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Ensuring Food Security in a Scenario of Unrelenting Drought in Bundelkhand Region of Madhya Pradesh

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ABSTRACT

The impact of climate change is evidently visible in Bundelkhand region of Madhya Pradesh and it has changed the life of the farmers. Bundelkhand had 12 drought years during the 19th and 20th centuries. On an average, drought occurred once in 16 years. However with the changing climate, frequency of droughts has increased. Hence failure in agriculture has become a cyclical phenomenon in the region. The economy of Bundelkhand is predominantly agrarian; agriculture, livestock rearing and seasonal out migration provides for more than 90% of the rural income in area. Since last decade, climate change has hit the agriculture based livelihoods and food grain production has decreased by 58%. The growing population and parallel increase in demand for natural resources has left the agricultural and water resources in the region susceptible to increasing climate change risks affecting the livelihoods of the communities. As the climate change impacts are likely to be faced most severely by such vulnerable regions of developing countries like India, there is an urgent need to integrate adaptive strategies at the local level.

Key words: *Climate Change, Variability, Erratic Rainfall, Drought and Decline in Food Production*

INTRODUCTION

Sustainable development, food and economic security of nations which depend more on natural resources are at threat especially when there are limited accesses to financial and technological resources that can help abate the adverse impacts of climate change. In recent years significant changes are taking place in physical and biological systems across the globe due to warming of climate (IPCC, 2007, AR4-WKG-II). The natural resources based economy makes India more vulnerable in this perspective. In India, climate change is inducing an additional stress on the ecological and socio-economic systems as they are already under tremendous pressures for various reasons including increasing population, rapid unplanned urbanization, industrialization and associated activities.

Madhya Pradesh is considered to be one of the most vulnerable states of India. It is a centrally located land locked state with undulating topography and diverse physiography. As per the census 2011, total population of Madhya Pradesh stands at 72.6 millions, out of which 52.5 million are located in rural parts which rely on primary sectors like agriculture, horticulture, fishery, livestock, poultry and forestry for livelihood. These natural resources based livelihood sources are expected to be impacted more than the secondary and other sectors. Uncertain Climatic conditions, developmental challenges and associated agonies

together with reduced adaptive capacities are making Madhya Pradesh highly vulnerable to the impacts of climate change. But here I am specially discussing about Bundelkhand region of Madhya Pradesh.

The semi-arid Bundelkhand region of Central India with six districts in Madhya Pradesh suffers from significant development deficit and challenges of poverty and is one of the most backward regions of our country. It is highly perturbed with variable climatic conditions intensified by erratic precipitation trends, high evapo-transpiration losses, high run off rates and poor water retention capacity of the soil and large area of barren and uncultivable land. Therefore, the development challenge of regions such as Bundelkhand together with uncertainties posed by climate change impacts becomes a strong rationale for focus on climate adaptation interventions.

Trends of Climate Variability in Bundelkhand Region

Today's the climate of the Bundelkhand region is very much similar to the climate science data developed by IITM which revealed the climatic change exposure of Bundelkhand region. Farmers in Bundelkhand faced a famine-like situation after deficient rainfall in 2014 and 2015, but that is not all. The region has faced an unending spell of natural disasters—continuous drought between 2003 and 2010, floods in 2011, a late monsoon and deficit rain in 2012 and 2013; and then the droughts. But low rainfall alone did not cause farm distress. While the reservoirs in the region had run dry, unrestrained and unscientific digging of borewells led to over-exploitation of groundwater at such a rate that often even a good monsoon is not sufficient to replenish groundwater. Most of the farmers had not sowed seeds or had seen their crops fail miserably since 2010—the year when most of the region received normal to above normal rainfall.

The ultimate effect of climate change is being faced by the natives of Bundelkhand where the monsoon has restricted to 24 days instead of 52 days during the past 12 years.

