climate change has been attributed to lack of understanding of the dynamics of the characteristics of the environmental varieties particularly weather and climate. Unplanned physical expansion that encourages property development on natural pathways of runoff obstructing water flows, exacerbates the implications of climate change in Nigeria."[1]

An obvious consequence of global warming isits direct impact on agriculture. Statistics reveal a disproportionate impact on developing countries' population who are eking out a living from rain fed subsistence agriculture. Highly unpredictable occurrence of rain in terms of both time and ferocity, keeps agricultural fortunes swinging between alternating and erratic, droughts

[1]E.I. Okoyeh, B.C.E. Egboka, O.L. Anike, E.K. Enekwechi and I.C. Mjemah(2013)

and floods. An example of each of these problems is cited below which are micro studies of different parts of India. Solutions as we see are contextual.

Recently, (Pavan Dahat,August2013)[2],Yavatamal district inVidarbha, Maharashtra which is known for its extreme drought has reported floods that havedestroyed the entire cotton crop. The farmers had sown seeds a second time after the first sowing of June was lost. This has increased indebtedness to almost Rs. 45 000per cotton growing family with no crop in sight this season. Strangely there is a farmer suicide here due to floods. So far this district had farmer suicides for drought.

Another acute problem which is also encountered is "salinity ingress" in coastal regions.. We have the report of spreading salinity in Kalyanpur of Jamnagar district of Gujrat[3].The process of creeping of marine water into fresh aquifers has gone on since 1970's and noticed after the tubewell revolution in Indian agriculture since 1980's. But the rate of ingress is now assessed to be ½ km per year along the 1125 km of the coastline, affecting 2500 villages. Excess withdrawal of water for both agriculture and domestic purposes in the coastal area has depleted groundwater accentuating salinity. There is a success story of Beria in Rajkot where public effort, guided by Swadhya, asocial, spiritual organization working since 1980's has reduced salinity by rainwater recharging directly the irrigation wells There are133 small check dams in the area already. Also a joint effort between Coastal Salinity Prevention Cell, (promoted by the Agha Khan Rural Support Program) and the State government promoted Water and Sanitation management is providing safe drinking water in the area. There is also new high cost initiative of constructingfreshwater canal to recharge ground water. For drinking water in fully saline areas, micro level roof top rainwater harvesting is encouraged.

Another unique story is that of West Bengal, Sunderban Delta area where salinity has affected a large area of rice land, making it useless for rice farmers. This was the aftermath of Aiila cyclone on Bay of Bengal in 2009. But persistence and use of traditional knowledge base has helped and the Society for environment and Development(ENDEV,Kolkata) has procured salt tolerating local rice seed. Over last 3 seasons, trial in small farm areas have yielded enough paddy to sow. The work is on in 5 Blocks of Sunderbans. The seeds are distributed to farmers who pledge to give back twice the amount they received ,every season. Thus over longer period more farmers will use the seeds starting a virtuous cycle and growth of a seed bank.

Like Nigeria,Tanzania and other West African countries, in India also, it is apparent that high temperatures, longer sunshine periods and delayed rains increase aridity, drain soil moisture, deplete ground water, dry out surface water resources like ponds. All these developments accentuate water stress .In addition to impact on agricultural production and hence food supply, availability of drinking water, livelihoods like livestock tending andfishing are negatively affected.Adaptation to these changes must mean crop rotation and diversification in a locally suitable manner. In Nigeria, multiple crops are

[2]PavanDahat,(2013)
[3]Sudhirender Sharma (2013)

grown such thatrice, maize, corn, millets, sorghum and tubers like cassava, yam, cocoyam and potatoes are all major agricultural products. India also has special programs for the drought prone areas. There areas will have worse water stress with global warming. UnderRashtriyaKrishiVikasYojana,sustainable agriculture based on millets and tubers, vegetable and oilseeds etc. is likely to pave ways for holistic development.But there is need to know regional suitability,prices and also local taste and preferences.

To sum up, climate change and specifically global warming has lot of scope for policy makers to think out of box solutions to these grave problems and a cooperative outlook is beneficial . It is important to look for synergy between State machinery, NGOs and local stakeholders. This paper will befocusing on increasing temperatures and delayed rains multiplying water stress in already water scarce areas.

This paper aims to establish that the problem of water stress has a regional character, needing local initiative(both of the community and the NGO) along with the State action. This is because unique opportunities of change in agricultural practices, crop choice and water use are recognized only at the local level. Hencecommunity's support and cooperation , over and above State funding and guidance is required. The paper has strictly a rural perspective and climate change policies mentioned here are mainly for the State of West Bengal. For this purpose, two villages of West Bengal will be considered whose experience of water stress will be compared in two time periods (2005-6 and 2013) .Inter temporally, positive outcomes can beunderstood as, higher agricultural production or lesser water stress in dry season or fall in outmigration. Section 2discusses climate as a concept and climatic divisions in West Bengal. The Agro climatic Regions are delineated. Section 3 is on choice and description of the villages and summing up the observation in January-March 2005-6. Section 4 points out the differences noticed in August 2013.

2. West Bengal and climate change.

A brief overview of the State..

The State of West Bengal is located in the Eastern part of India, bordering three countries namely Bangladesh, Nepal and Bhutan. The periphery of the State is nestling against borders of five Indian States- namely Orissa, Jharkhand, Bihar, Sikkim and Assam. It is known to have porous international borders, especially with Bangladesh which often makes the Census process difficult. The State covers an area of 88,752 sq.

km, representing 2.2% of the geographical area of India. According to 2001 Census, the State is divided into 19 districts which numbered 17 in 1991 Census.[4]

The States' rural bias in terms of population and poor history of industrialization, makes agriculture very important as a means of livelihood. Since 1985, the State saw a turnaround in productivity of agriculture which was caused both by technological and institutional change. Technological change was in the form of HYV seeds, mechanization and a tube well revolution that augmented sizable areas to double cropping. Institutional change, through Operation Bargha affected land ownership and also financing of agriculture substantially improved, making 1980's highly productive for agriculture in West Bengal. Although the same trend of prosperity did not continue in the 1990's, West Bengal continued to bethe highest producer of rice among major States in India in 2000-01.[5]There was practically mono culture in rice which hadmore than 90% share in food production.Pulseswere produced with a small percentage share of 6%. However, by 2010-11 West Bengal is second largest producer of potatoes after Uttar Pradesh and one of the highest producers of rice.

