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CLIMATE CHANGE, ADAPTATION AND MITIGATION EFFORTS IN THE TRIBAL AREAS OF INDIA

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ABSTRACT

The economic impact of climate change is unequal and the thrust is more towards the vulnerable peoples like Tribals in India. Climate change disturbs their livelihood encompassing agriculture, hunting and fishing, minor forest produce, natural resources, tribal cultures, indigenous ecological systems, tourism, plants and animals, poverty, health, and frequent droughts. The Tribal people also add fuel to the worsening eco-systems by following jhum type of cultivation. It calls for a unique climate change adaptation and mitigation efforts to address their problems. The climate change destabilizes the economy, nibbles development efforts of the government and also widens inequality in distribution and opportunities. It costs heavily to the government to undertake mitigation efforts. India is forced to augment/divert resources to perform these investments and the tribal people are also forced to bear the cost. This study will focus on the economic impact of climate change, adaptation and mitigation efforts of the Government in the tribal areas of India based on secondary data.

KEYWORDS
Climate change, tribals, livelihood, adaptation, mitigation.

INTRODUCTION

Climatic change is an environmental problem and poses severe warning to the sustainable development in the tribal areas of India. Its impact on the tribal people is visibly seen in sectors like agriculture, non-agriculture, forestry, change in the quantity and quality of surface and groundwater sources, food security, natural resources, landscape, economic activity, human health, infrastructure etc. There are reasons to be concerned about the adverse effects of climate change which intimidate and cause dieback of natural eco-systems that sustain the livelihoods of tribals in the country. In India, the velocity of climate change is unprecedented and adds problems in dry farming, droughts, floods etc. This article will focus on the economic impact of climate change, adaptation and mitigation efforts in the tribal areas of India covering the following two aspects:

1. Glimpses of Indian Tribes and Tribal Development.
2. Climate Change, Adaptation and Mitigation efforts in Tribal Areas.

GLIMPSES OF INDIAN TRIBES AND TRIBAL DEVELOPMENT

Indian tribes, an oldest ethnological people are the aborigines or indigenous people or 'the Adivasis' of the country. There are 573 tribal communities accounting nearly 7.9 percent of the total population. They speak over 150 languages and 225 subsidiary languages. With a long history, they widely dispersed all over the country in hilly, forest and plain areas. The tribals living outside the Scheduled Areas are called as "Dispersed Tribals" while within the Scheduled Areas are noted as "Predominantly Tribal areas"[1].

In the initial years of planning, no specific tribal development programmes were implemented due to the non-interventionist approach[2] advocated by the founding fathers of Constitution of India. The Renuka Ray Team[3] of 1959 also made it clear that no deliberate measures were needed to make any haste process of tribal development programmes. However, the Dhebar Commission[4] had noted that without planning the physical needs of the tribals cannot be achieved.

Subsequently the Government of India has extended a number of development programmes by seriously considering poverty and high illiteracy of the tribals. In course of time, transport, communication, market, industry and the non-tribal's economic system have penetrated into the tribal areas. The non-tribals have settled in the tribal areas as traders, moneylenders, and officials. As a result a situation with no possibility of isolating the tribals from the effects of social, cultural, economic and technological changes taking place around the tribal areas aroused in the country. Majumdar has observed that there is no single group today which may be said to mark `zero' point of cultural contact[5]. It is imperative to note the report of a study team under the leadership P.Shilu[6] has cautioned about the tribals psychological adaptation and non-tribals entry and the resultant problems in the tribal areas.

The Tribals depend on the forest and forest-lands not only for its natural vegetation but also as a source of livelihood. "The ties with the forests go back to the times of immemorial. Further they have enjoyed freedom to use the forest, in whatever manner they like, to such an extent that they have developed a conviction that they belong to the forest and the forests belong to them"[7]. However, in the course of time the measure initiated in the forest areas under the pretext of scientific management of forest had halted this ingrained belief and tribals access to forest area has been shrunk in size. In some areas, the tribals entry into forest has been constrained due to forest conservation Acts.