Table 1: Percentage departure of southwest monsoon in Bundelkhand region of Madhya Pradesh

Year	Chhaterpur	Damoh	Datia	Panna	Sagar	Tikamgarh
2004	- 10	- 9	- 34	12	- 12	- 46
2005	- 9	53	- 42	33	44	- 28
2006	- 45	- 30	- 47	- 49	- 16	- 44
2007	- 53	- 22	- 34	- 67	- 35	- 65
2008	- 8	17	34	- 46	- 8	34
2009	- 43	- 44	- 19	- 40	- 22	- 43
2010	- 17	4	- 10	- 37	- 29	- 47
2011	9	25	- 5	-2	16	30
2012	- 18	- 2	13	-	- 19	- 8
2013	29	54	26	32	69	30
2014	- 46	- 37	- 29	- 39	- 33	- 19
2015	- 37	- 32	- 31	- 45	- 41	- 37

Source: Ministry of Earth Sciences, Government o f India, 2016

The unpredictable nature of temperature was also seen in the region. The peak season of heat in Chattarpur district, is in May when the maximum temperature used to be 41.1 degree Celsius. But in the Year 2008, a temperature of 42 degrees was recorded on April 12th itself. Normally it winter temperature in second week of December used to move around 25 degree Celsius at maximum and 11 Celsius in minimum category, but this years it is around 34 Celsius maximum and 20 degree Celsius.

The data developed by IITM (2012) using the PRECIS model run over three time slices (2020s, 2050s and 2080s) using 1970s as base period also focused on two major indicators of climate change- rain fall and temperature in the region. The results from the model predicted variability in climate by the end of the century. The annual average surface temperatures are projected to raise by 1-2^0 C, upto 3^0 C and upto 5^0 C towards 2020s, 2050s and 2080s respectively especially in the northern part of Bundelkhand. Projected rise in lowest minimum temperature is more as compared to rise in maximum temperature.

As per studies done by IIMT, the rainfall in July is likely to decrease but other months show an increase in rainfall by the end of the century. The number of cyclonic disturbances may decrease in future but the systems may be more intense with increase in associated rainfall by 10-15 mm. Moreover, the number of rainy days may decrease, but may be more intense in the future. Climate data from 1980 to 2005 period has indicated an increase in the mean maximum temperature in Bundelkhand region by 0.28º C as compared to the baseline period of 1960-1990. Analysis of the simulated data generated by PRECIS Regional Climatic Model predicts that the temperature throughout the year is likely to be higher, in the range of 2 to 3.5º C by mid century. The major precipitation season is expected to shift by one month (from July to August). The shift in monsoon causes delay in sowing which in turn delays harvesting and in drier conditions the potential yields would be lesser.

Drought and Its Impact on Region

It is worth noticing that the frequency of drought in Bundelkhand is increasing. The records from Government show a spell of one drought in 16 years during the 18th and 19th centuries in Bundelkhand. From 1968 to 1992, the region saw a drought in every five years. However in the 21st century the region has already suffering drought from more than a decade.

A new study by National Institute of Disaster Management (NIDM, 2014) now gives a composite map of the drought which is aimed at giving an overall scenario for drought and explains the reason for the region witnessing drought year on year. The report talks of three kinds of droughts—meteorological, agricultural and hydrological. Dr. Anil K Gupta, associate professor at NIDM and principal investigator of the study says the most important finding that has emerged from the study is about anomalies between different kinds of droughts. "The usual pattern is that first the meteorological drought—rainfall much below average—happens. It leads to agricultural drought in the same year because India depends on monsoons for agricultural production. If the meteorological drought continues for the second consecutive year, then the hydrological drought—below average water availability—occurs. In Bundelkhand this pattern (cycle of drought) has been broken many times. In 2011 the entire region received above average rainfall residents of Bundelkhand experienced acute scarcity of water for agricultural and domestic use.

The study shows that droughts are not a result of just climatic conditions, but also man-made. There is not an iota of doubt that the drought conditions in Bundelkhand is largely due to ecological instability and inappropriate policies have led to its perpetuation. In ancient times *Chandela* and other similar tanks are reservoirs that were built to prevent rainwater from running off as streams. But these traditional reservoirs and traditional knowledge of water conservation have been lost in the region over years. Anil Gupta, author of the NIDM report on Bundelkhand, says that community-oriented water management practices hold the key to the region's water and agrarian crisis

The persistent drought conditions in the region leading to unstable socioeconomic conditions. Varying weather conditions such as extreme temperatures, erratic rainfall, frost etc. influence crop productivity in summers as well as winters. Monsoon is a critical determinant of sowing time, which has been varying drastically in the past few years, causing huge losses to the native farmers. The lack of adequate water in reservoirs and drying up of wells is also of the leading causes of crop failure in the region.