Most production is small scale as 90% of agriculturists are small farmers. 88.8% of farmers hold<1 hectare land per head. It has 3 crops of rice in the irrigated areas following multiple cropping, namely, autumn rice (aus), winter rice (aman) and summer rice (boro). Boro cultivation is very popular but totally groundwater dependent. It showed an increase in acreage over the decade (1990-2000) from 896.1 to 1474.3,[6] However, Boro cultivation is proving to be unsustainable both due to depletion of ground water and the loss of crop diversity it entails.

Climate .

In general the climateof West Bengal is tropical and humid except in the Northern Hilly Region. **Temperature** is a prime determinant of climate type. Maximum temperature in the State varies from 24 to 40 degrees centigrade.in summer and 7 to26 degrees in winter. Recent years the temperature norms are exceeded often.2012 saw 40 degrees temperature in Kolkata and 46 degrees in Asansole. There were many heat stroke deaths reported in 2012.

In Table1 below,district wise rainfall data is given. The **normal average annual rainfall** according to the 1990 rainfall record in the State varies between1322 mm in Purulia and

[4]The additional districts are obtained by division of Medinipur into East and West and taking Kolkata as a separate unit.

[5]Between 1980-81 to 1990-91, growth in yield rate for rice was 5.2% for Aus and 4.5% for Aman. Rate of growth per annum for rice was 11.47 %.(Directorate of Agriculture, West Bengal).

[6]Directorate of Agriculture. Government of West Bengal..

3508mm in the Jalpaiguri district.However,the annual rainfall in most districtsof West Bengal has shown an overall decline over the yearswith respect to the normal annual record of 1990.

Another parameter to look for is **RH** (relative humidity)This isrelatively high in the northern hills of Darjeeling(2-94 in summer; 97-98% in monsoon and84-85% in winter.In sub Himalayan region it varies between65-96% in summer,82-93% duringmonsoon and 79-91% in winter. In the Gangetic West Bengal RH value ranges between 60-84% during summer,82-90% in monsoons and 60-80% in winter.[7]Following is the annual rainfall data of the State and the month wise data from 2010 March to 2011November.

The figures for entire Khariff season for last 2 years, 2010 and 2011 is showing different rain pattern, Bankura and Birbhum have rain fall in 2011 as agaist 2010hilly districts with higher annual average show the opposite rain outcome.

Table 1.Rainfall (Actual) in West Bengal

(In millimet

Year/Month	Sub-Himalayan West Bengal						Gangetic West Bengal				
	Darjeeling	Jalpaiguri	Cooch Behar	Malda	Uttar Dinajpur	DakshinDinajpur	Burdwan	Birbhum	Bankura	Mediniı	
										Purba	P
1990-Normal	3085.0	3508.0	3042.0	1485.0	2042.0	1755.0	1348.0	1431.0	1386.0	1702.0	
2004-Annual	2841.0	3924.0	3067.0	1919.0	1513.0	1640.0	1193.0	1422.0	1211.0	1505.0	
2005-Annual	2490.0	3073.0	3274.0	1579.0	1826.0	1965.0	1224.0	1264.0	1213.0	2259.0	
2006-Annual	3015.0	3017.0	2149.0	1329.0	1261.0	1156.0	1446.0	1605.0	1313.0	1703.0	
2007-Annual	3806.0	3480.0	2537.0	1716.0	1528.0	1501.0	1813.0	1711.0	1803.0	2171.0	
2008-Annual	3463.0	3531.0	3057.0	1541.0	1505.0	1383.0	1557.0	1400.0	1561.0	1703.0	
2009-Annual	3341.0	3155.0	2438.0	1204.0	1521.0	1256.0	1229.0	1278.0	1231.0	1301.0	
2010-Annual	4018.0	3882.0	3673.0	1129.0	1588.0	1683.0	857.0	985.0	917.0	1244.0	
2010-March	0.0	74.0	30.0	0.0	0.0	0.0	1.0	4.0	3.0	1.0	
April	72.0	159.0	385.0	26.0	70.0	71.0	22.0	18.0	24.0	1.0	
May	355.0	396.0	600.0	121.0	187.0	171.0	92.0	77.0	129.0	94.0	
June	896.0	900.0	711.0	263.0	310.0	419.0	219.0	219.0	204.0	178.0	
July	1142.0	1044.0	863.0	211.0	376.0	237.0	133.0	206.0	163.0	266.0	

[7] Analysis based on india meteorological Department for years-2000 and 2001.

August	876.0	688.0	525.0	174.0	268.0	367.0	115.0	115.0	144.0	295.0	
September	456.0	539.0	496.0	218.0	319.0	268.0	178.0	223.0	141.0	246.0	
October	188.0	70.0	61.0	103.0	57.0	144.0	46.0	65.0	58.0	125.0	
November	33.0	10.0	2.0	7.0	1.0	6.0	4.0	6.0	6.0	5.0	
2011-March	21.0	78.0	56.0	9.0	21.0	28.0	35.0	38.0	49.0	13.0	
April	143.0	184.0	138.0	36.0	59.0	58.0	77.0	68.0	109.0	76.0	
May	230.0	321.0	294.0	156.0	286.0	220.0	113.0	94.0	123.0	112.0	
June	565.0	552.0	431.0	317.0	348.0	339.0	319.0	411.0	493.0	309.0	
July	1098.0	889.0	775.0	253.0	408.0	236.0	213.0	187.0	212.0	272.0	
August	677.0	562.0	476.0	389.0	306.0	311.0	318.0	444.0	392.0	384.0	
September	562.0	508.0	465.0	249.0	328.0	265.0	220.0	214.0	324.0	335.0	
October	77.0	39.0	20.0	24.0	5.0	6.0	26.0	19.0	33.0	24.0	
November	32.0	2.0	0.0	0.0	12.0	4.0	0.0	0.0	3.0	0.0	
Kharif Season											
2010 (June to Sept.)	3370.0	3171.0	2595.0	866.0	1273.0	1291.0	646.0	763.0	652.0	985.0	
Kharif Season	2902.0	2511.0	2147.0	1207.0	1390.0	1151.0	1069.0	1256.0	1422.0	1300.0	
2011 (June to Sept.)											