With all these the tribals in India have been exposed to the non-tribal culture, food habits, socio-economic pattern, psychological impacts etc. The entry of plastic items, climate volatility and changed life style has created environmental problems in the tribal areas. Altogether, the tribal areas are in transition and they are unable to comprehend and withstand the effects of development.

CLIMATE CHANGE, ADAPTATION AND MITIGATION EFFORTS

Assam, Meghalaya, Mizoram, Manipur, Tripura and Nagaland are in the North Eastern Region, while Arunachal Pradesh and Sikkim are in the Himalayan region. These regions are the world's notable biodiversity hotspots with 52 percent of area under forest. In these regions, the rapid changes in topography cause climate changes and also vulnerable to the changing climate wetter and warmer periods, opportunities for transmission are likely to increase for a longer. The precipitation is projected to increase by 5-10 days and the temperature may rise from 1.8°C to 2.1°C by 2030. The number of rainy days may increase by 1-10 days with intensity of rainfall to increase by 1-6 mm/day.

In the Himalayan region, the annual temperature may vary from 0.9±0.6 °C to 2.6±0.7°C in 2030's. The net increase in temperature is ranging from 1.7°C to 2.2°C during the period and the seasonal air temperatures also show rise in all seasons. The temperature in Western Coastal India may vary from 1.7 to 1.8°C. Temperatures are also projected to rise for all seasons for all the three simulations from 1.5 to 2.2°C, with the rainfall period of June, July, August and September showing the minimum rise in all seasons. As regarding the East Coast India the surface annual air temperature may rise from 28.7°C to 29.3°C. The standard deviation is from 0.6 to 0.7 respectively. The maximum increase in temperature is for March, April and May would be ranging from 1°C to 3.3°C[8].

The Tribal people also add fuel to the worsening eco-systems by following jhum type of cultivation. Indian tribes as cultivators, practice either shifting cultivation or settled cultivation. Shifting cultivation[9] is an age old institution adopted by the tribals of Assam, Orissa, Madhya Pradesh, Bihar and to certain extent in the other tribal areas. It is used not because of any deep-rooted superstition but because of absence of an alternative to it[10]. Contrary to this, Baigas of Madhya Pradesh and Orissa, practice shifting cultivation by considering it as an order from Bhagwan. In the Himalayan and the North-East- regions, of the total cropped area of 4.2 million hectares, about 2.7 million hectares i.e., 64 percent of land is under shifting cultivation. This raises the temperature of the soil, carbon and

nitrogen equilibrium summarily. The carbon level is lost and the nitrogen is converted into nitrate which leads to a loss of about 0.824 million tonnes of NPK from the soil. According to experts such practices in the fields wipe out fauna and bacteria[11].

PHOTOGRAPH 1: FOREST FIRE CAUSED BY JHUM BURNING IN A TRIBAL AREA

Source: Government of India, State of Environment Report, 2009, p12.