Table 2: District wise Crop Production in Bundelkhand Region of Madhya Pradesh

District	Cereals & Millets		Pulses		Oilseeds		Fodder Crops	
	1984-85	2005-06	1984-85	2005-06	1984-85	2005-06	1984-85	2005-06
Datia	45.6	36.7	41.2	43.5	10	16	0.8	1
Chhatarpur	54	36.2	24.3	39.1	9.8	9.8	10.7	2.9
Tikamgarh	62	36.1	15.7	25.3	8.7	23	12	5.2
Panna	66.3	48.3	18	46	14.4	4.4	0.1	NA
Damoh	57.5	24.7	29.5	39.9	8.9	10.2	3.7	0.5
Sagar	56.7	25.7	21.8	43.5	12.1	25.3	11.3	3.8
MP Bunl..d	57.8	32.5	23.5	37	10.8	17.7	8.8	-
MP	-	38.2	-	22	-	30.8	-	3

Source: 1984-85 figures are from district statistical handbook figures quoted in Grassland & Fodder Atlas of Bundelkhand (Indian Grassland and Fodder Research Institute, Jhansi; 1997 and 2005-06 from district statistical handbook).

After a long search I am unable to produce a latest data on district wise crop production in the region. But certainly table 2 is self explanatory that how a climate changes is affecting crop production in the entire region. The drought condition is prevailing in the Bundelkhand region since 2003-04 i.e. more than 12 years; one can easily guess the current crop production in the entire region.

The growing population and parallel increase in demand for natural resources has left agricultural and water resources in the region susceptible to increasing climate change risks, affecting livelihoods of the communities. The Synthesis Report entitled Climate Resilient Development in Bundelkhand Region of Madhya Pradesh by Development alternatives presents the vulnerability profile of six districts of Bundelkhand region of Madhya Pradesh. Here the vulnerability implies the susceptibility to damage or injury due to any negative impact. In the perspective of climate change, vulnerability simply refers to the probability of being negatively affected by the variability in climate, including extreme climate events.

*Table 3: Vulnerability Index of **Bundelkhand Region** M.P.*

District	Vulnerability Index
Damoh	0.242242
Sagar	0.104078
Chattarpur	-0.03927
Tikamgarh	-0.09543
Datia	-0.22251
Panna	-0.26794

Source: Vulnerability and Adaptation Assessment of Bundelkhand Region of Madhya Pradesh, 2013