Year/Month	Gangetic West Bengal (contd.)						
	Howrah	Hooghly	North 24-Parganas	South 24-Parganas	Nadia	Murshidabad	Purulia
1999-Normal	1536.0	1476.0	1624.0	1876.0	1444.0	1377.0	1322.0
2004-Annual	1365.0	1118.0	1407.0	1599.0	1224.0	1471.0	1220.0
2005-Annual	1612.0	1198.0	1262.0	2155.0	1195.0	1172.0	1079.0
2006-Annual	1513.0	1129.0	1316.0	1892.0	1143.0	1372.0	1276.0
2007-Annual	2025.0	1606.0	1479.0	2169.0	1612.0	1722.0	1614.0
2008-Annual	1815.0	1471.0	1349.0	1328.0	1436.0	1270.0	1348.0
2009-Annual	1352.0	1263.0	1410.0	1415.0	1209.0	1180.0	1024.0
2010-Annual	1219.0	1044.0	1180.0	1227.0	940.0	989.0	798.0
2010-March	3.0	1.0	1.0	2.0	0.0	0.0	1.0
April	4.0	18.0	34.0	3.0	28.0	18.0	9.0
May	145.0	145.0	170.0	115.0	143.0	127.0	79.0
June	218.0	190.0	205.0	237.0	192.0	232.0	104.0

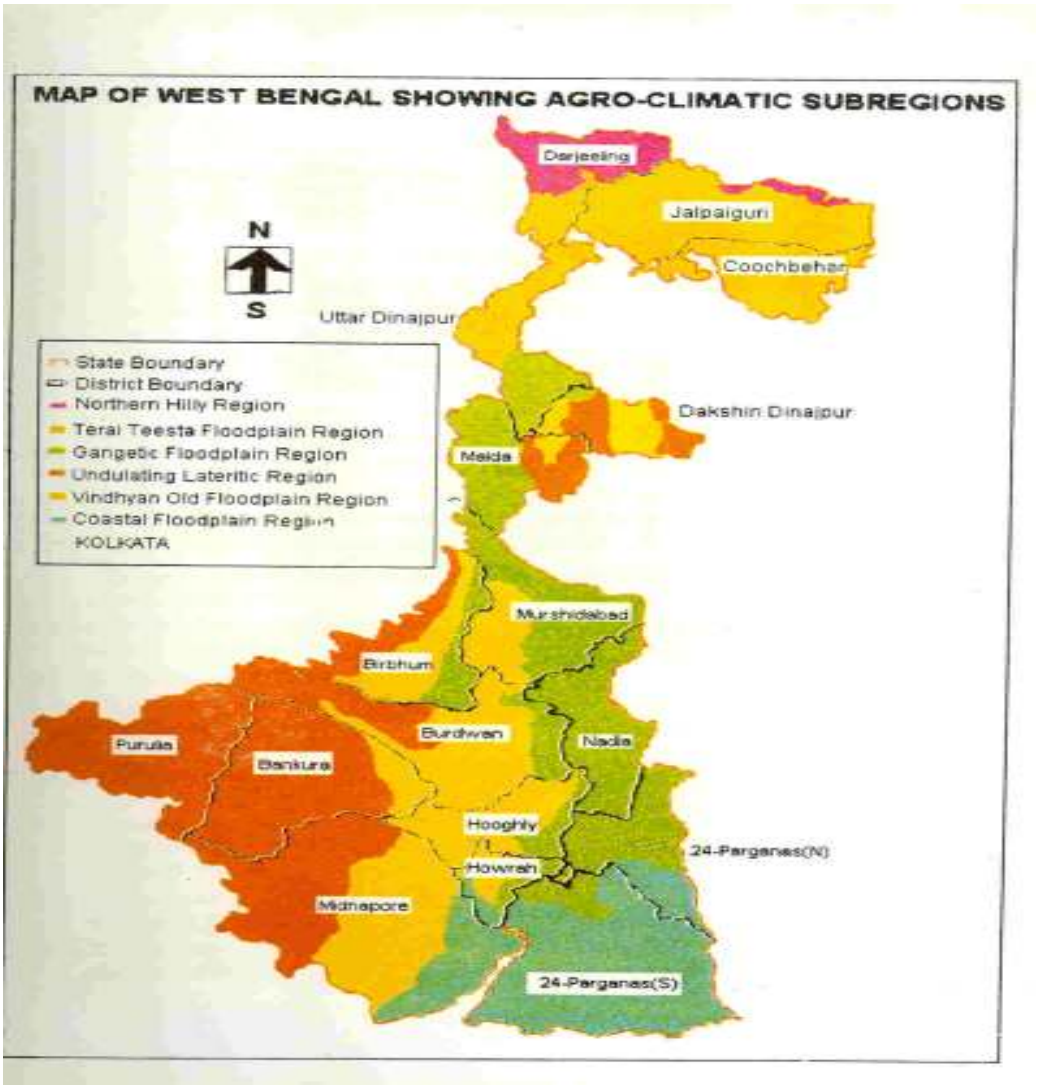
July	179.0	155.0	181.0	245.0	115.0	157.0	159.0
August	250.0	211.0	215.0	258.0	97.0	128.0	192.0
September	237.0	212.0	241.0	215.0	176.0	186.0	148.0
October	137.0	80.0	107.0	130.0	131.0	101.0	46.0
November	5.0	3.0	4.0	5.0	6.0	2.0	9.0
2011-March	40.0	51.0	45.0	24.0	47.0	26.0	37.0
April	63.0	52.0	62.0	35.0	83.0	82.0	38.0
May	94.0	130.0	118.0	89.0	118.0	122.0	79.0
June	326.0	327.0	344.0	342.0	340.0	398.0	421.0
July	227.0	253.0	321.0	210.0	245.0	238.0	227.0
August	453.0	449.0	488.0	522.0	378.0	406.0	393.0
September	262.0	257.0	264.0	276.0	250.0	219.0	337.0
October	27.0	33.0	25.0	30.0	25.0	30.0	20.0
November	0.0	1.0	0.0	0.0	1.0	0.0	0.0
Kharif Season							
2010 (June to Sept.)	884.0	768.0	842.0	955.0	580.0	703.0	603.0
Kharif Season	1267.0	1285.0	1418.0	1349.0	1213.0	1262.0	1378.0
2011(June to Sept.)							