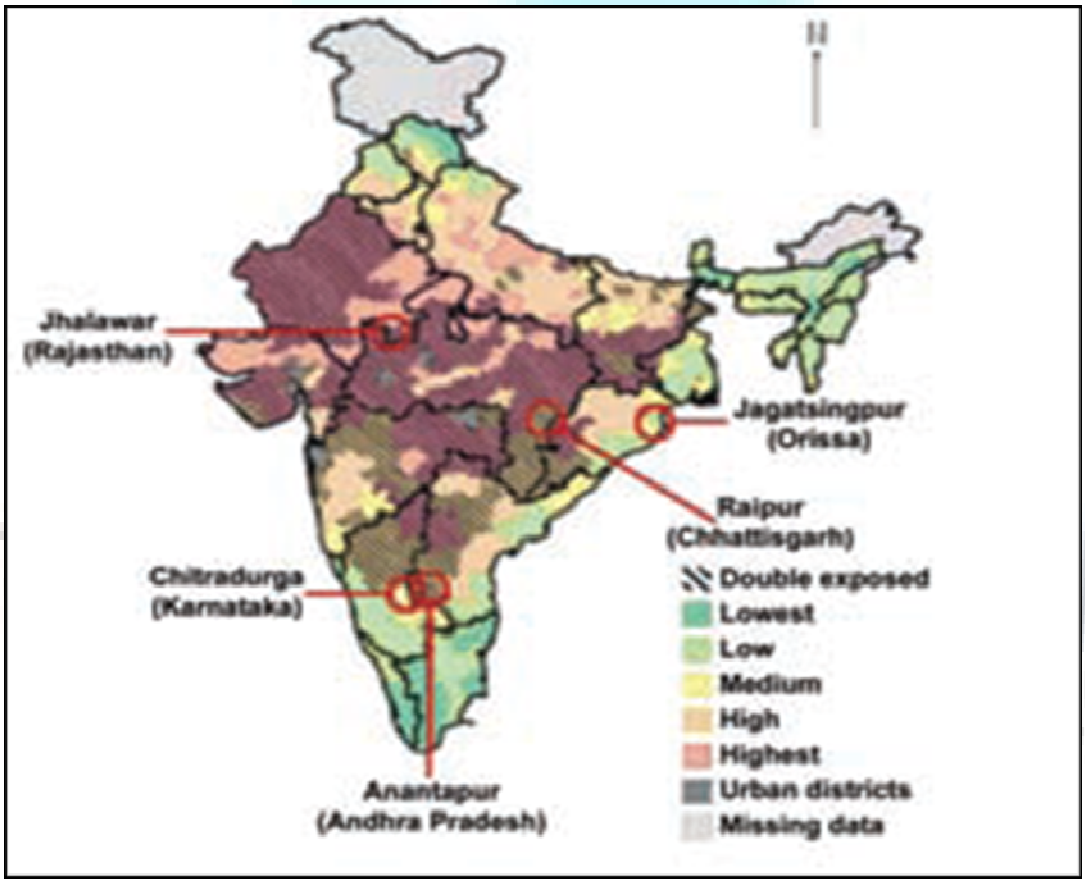
The health effects of climate change are seen from the eruption of vector borne diseases like malaria, schistosomiasis, dengue fever, diarrhea, heat or cold deaths due to cardio-vascular disease, malnutrition, heat and cold stress on people are more widespread. The brunt is severe to the economically poor people as they cannot afford to take precaution to offset the effects of climate change. It also causes additional expenditure to the exchequer of the Government and to the people.

The biophysical and socio-economic impacts of climate changes are matter of concern in the tribal areas. In addition, migration emanates urbanization pressures and add additional burden to the urban governance in terms of new housing policy, water, sanitation, health and hygiene policy, electricity, improved infrastructures etc.

The impact of climate change in the tribal area is landslides and floods due to heavy rainfall. With regard to agricultural crops, the yield of irrigated rice it is expected to gain marginally due to warming as compared to rainfed crop. But for Maize and sorghum the yields in all these regions are expected to fall in 2030 by about 40 percent. The Himalayan region is vulnerable to water induced disasters, fragile geo-environmental setting and economic under development[12].

Any adverse impact on agriculture will be bang on food security and health of the people. The extreme weather events occurring in the country emanates climate change. Some events in support of this show that: the glaciers in the North Himalayan are thinning down by about 16m every year. In Kashmir valley, 2/3rd of ground water levels have dropped due to the receding glaciers. In May 2002, heat waves were recorded in coastal districts of Andhra Pradesh and in 2003; twenty two out of twenty three districts in Andhra Pradesh were in the grip of a heat wave and 80 per cent of the state faced a drought. The desert region of Barmer in Rajasthan was affected by floods in 2006 and killed 140 people. The vulnerability of Indian agriculture to climate change is given in Map 2.

Map 2: Vulnerability of Indian Agriculture to Climate Change



Source: The Energy and Resources Institute, 2003-04.