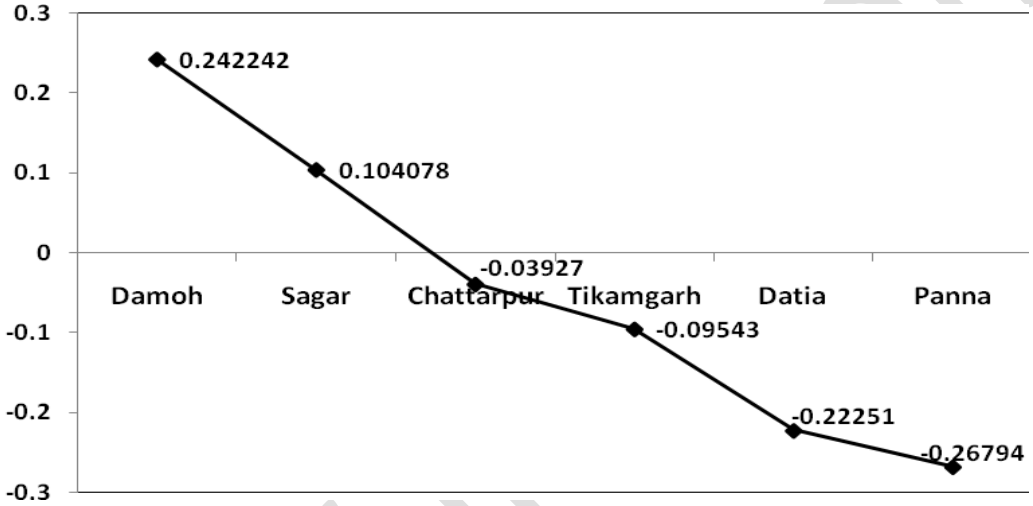


Fig.1 (DA-SDC Climate Resilient Development in Bundelkhand Region of Madhya Pradesh: Vulnerability and Adaptation Assessment of Bundelkhand Region, 2013)

The vulnerability profile of six districts of Bundelkhand region of Madhya Pradesh ranges from -1 to +1 depicting low to high vulnerability and Damoh is the most vulnerable district.

The Crisis and a few Lessons learn

In Bundelkhand more than one-third of the households have been identified as below the poverty line (BPL). Lack of agriculture and employment opportunities has further aggravated poverty in the area. Thus, insecurity of livelihoods and lack of supportive governance have led to forced large-scale migration of the local population – over 80 percent of the menfolk in the villages migrated to work as unskilled labours in cities. The National institute of Disaster Management (NIDM) in its 2014 report 'Bundelkhand Drought: Retrospective Analysis and Way Ahead' pointed out that despite several central and state government efforts and schemes on paper and on ground as well, the risk has been growing with more and more complexities. The Farmers in the Bundelkhand region are fighting climate change the hardest way, as erratic weather conditions have led to drought in the area. The region has seen its longest drought ever. Acres lie barren, starved of water. Only 25 percent of 10 lakh hectares

has been cultivated this year. At present Bundelkhand is a land stalked by hunger and mal nutrition.

The dangerous coping mechanism of tribal communities of Tikamgarh for addressing the severe shortage of food is that, they collect the wild Samai grass in big quantities and dry the grains from the grass to make it into flour. This flour is used to make themselves 'rotis'. This wild grass has become popular among the villagers for long, not because the grass is their traditional food or nutritious enough, but because; it is a substitute for food. It is this wild grass which extinguishes the burning sensation caused by hunger. The starving villagers keep ample of this grass in their homes. This is despite the fact that its consumption causes many life-threatening diseases.

As stated in the blog entitled Living with Climate Change (Blog series: Write-up 2) written by Sumit Vij on 11 Oct, 2013 that Shri. Prakash Kushwaha of Rajawar village in Tikamgarh district has initiated a local movement that emphasizes organic methods of agriculture. This 25 year old has learnt about organic farming techniques from the Shubh Kal program broadcast on Radio Bundelkhand – a community radio based in Orchha and promoted by Development Alternatives, a civil society organization working to empower rural communities. Shri Prakash believes that the climate has been very unpredictable recently, especially with the heavy rains this year and continuous droughts from 2004 to 2009.

Having seen cracked fields during the drought years, Shri Prakash understands the significance of agriculture adaptation strategies. He took steps towards preserving fertility of the soil and enhancing agricultural productivity by adopting organic farming techniques such as vermi composting and amrit mitti (a type of organic fertilizer). He has also been advocating the use of kitchen gardens and rainwater harvesting.

With these practices in place, Shri Prakash grows several kinds of crops in Kharif (monsoon) and Rabi (winter) cropping cycles and has recently started cultivating a crop of medicinal importance called Chlorophytum Borivilianum (common name: Safed Musli). It is sold for Rs 600-800 per kg. Many women in his village have taken up the kitchen garden activity since he started advocating for the same. Women grow tomatoes, eggplants, bitter gourds and other seasonal vegetables. Communities feel that kitchen gardens not only ensure steady source of food for household consumption but also increase the aesthetic value of the households.