Source : Agricultural Meteorologist,
Directorate of Agriculture,
Govt. of West Bengal.

There is another climatic element of great importance,particularly for use in
Agricultural climatology namely, the P-PE factor where P is the mean annual precipitation and PE is potential evapotranspiration. Without these differentiation between dry and moist climate cannot be done.

All these elements make for categorization of regions as climate types. There are some 12 climate types or sub regions. recognized. Including temperature, average annual rainfall, RH and P-PE type of natural vegetation and climatic hazards together determine the Agro climatic divisions.

Fig.1. Agro climatic subregions.



Agro climatic division of West Bengal.

The State exhibits all major ecosystem types viz. **mountain eco system** (Darjeeling district); **forest ecosystem** (hill forests, forests of Dooars-Terai, forests in Gangetic plains, mangrove forests in Sunderbans); **freshwater ecosystem** (prevalent in riverine area as well as natural and manmade wetlands and lakes); **coastal and marine ecosystems** (covering 220 km of coastline in Medinipur, both South and North districts of 24 Parghanas); **semi-arid ecosystem** (Purulia,

Bankura and Birbhum districts of red laterite zone) and **island ecosystem** (islands of Sunderbans in the Hugli-Matla estuarine region).

The state, in most parts, has a climate that is hot and humid but it has great variability between different regions.[8]

There are three main Agro-climatic zones which cover the State. They are **Eastern Himalaya, and Bramhaputra valley (EHM); Eastern Plateau Hills (EHG) and Lower Gangetic Plain (LG).**

Due to great diversity in the state, identified by other ecological criteria like soil quality, water quality etc., there are six sub regions within the broad Agro-climatic zones.

Northern Hilly Region: covers the Northern Part of Jalpaiguri and major portion of Darjeeling District. The area has dense forest, intercepted with terrace cultivation of paddy and plantation, mainly of tea. The area has variability in both temperature and access to rain. The steep slopes in the area has shallow soil depth, poor water retention and ample scope for erosion. So in spite of good fertility of soil, the extension of agricultural area and yield are moderate.

TeraiTeesta Floodplain Region: covers the alluvial plains of Jalpaiguri and Coochbehar, parts of Darjeeling and Uttar Dinajpur. The region has hot humid climate with good soil depth. But 20% of the area is prone to water logging and sand deposits by quick gushing rivers. This plus soil reaction being acidic, makes the region agriculturally, not prosperous..

Undulating Laterite Region: has mixed climate types viz. the hot moist sub humid one, covering parts of Malda and DakshinDinajpur of the Gangetic plains and hot dry sub humid type in the western parts of Bardhaman, Bankura, Birbhum, Purulia and Medinipur. The upland areas face the problem of runoff and loss of soil nutrients that make the areas low in agricultural yield and extend the areas not fit for cultivation. The low lands alternately are rich in fertility.

Gangetic Floodplain Region: covers Nadia, parts of Malda, DakshinDinajpur, Murshidabad, Bardhaman, Hugli and two districts of 24 Parghanas. The soil is non acidic and fertile with high potential for retention and recharge of ground water and the region is lush with multiple cropping of paddy, oilseeds and horticultural products.

[8] Considering factors of temperature, humidity and precipitation, there are four climate types namely humid north montane, super humid Terai, semi-humid north and south and sub-humid east and west.

Vindhyan Floodplain Region: consists of Western Murshidabad, Hugli, parts of Nadia, and Eastern parts of Birbhum and Bankura , Central parts of Bardhaman and Medinipur and North Haora. The region has hot moist sub humid type climate and high soil fertility but is highly flood prone, due to poor drainage after river outflows of Ajay, Damodar and Bhagirathi.

Coastal Floodplain Region: is defined by the moist sub humid climate, consisting Haora and East Medinipur districts, lower regions of 24 Parghanas(N), 24 Parghanas (S), including islands of the Sunderbans. The fertile alluvial soils are saline in character. The Magnesium in the soil results in non-porosity, making salinity and water logging hazards of the area. Potable water is available only in very deep tube wells.

3. Case study of two villages forcomparisonof community participation.

Objective.

.1.To study the present day problems of water stress in the two villages. Compare the situation in 2005-6 and August 2013.

2.To enquire if regular migration from the villages is lesser or more, both daily and seasonally.

3.To see whether local community with NGO assistance is a better catalyst of change or State help deserves more credit.

Methodology.

Collection of information on the two villages, following an interview method.

The contact areas were

The NGO, LokKalyanParishad of Kolkata, Bolpur and Labpur for village Kalikapur. Meeting the village SHGs in Kalikapur.Touring of the village for perceptible changes in lives of people, school and ponds.

Collecting written documents on SHG functioning in the village.

Meeting Dr. AshishGhosh,Director of ENDEV(Society for Environment and Development) in Kolkata.

Visit to interview The BDO,Chhatna Block, GP of Ghoshergram for information on degr o

Out migration for work and NREGA impacton the village.,for the village Ghoshergram.

Data.

Climate data from Economic Review, 2011-12 GOWB..

RashtriyaKrishiVikasYojana , West Bengal.

Status of Environment:The Second Citizen's Report

.Reports on climate change and State Action Plan for Climate change. (SAPCC)

Own Primary survey data(2004-5)

Choice of villages.