Indian Agriculture is facing multiple challenges and hence Sharad Pawar cautioned that, 'irrespective of the outcome of the international negotiations on climatic change, agriculture has to become more competitive, efficient, profitable, and develop mechanisms to reduce its vulnerability. Indian farmers, scientists and policy makers have to address these issues in totality and develop strategies to increase our adaptive capacity. We have built capacity earlier to climatic

extremes such as drought by establishing buffer food stocks, strengthening irrigation infrastructure, and developing agricultural insurance schemes. We now need to put more emphasis on anticipatory adaptation measures, especially 'no-regret' adaptation strategies that will allow attainment of sustainable development goals even if there is no climatic change or its magnitude is different from current projections'[13].

Varying rainfall level results in soil erosion, soil moisture, reduces crop yields alters cropping patterns and irrigation. Severe droughts and dry periods due to climate change have resulted in water shortages for irrigated crops in some river basins of India. Occurrence of droughts and floods lead to loss of livelihoods, production and food insecurity. New varieties of rice need to be developed suitable to withstand weather conditions including droughts, floods and new pest and disease. Air temperature shortens the crop duration and reduces output and for instance a 0.5°C increase in temperature would reduce wheat crop duration by seven days and reduce yield by 0.45 ton per hectare in the high yield states of Punjab, Haryana and Uttar Pradesh. Aerobic rice cultivation is a boon in areas where water is scarce[14].

India is gifted with assorted agro-climate, topography and soil types. The agro-climatic zones categorized by the Indian Council of Agricultural Research are: Western Himalayan Region, Eastern Himalayan Region, Lower Gangetic Plains Region, Middle Gangetic Plains Region, Upper Gangetic Plain Region, Trans Gangetic Plains Region, Eastern Plateau and Hill Region, Central Plateau and Hill Region, Western Plateau and Hill Region, Southern Plateau and Hill Region, East Coast Plains and Hill Region, West Coast Plains and Ghat Region, Gujarat Plains and Ghat Region, Western Dry Region, and Island Region. In the country, there are 20 Agro-Ecological Regions on 1:4 million scale maps in terms of physiography, soils, climate, growing period, and available water capacity of the soil.

TABLE 1: CLASSIFICATION OF 'DRYLAND' REGIONS IN INDIA BY USING THORNTHWAITE CLASSIFICATION

Sl.No	Region	Annual AV. Rainfall (in mm)	Moisture Index (Thornthwaite Classification)	Growing Period (in days)	Total Land Area	
					in mha.	in %
1	Glaciers & Others	-	-	-	5.2	1.5
2	Hyper Arid	<100	<-83.3	0-60	22.9	7.0
3	Typic Arid	100-500	-66.7 to -83.2	60-90	22.7	7.0
4	Semi-Arid (dry)	500-750	-50 to -66.6	90-120	51.2	15.6
5	Semi-Arid (moist)	750-850	-49.9 to -33.4	120-150	72.2	22.0
6	Sub-humid (dry)	850-1000	-33.3 to -0	150-180	54.1	16.6
7	Sub-humid (moist)	1000-1500	0 to 20	180-270	39.8	12.1
8	Dry/Moist/ Sub- humid transition	1000-1500	0 to 20	210-270	21.0	6.4
9	Humid	-	21 to 99.9	210-330	16.6	5.1
10	Per humid	>2500	>100	>300	20.5	6.3
11	Transition Humid/Per humid	>2500	>100	>300	1.8	0.5
12	Total	-	-	-	327.9	-

The area of bio-climatic regions 1-6, which fall under the dry land regions (as per Thornthwaite Classification) = 228.3 mha