Shri. Prakash has been spreading his message using various communication channels that include participation in radio shows and making demonstrations at the local agriculture line department offices to promote organic farming as a climate adaptive strategy. He has been demonstrating the use of amrit mitti in neighboring villages and districts. The constituents required to make amrit mitti are one kilogram of cow dung, one liter of cow urine, 50 grams jaggery, 25 kilograms of dried leaves and 100 liters of water. He has even made field demonstrations of amrit mitti at the local Krishi Vigyan Kendras (KVKs i.e. agriculture extension centers of the Government of India) in Jhansi, Datia and Shivpuri districts. With the potential impact of climate change bearing down on the drought prone region of Bundelkhand, organic farming practices can ensure high soil fertility and a good crop yield for the future.

Mitigating Strategy of Reducing Vulnerability in the Region

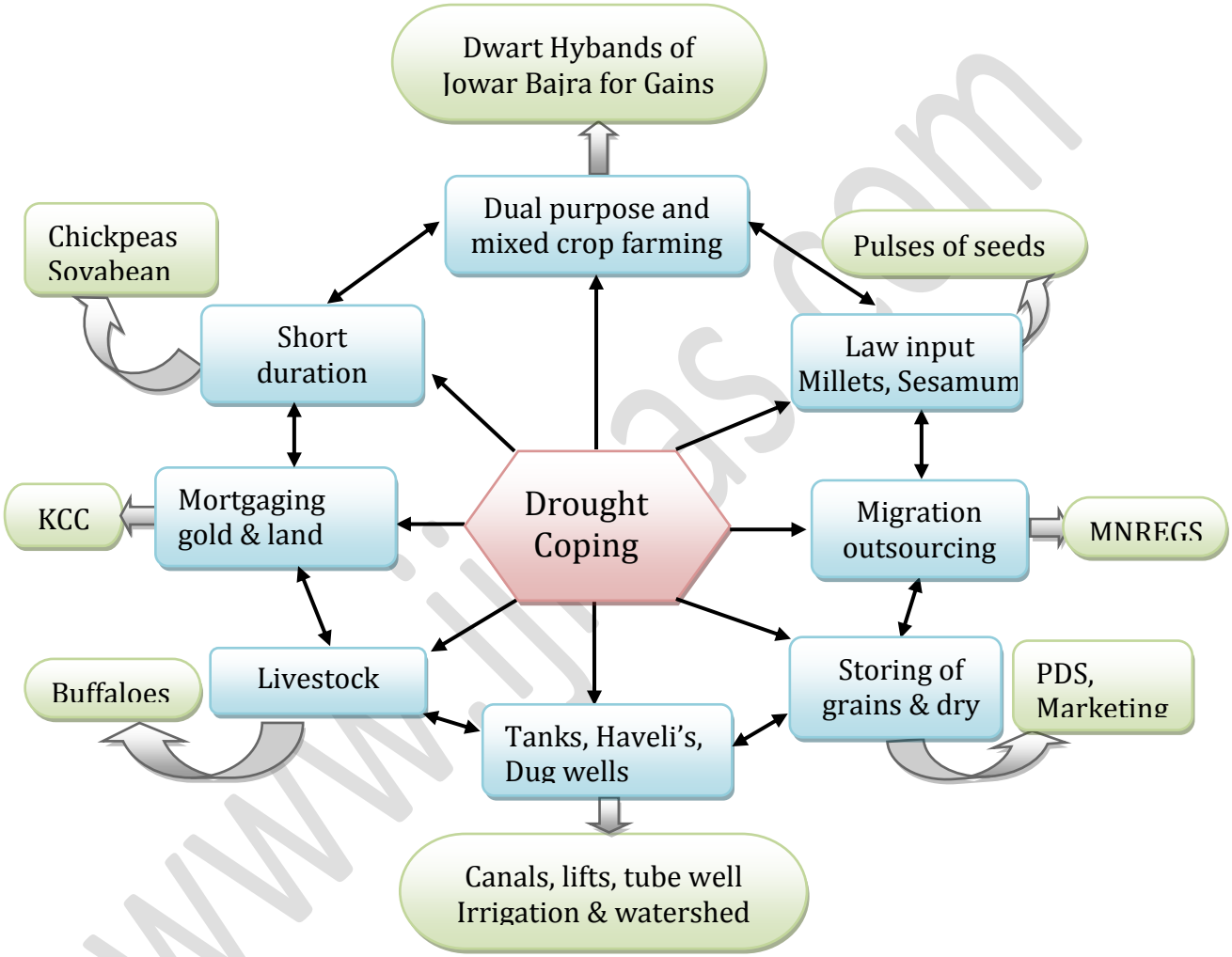
The pro-active mitigating strategy of reducing vulnerability by enhancing coping mechanisms and resilience of the production systems is quite different than the calamity relief. The mitigation is also planned around normal or excessive rainfall years when there is enough precipitation for recharging soil with water, aquifers, surface storage and adequate production to acquire assets. Rainfall is the ultimate source of surface and ground water resources for managing risks and distress associated with spatial and temporal variability in the rainfall and its distribution pattern (Samara 2008). Various coping mechanisms of cultivating drought tolerant dual purpose crops, mixed cropping, farming system, drought hardy millets, sesame, livestock rearing, storing of grains and fodder during normal or excessive rainfall years are quite common. Input intensive advanced technologies and ground water exploitation of Indo Gangetic plains was replicated at the neglect of traditional tanks, ponds and dug wells. Low input and low yielding subsistence farming was less risky. In a mixed system some component will give some return without a complete collapsing like Bt. hybrid crops. Mortgaging of gold or land, liquidating assets like selling trees or animals, raising loan, seasonal migration, taking children off the school and out sourcing of income are important for moderating or mitigating adverse effects of drought (Fig. 2).