The villages selected are:**Kalikapur** in the LabpurBlock of District Birbhumand **Ghoshergram,** under the Chhatna block of district Bankura. These villages were part of a bigger study that covered 7 villages from7 districts of West Bengal. Together they represented all 3 Agro climatic regions of the State. The Primary survey was conducted in December-January 2004-5 and a second survey on water quality in March 2006

Their choice in this study allows a comparison of village realities in today's time The present period interaction with the village community was between 16/8/13 and 21/8/13. The present information is based on Gram Panchayat (GP)and LokKalyanParishad (LKP) interview for Kalikapur , and additionally with the SHGs in Kalikapur. For Ghesherhram, the information sought was from the Block Development Officer (BDO), GP and the Agricultural Development officer (ADO)l.

The choice of the villages is appropriate by the climatic setting. Both the villages belong to The Agro Climatic Zone EHG and Undulating Laterite Agro climatic sub region. Their climate type is sub humid west.In this climate type,minimum temperatures always >13, average annual rainfall <1500mm. Mean relative humidity (RH) always<65% P<PE –meaning that evapo transpiration is greater than precipitation.Their climatic hazards are- frequentdraught, prolonged heatwaves during summer months.

Additionally, both villages belong to areas categorized as Semi critical with regard to ground water. Both the rugged districts of Bankura and Birbhum, hydrogeologically are placed in the category of Consolidated/ semi consolidated, having limited ground water potentiality.Both are characterized by

high run off leading to low capacity recharging groundwater.[9]Bankura and Birbhum have undulating topography and a wide fluctuation in water table. These areas are classified as recharge zones that are water-stressed beyond January and are optimally recharged in the monsoon period.[10]

Both districts are classified as water stressed. Water stress is understood by the norm of water availability of 100-1600 cum per capita, any decrease from the norm signifies water stress. The water from all sources is taken into account for calculation of the per capita availability. namely monsoon and non-monsoon rainfall, surface water, ground water and trans boundary water from neighboring States.[11]

Description of study area.

Location and physical setting:

KalikapurIt is about 26 km from Bolpur.[12]The basic information about this village is not available from the Census as it is not a revenue village.[13] The village is about 84 years old.. 100% of its population is Tribal and hence ST. It is interesting to know why it is so. A short history of the village was narrated by a retired GP member. Around 1930, the Zamindar of Labpur, ShasthiKinkar Banerjee, brought 6-7 families of Tudu, Soren and Murmu caste and gave free homestead land. Some more Kishku families came later. All the settled families were given in addition to bastu(homestead land), some land as Krishani (sharecropper). The share of the landlord was 3/5 of total produce. The famous Tebhaga stir in West Bengal, to bring down share of land lord to1/3 of produce, was not beneficial to this village as they remained isolated due to their special situation. A sense of servility prevailed. After abolition of Zamindari, in 1953, some land was vested with an understanding of allegiance. After 1969, there was 1 hectare and 2.47 acres vests to individual beneficiaries, none of whom were landless. Since 2003-4 the Land

[9] These areas need to be conserved for reducing run-off as well as soil erosion through intensive aforestation.
[10] Proper rainwater harvesting and watershed development have great scope here.
[11] The information on climate is from ENDEV (2013).
[12] Bolpur is the host town of Shantiniketan and the Vishwabharati University founded by Rabindranath Tagore.
[13] It is a part of the Shekhampurmouja under GP ChouhattaMahodary-I. The information on population, exact number and location of village Households, also on CPR land and water of Kalikapur was provided by the GP (gram Panchayat)from the Mouja map of Shekhampur.

Records of West Bengal villages were being finalized. It was astonishing that in this poor village, there were only 10% registered Bargadars (share croppers), 90% families did notqualify.

Ghoshergram.

It isunder the Chhatna block of district Bankura. It is a full mouja village so that the GP is also Ghoshergram. This is a large village with six hamlets (padas) of heterogeneous population. There is Majhpada that has a total population of adivasis; Kamarpada that has some adivasis but the name is owing to the fact that mostly people are blacksmiths (kamars); Bauripada where we have wage laborers as well as cultivators but the name is derived from the fact that majority of the population are of Bauri caste. The other padas are Dhadanga, Kashipada and Gerardihi which have mixed population of general caste, SC and OBCs. These hamlets are poor, dirty, congested and have very poor facility of drinking water and road.

The village has undulating land with high degree of porosity. As a result, there is both soil erosion on the slopes and fast loss of moisture on lower land

Ghoshergramis the only village with total heterogeneity of population and where village hamlets are marked out caste wise. But the village still has a lot of social cohesion and amity. It is a very backward village in terms of facilities. There are noall-weather roads in the village.There is only a primary school and a Balwadi within the village.With the Primary Health Centre at a distance of 12 km, there is no registered medical practitioner or family welfare center nearby i.e. within 10 km.There is no ration shop in the village. People have to walk at least 1.5 km. The village has no market. There is no weekly or fortnightly market also. They access a market 2 km away for all purchases.There is a library at a distance of 2 km which hardly any one accesses.There is no electricity in the village.There is open and improper drainage.

Land use:

Since Kalikapur is not a revenue village the ROR was taken from the Mouja Map of Shekhampur from the GP.The total land area is 76.20 acres. Of this the area that is Common Property Resources (**CPRs) = 65.38 acres. Common Property Water Resources (CPWRs)= 3.18 acres and CPR land = 62.20 acres.** The category of barren land dominates the type of

CPRs.[14]At present, there is almost no Common land area left other than the roadside, pond boundaries and Tribal social and religious meeting places. The wood lots, created by the zamindar were later taken over by the Forest Department. Much of the Common land was converted to rice fields or residential land.

In Ghosherhram,Land use pattern shows private land use is predominant.Out of the total land area of 888.54 acres, CPR land= 103.16 acres.

CPWRs=54.57 acres.Common property land + water only amounts to 17.7% of land area.

Water Scenario.

Kalikapur is in the extremely dry patch of Birbhum although there are 2 rivers which are accessible to the village. One is called River Kopai which runs about 20 feet below the village surface, and a seasonal river called Kuyenadi. The village is also near the confluence of River Kopai and the Bakreshwar hot springs. At a distance of 11 kms, is the river Mayurakshi, which is accessible only to the young and able villagers as there is no transport facility. This village is ravaged by flash floods from the big rivers of Birbhum, namely Ajay and Damodar.