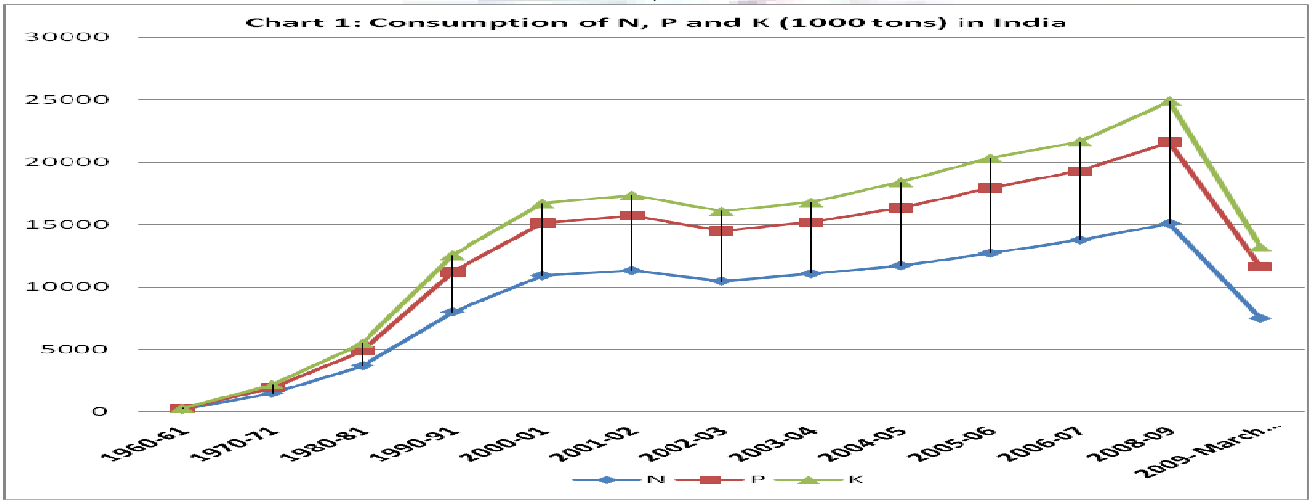
Source: National Bureau of Soil Survey and Land Use Planning, Nagpur.

Table 1 show that the arid regions get erratic and inadequate rainfall, frequent droughts, high evaporation, and intense heat. Therefore, the soils in these areas are not advantageous for crop cultivation. Per humid and transition humid/per humid areas get >2500 mm average annual rainfall and the moisture index is also >100. In India, the majority of land is Semi-Arid (dry) (15.6 percent), Semi-Arid (moist) (22 percent), Sub-humid (dry) (16.6 percent), while 7 percent of the land area is in typic and hyper arid. Chart 1 depicts the trends of growth in the NPK usage in India.

TABLE 2: ALL INDIA CONSUMPTION OF N, P AND K (1000 TONS)

Sl.No	Year	N	P	K	Total
1	1960-61	210.0	53.0	29.0	292.0
2	1970-71	1487.0	462.0	228.0	2177.0
3	1980-81	3678.0	1214.0	624.0	5516.0
4	1990-91	7997.0	3221.0	1328	12546.0
5	2000-01	10920.2	4214.6	1567.5	16702.3
6	2001-02	11310.2	4382.4	1667.1	17359.7
7	2002-03	10474.1	4018.8	1601.2	16094.1
8	2003-04	11077.0	4124.3	1597.9	16799.1
9	2004-05	11713.9	4623.8	2060.6	18398.3
10	2005-06	12723.3	5203.7	2413.3	20340.3
11	2006-07	13772.9	5543.3	2334.8	21651.0
12	2008-09	15090.0	6506.0	3313.0	24909.0
13	2009- March 09	7486.0	4132.0	1607.0	13225.0

Source: Government of India, Ministry of Agriculture, Agriculture Statistics at a Glance, 2006-07 and Ministry of Chemicals & Fertilizers, Department of Fertilizers, 2009-10.



In the cultivation of various crops, the use of NPK and other fertiliser and pesticides are high (more use for rice and wheat cultivation) which adds to water and air pollution in the country. In India, per hectare consumption of fertilizers has increased from 292 thousand tons in 1960-61 to 24909 thousand tons in 2008-09 with a growth rate of 8430.5 percent and the details are given in Table 2.