However these traditional mechanisms have been altered (shown by arrows in Fig.2) by technological changes, market forces, socio - economic shifts, and public policies. Hybrids of Jowar and Bajra have increased productivity of grain at the cost of fodder for animals. Hybrid of sunflower, castor, Bt. Cotton etc. are input intensive and failure of crop or marketing leads to high distress. Drought resistant low input millets have been replaced by oil seed crops especially soyabean and pulses. Employment guarantee schemes, institutionalized credit and insurance system have also impacted the traditional vulnerability and coping mechanism (Samara 2008).

The Public distribution system encouraged marketing of surplus production during normal or excessive rainfall years instead of storing for contingencies. Public investments into surface, ground water resources and watershed management led to the neglect of Peshwa, Chandela or Bundela tanks, Haveli cultivation, dug wells and other traditional systems. Quarantine enforcement has restricted interstate movement of livestock as drought escaping mechanism or outsourcing of the resources. Ground water exploitation, increased availability of crop residues, fodder and feed led to stall feeding and rearing of buffaloes. Kissan Credit Cards (KCC), institutionalizing credit raising and recent loan wavers may discourage lending from private money lenders. New varieties of soybean, chickpeas, mustard, sunflower, safflower and oil mills have encouraged diversification in various dimensions. The Bundelkhand does not cultivate some important cash crop except small acreage under oil seeds.

About 90% of the geological area of Bundelkhand is a hard rock with very poor yield of aquifer, fast depletion of water table and inadequate rate of replenishment or recharging. Development of ground water resources is not very dependable or attractive and aquifer water should be prioritized and preserved for drinking purpose. Therefore, watershed management, development of surface water resources, improving water use efficiency, enhancing biomass productivity of forest and livestock sector are the most important options of the new strategies.

Watershed management in the upper most forest catchment is the highly prioritized starting point for integrated development of resources from ridge to valley. Therefore, watershed management, development of surface water resources, reviving of traditional dug-wells and tanks, desilting ponds, command area development and efficient micro irrigation systems should get high priority of the investment portfolio. Intensification of diversification, marketing, value addition, processing and ensuring the risks are also essential to consolidate gains of enhancing productivity and other mitigative effects.



After Samara, 2008

Fig. 2: Mitigating Strategy of Reducing Vulnerability in the Region

CONCLUSION

The watershed management approach is beneficial for the development of climate-resilient agriculture in the region because in a watershed development framework water, energy-efficient systems, integrated / mixed tree-based farming and livestock development were

integrated in maximum synergy. These hold the key to enhancing the capability of the farming community to adjust and adapt to climate changes in the region. It ensures dietary diversity and food security. The promotion of alternate non-farm livelihoods for small-holding producers reduces their dependence on agriculture and the natural resource base of being the only sources of income.

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