Hence, the village suffers extreme drought and occasional floods, both negatively affecting crops. There is immense ecological problem of water stress caused by porosity of soil, also alternate bouts of floods and draught. The water related degradation is compounded by the highly porous soil quality which soaks up all rain water.

Primary source of drinking water is tube well or hand pump The villagers often take drinking water from under the sand of Kopai between March to May.Within the village there are 6 water bodies, 3 of which run totally dry in summer months.

In **Ghoshergram,** drinking water is available from 5 Tube wells, all dug and maintained by the GP and hence have Common use. They are not very deep, only 120- 125 ft. Many times they do not work due to over use and then a long period of stress ensues, as no alternative sources of water are there. In fact only since 2002, number of tube wells have increased. In 1991 Census,

[14] Actually the entire area of 65.38 acres is treated as CPR (sholoannasapatti) in the demarcation on the mouja map because they are redistributed land from the vest and as such are CPRs. Although these lands they in possession of private cultivators the nature of tribal society treats it as Common.

the village reportedly had only 1 tube well for 6 hamlets. So carrying water was a significant Household chore. Now the water source is nearer.

The unique feature of this village is that other than ponds, there is no provision for water for bath and other Household requirement, washing cattle or irrigation.

For irrigation, a manual hose called duni is still used to water the fields from the pond. There is very little use of modern equipment for agriculture.

It is the only village with a watershed program of the Central Government called Hariyali Project (commissioned under the 11th Plan) which is designed to reduce soil erosion and water stress in the village.

The project has encouraged step wise planting of trees and making arrangement for better recharge of ground water. This may be the beginning of a turnaround for agriculture in this village.

Socio economic details.

Kalikapuris a very poor village.as is clear from observation that other than the Panchayat school building, there is only one pucca house of an old settler. All others are mud houses. Out of total 120 Households, 68 Households registered as Below Poverty Line(BPL) but there are many others which deserve to be. On an average day, nearly 45% of all able bodied people went out of the village seeking work. It was odd, that the village was populated by children and old people only, between 9am and 5pm. All Households interviews therefore had to be in the evening. [15]

The traditional variety of paddy production involved a full 7 month period from mid-June to mid January. But HYV (swarna) variety is fast yielding and has a crop period lasting full 5 months- from mid- June to mid-November. With no provision for irrigation, all local farming is in single crop mode. As a result, during the months of November-January, and again March – April, nearly 75% of agricultural labormigrate to Mayurakshi riverside (nearly 11 km. away) for Rabi and summer cultivation. There also, demand for labor is of shorter duration due to HYV paddy.Everyone in the village pointed out that availability of water is crucial for their

[15] This had the disadvantage that after dusk, one could not actually see the trees and other vegetation on homestead land. This problem was overcome, by choosing houses with home garden, for survey during daytime.

survival.Their societal norms of co-operation in all communal matter is monitored by their tribal Headman(the Morol or Chowkidar). Use of all Common water resources (6 ponds)is graded in the following way:

Jamdapukur is only meant for collection of cooking water, washing vegetable and rice, dal and utensils and bath.

Koiragori (alongside banana grove) is used for fishing, bath and sanitary use.

Gugrupukur is used for washing of livestock and retting of jute. It is also full of fish of the wild variety.

Hishabbandh is used only for rearing fish. The fish pawns are introduced in May-June. Here fishing using net is not allowed.

Harangadi has water only in the rainy season, later there is too much pebble and gravel for it to be used.

Dai jom is only used for bathing.

All the 6 ponds in the village are CPWRs (called SholoannaShompotti) ie. all have equal stakes in use and conservation. All members of the community are allowed to collect minor pond resources like small fish, shells, snails, oyster and greens.There is a committee of the gram sansad members which monitors the big fish production and use in the pond. Twice a year, they catch all big fish and distribute the catch equally among allHouseholds. Usually it precedes the festivals two times a year.

Although very poor, the community shies away from borrowing for consumption.. Collection from Commons and a frugal lifestyle is the norm.**Ghoshergram** has an average family size of 5. In this village the sex ratio is surprisingly high, at 1005. Reportedly, the entire village population is Hindu.

A water starved village, with 44.7% as cultivators and 18.6% as agricultural workers, the village has a single crop of paddy. This explains a high percentage of total non-working population

Nearly 40% of workers belong to the “other worker” category and along with agricultural laborers in the non- cropping months, constitute almost 85% of working population who go out of the village each day in job search. Particularly, in months of December, January, March and April, almost 25% of Households migrate to find work.

Ghoshergram is a very backward village in terms of facilities. There are no all weather roads in the village. There is only a primary school and a Balwadi within the village. With the Primary health center at a distance of 12 km, there is no registered medical practitioner or family welfare center nearby i.e. within 10 km. There is no ration shop in the village. People have to walk at least 1.5 km. The village has no market. There is no weekly or fortnightly market also. They access a market 2 km away for all purchases. There is a library at a distance of 2 km which hardly any one accesses. There is no electricity in the village. There is open and improper drainage.

Very few people own ponds or have shares in some.

In spite of this, high dependence of Households on ponds both for collection and for domestic use suggests strong CPR-PPR interface for water use. Ownership matters in terms of rights of fishing. Most Households in the village are allowed to collect other edibles, collect cooking water and also use the pond water for other domestic use like bathing, by consent of the owners. The existence of social piety in surveyed villages makes possible high dependence on ponds of the villagers, without ownership.

The user profile for water for domestic use showed that the nature of dependence on ponds is diverse. They have multiple uses for bathing, washing utensils, clothes as well as livestock, washing rice and vegetable, fishing, and other commercial uses. In the absence of alternative water sources, these are not segregated activities. Also due to poor facilities of drainage and sanitation, ponds are used for sanitary purposes. There is no community rules to preserve water quality of the ponds

Ponds have existence value for religious and social functions. Particularly, in rural West Bengal, ponds are used for immersion of idols after worship. Some have the status of “Sacred water bodies” and hence are highly valued in village society.

Collections from water sources are positive to wellbeing of collecting families as their nutritional status is improved.

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Ponds have great economic value from the point of view of their non-commercial production of edible greens, flowers, fruit, fish, snail, crab and shells which the poor predominantly collect. Collections from water sources are positive to wellbeing of collecting families as their nutritional status is improved

Notably, this village under the GP initiative had started planting Jatropha (Bio-fuel plants) on village Common lands.[16]

This village has been chosen for this study because it represents the best example of multi-purpose usage of CPWRs, in this case, of one Common village pond.

NGO activity

In**Kalikapur,**LokKalyanParishad (LKP), based in Kolkata with a rural base in Bolpur and Labpur. has a benign presence.

Other than guiding the villagers to form SHGs, LKP is instrumental in giving them a lead in agricultural development, creating and maintaining social capital in terms of local initiatives.

The Fruit tree Project of LKP, uses 4 Bighas or about 1.33 acres of Common land area for plantation of fruit trees like mango, guava, custard apple,pomegranate, lichees and sweet lime by the SHGs.

Waste land use Project of LKP used roadsides for pigeon pea and some culturable wasteland for gram production by the SHGs. Gourds and bananas were planted on the pond peripheries.

Also 3self help groups. (SHGs) were entrusted with 1 bigha vegetable plots where different local greens –called panka, palak, chauli, puin, radish, and vegetable like string beans, red pumpkin, ash gourd and kundru were produced.

[16] The Jatropha system can be an integral part of rural development with its multiple benefits of control of erosion, acting as a source of renewable energy, acting as a strategy for rural income generation using CPRs that are agriculturally unusable.

All three projects had co-operation between authorities and the people, mediated for all hurdles, by the LKP.

This village is an example of amicable and co-operative effort to create social capital in which, the villagers, the Panchayat and the social organization LKP are participants. Inspite of crushing poverty, there is indomitable spirit of the people which LKP is channelizing to build strong SHGs.

In Ghoshergram there is no NGO activity. However, there is a religious foundation called Dhaulpur Ashram which gives guidance to young people to co operate on social matters and also promotes women's cause. Awareness of the value of education ,child care and nutrition and teaching of destitute boys with free dormitory are some of the services of this foundation.

Table 2 and Table 3 provide snap shot of the village profile which will be handy for a comparison between the past and present.

Table 2. Locational and physical features.

	Agro-climatic zone (ecological zone)	**Distinct land type**	**CPRs village land (acres)**	**CPWRs (acres)**	**CPRs percentage to geographical area**	**Type of degradation**	**Ecological crisis working against development**
Kalikapur	EHG (Laterite)	Porous and sandy, cannot retain water	62.20	3.18	85.8	3out of 6 ponds dry out; bushes have vanished; Cycle of draught and flood degrading agricultural land.	Water in ponds vanish in summer because of pullof the river 20 ft. below.
Ghoshergram	EHG (Laterite)	Sandy loam; undulating, porous land	103.16	54.57	17.75	Pollution of the Common pond. Degradation of agricultural land	Soil erosion and high degree of run off due to undulating land surface. Extreme water stress.

Table3: General information of village society

Village name	Type of employment within village	Seasonal migration (percentage Households)	Presence of NGO's	No.of SHGs	SHGs initiative	Festivals	Sacred Land/water resources
Kalikapur	Self empl.inagr./agr. Labour, leaf platesand bowls/mats, Haandia and broom making	Nov.-Jan. & March-April (75%) Daily (45%)	LokKalyanParishad (LKP)	3	Fruit tree project; waste land use project; vegetable growing and seed multiplication project	Badna (mid.Jan) jahererha and Gosainerha.	MajhiHarham is the sacred tree with prayer platform. Jamdapukur, sacred CPWR sacred
Ghoshergram	Agriculture and allied services	Dec.-March. Daily(85%) of workers.	No NGO	2	Monthly saving of Rs.30/- per family.	Worship of Manasa, Saraswati&Anukul Thakur(Hindus); Thusu(ST)	None but KulurBandh is used for immersion of idols & is defact, sacred

4. Analyzing changes that have taken place in the villages.

Both Kalikapur and Ghoshergram have shown positive change in level of living.

In Kalikapur, the number of Households is now 150 and the number of SHGs have increased steadily from only 3 in 2005-6, to 10 now. Each has 10-12 members. All adult women from the 150 Household are SHG members.According to norms of Panchayat , all groups are registered with the GP and each SHG is a member of the cluster of groups under the ShekhampurMouja.

However, the guiding factor in all their projects is LokKalyanParishad (LKP).

Livelihood plans:

There are some additional groups promoted by(SwarnajayantigrameenSwarojgaryojana,(SGSY) 1)and NABARD(3). Their Projects are separate from the other 10..

a)Two livelihood options open to all groups is Bidi binding and cooking the mid-day meal in the school. For this, members take turns. The payment for this service is available from the SarvaShikshaAbhiyan.

b)Two new options are being offered namely, embroidery of Kantha stitch designs and pissiculture, taking a pond on lease. One group each have taken on these projects but for these the necessary skill set has to be developed.

c) Each group can have 3 or 4 options so not everybody is involved in all projects and a systematic division of labor emerges. The activities are:21 in number.The popular ones are:

agro-basedactivity,fishery, animal rearing, nonfarm processing,common farming (foodgrains,pulses, oilseed, vegetable+yam+cassava), beekeeping, poultry/ goat/ pig farming, compost production, plantations on CPR land etc

Water crisis:

In 2006 when I had my last visit in the village, there was red clay for road building and dry parched land. That was March, the beginning of summer. The village is now green with paddy, fruit and vegetable garden. The fruit trees of 2006 Re mature and fruit bearing now and being on CPR land , accessible to villagers. There has been tremendous improvement in water availability. The 3 ponds which dried out everyMarch- April has water till May now , suggesting

Postponement of drought.The New pondwhich is of 3 acres and was dry in March 2006 was water sufficient. Partly the reason is, successful pond excavation under NREGP since 2010-11, each year at least one member of each family has got 100 days' work within village. The bottom pit soil has been used to cover the pond boundary and divided into 11 equal plots to 10+1(SGSY) SHGs. The plots were distributed by using lottery system. This common vegetable farming is not competitive but efficient.Different kinds of vegetable are grown in different plots so that barter can work between groups. The entire project is the brain child of LKP.Their field associate and overall coordinator are present on field each day to advise the women. Other than LKP, the efficient handling of NREGP is responsible for the turn around. The New pond now has a pump installed by the GP. The village received a lot of rain in August which shows delayed monsoon .

Condition of 5 ponds is good. The ponds were all engaged for fishing..

The rules of conservation are partially followed but user profile of ponds is changing. With adding of another Tube well people access cooking water from tube well.

Economic condition:

Incomes are improved as annual 'income of families from SHG activities are between Rs. 8000 to 12000 which shows gainful employment.

Besides, the Rs. 1.00.000 of ST allocation comes to each group because of the homogeneity of population. money is divided equally for individual initiative.

The monthly saving by each member to the grouphas risen to Rs. 30 now. There is a cap of Rs. 50 for monthly subscription. This was Rs 10 in 2006.cumulative savings of SHGsismore than Rs. 20,000 for some groups.

Cumulative Bankloans amount toRs.2,50,000 max.

Infrastructure:

The school has a good pucca building which is 2 storyhigh. It has a play area in the opposite plot of the school which houses the kitchen and dining space for mid day meals for children. There are separate toilets for boys and girls. Much of this and school's beautification is through the funding of SarvaShikshaAbhiyan.

However, residential houses are still mostly mud walls, thatch roof kind. Toilets are not at home still.

Roads also need to be better. But the yearly making of roads has given way to use NREGP money more creatively. This should be a matter of joy.

Out migrationfor the season has come down to about 10% from nearly 75%. Even daily.migration for work outside village has come down from 45% to barely 10%.

Ghoshergram

This village was part of awatershed development project around Sushunia hills.For this reason Meteorological Report is available for villages within the watershed. Climatic data otherwise in by district. A comparison of annual rainfallfrom year 2003 (1608) shows-a reduction in rainfall and also with irregularity[17]

This watershed has one check dam in this village. Water of Sushunia spreads over 40-50 bighas and is already reducing water stress there.

Thedry village here also was green with bounty of heavy rain. It was ironical that investigation on water crisis invites you into water bounty! But that is climate change.

The plan of the Chhatna Development Block of which this village is included, is to have that will relieve the crisis on the side of drinking water. Micro watersheds with the help of funds and expertise from IWMP

The GP project is at first to complete the garden plans. There is also the moram road to be built Also regular village roads are to be built under the PradhanMantriSadakYojana.

.A lot of NREGP effort since last year is on deepening of water structures. This includes even dredging of the check dam.

Block level plans affecting the village.

Agricultural development Authoritieshas interesting plans, the simplest of this is the development of kitchen garden as summer project. Over 4000 hectare of land is to be developed by4 committees. They will use PRA method to collect suggestions from villagers about their aspirations during this plan(12^{th})They will also have entry point activity of popularizing the projects.

There is a plan for 40 to 50 dug wells over 8-9 villages

[17].It is-1400 for 2004.1329 for 2005, 1334 for 2006.1895 for 2007, for 2009 , 1045 in2010,1568 in 2011 and 1521 in 2012.

In agriculture, diversification is thought of .For this, highlands should produce maize, groundnuts and arhar

The Dhaulpur Ashram people are helping with production of Kharif onions, turmeric etc. which are to be off season income generating activity.

In production of paddy, thereis a plan of both a) systems diversification depending on weather, climate and land quality and b) system of rice intensification (SRI) i.e. increasing crop yield.This village has had soil testing done which indicated:

soil texture- sandy loam; Ph-5.5; organic carbon low;nitrogen contentmedium to low; phosphorus contentlow and potassium content high.The land is good for vegetable.

Livelihoods to be encouraged are agriculture, fish culture, animal husbandry, lac culture, sericulture etc.

Agriculture has done well in this Block and also the village. For the first time, productivity of paddy is 4200 kg per hectare higher than any reference year in the district

There are **140 SHGs** now who are formed by the govt. via GP but are not spontaneously growing. Many are not members.

Training programs are organized for skill improvement and Vocational trining like tailoring, achaar making, composte making etc.

Infrastructure.

The village has progressed in one sense that in 2006 it had no electricity but now it has electricity, the prime users are farmers who are engaged in off season production of non cereal crops. Rice still is rain fed.

However other facilities like drinking water, roads and toilet facility have not improved. Also connectivity has not improved much.

The end result is that migration has come down substantially. Now there is marginal seasonal migration around 10 to 12%/.Daily migration now is morefor jobs to the town.ThePanchayat

and Block jobs are coveted. At least one person in the family aspires to have white collar employment. Computer educated youth are the first choice of employers.

5. Conclusion.

The above painstaking comparison of 2005-6 and the present crystalizes the opinion that over the years, both villages have tried to reverse the water crisis and right now they look pretty successful. Who made it possible? There it is apparent that it is people's enthusiasm and unselfish hard work that has brought this about.that in Kalikapur. But the pivotal role of LKP and Gram Panchayathas to be acknowledgedActually it is a tripartite effort of LKP, SHGs and members as well as workers of GP that has brought in the turn around. The increased budgets make a lot of things feasible now in terms new occupation that does not need lot of water.

Ghoshergram is on the other handa welcome change from the past The entire credit should go to the Block,GP and the Agriculture authority. If this village had cooperation of people in developmental work.development would be faster. This time the GP is not CPM but a coalition of 5 parties. But there is no lack of good will among different groups.

In the end, it is important to caution our enthusiasm. The nature of climate change is its unpredictability. The good monsoons of last almost 3 years is giving a bright picture but the basic causes of water stress have not been scientifically tackled to make a :Golden age " prediction.

In case of kalikapur, the nature of soil may bring back all old problems of drying of ponds we can look at water harvesting in reservoirs. I suggested rainwater harvesting using the school buildingterrace which will send down all the receiver pipes. But the water would go to an underground tank and not left for recharge oh aquifers. Also benign plastic lining for atleast one pond can be tried.

There is a need for government to be proactive and stand by innovation- by the people who are the stake holders of water stress.

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