In India, agricultural development impacted on the environment through farming activities with soil erosion, land salination and loss of nutrients. The green revolution results in exploitation of land and water resources and use of fertilizers and pesticides. Leaching from extensive use of pesticides and fertilizers is an important source of contamination of water bodies. Intensive agriculture and irrigation contribute to land degradation particularly salination, alkalization and water logging[15]. Further, nearly 45 percent of total geographical area of India is affected by soil erosion due to ravines and gullies, shifting cultivation, cultivated wastelands, sandy areas, deserts and water logging[16].

TABLE 3: GREENHOUSE GAS EMISSIONS IN INDIA IN 2007 (THOUSAND TONS)

Sector	CO_2 emissions	CO_2 removals	CH_4	N_2O	CO_2 equivalent
Agriculture	-	-	13767.80	146.07	334405.50
Enteric fermentation	-	-	10099.80		212095.80
Livestock Manure management	-	-	115.00	0.007	2436.70
Rice cultivation	-	-	3327.00	-	69867.00
Soils	-	-	140.00	-	43400.00
Burning of crop residue	-	-	226.00	6.00	6606.00
LULUCF	98330.00	275358.00	-	-	-177028.00
Forestland	-	67800.00	-	-	-67800.00
Cropland	-	207520.00	-	-	-207520.00
Grassland	10490.00	-	-	-	10490.00
Settlement	-	38.00	-	-	-38.00
Fuel wood use in forests	-	87840.00	-	-	87840.00

Source: India: Greenhouse Gas Emissions 2007, Ministry of Environment and Forests, Government of India, May 2010, p14.

Table 3 portrays that the agriculture emitted 334.41 million tons of CO2 eq in 2007. The GHG emissions from the agriculture arise from enteric fermentation, livestock manure management, rice cultivation (69.87 million tons of CO2 eq or 3.27 million tons of CH_4), soils and burning of crop residue as shown in Chart 2. Land use land use change and forestry (LULUCF) has emitted 177.03 million tons of CO2, fuel wood emission was 67.80 million tons of CO, crop land sequestered 207.52 million tons of CO2, and grassland emission was 10.49 million tons of CO2. The data proves how agricultural sector adds to environmental hazards in the country.

The economic impact of climate change is unequal and the thrust is more towards the vulnerable peoples like Tribals in India. Climate change disturbs their livelihood encompassing agriculture, hunting and fishing, minor forest produce, natural resources, tribal cultures, indigenous ecological systems, tourism, plants and animals, poverty, health, and frequent droughts. Increasing population and decreasing land productivity, relatively higher dependence on natural resources like forests are also constraints for the region's environmental sustainability.

The adaptation techniques for agriculture include changes in cropping pattern, irrigation, fertiliser use and infrastructure. Further, UNFCCC's Article 4(4) urges to help vulnerable developing countries in meeting the costs of adaptation to the adverse effects of climate change. This may be performed using the adaptation fund established from the Marrakech Accords. The 'Buenos Aires Programme of Work on Adaptation and Response Measures' adopted by COP10 in 2004 is for funding to undertake adaptation activities in developing countries[17].

To combat the negative aspects of the climate change India has signed the UN Framework Convention on Climate Change in 1992 and also agreed the Kyoto Protocol in August 2002. Dr.Manmohan Singh, the Prime Minister of India has released the national climate action plan on 30 June 2008, which has eight missions viz., national solar mission; national mission for enhanced energy efficiency; national mission on sustainable habitat; national water mission; national mission for sustaining the Himalayan ecosystem; national mission for green India; national mission for sustainable agriculture; and national mission on strategic knowledge for climate change. It calls for a unique climate change adaptation and mitigation efforts for the tribals to address their problems.

The climate change destabilizes the economy and also gnaws development efforts of the government. This accentuates inequality in distribution and opportunities. It costs heavily to the government to undertake mitigation efforts. India is forced to augment or divert resources to perform these investments and the people are also forced to bear the cost. Timely efforts are needed to perform adaptation and mitigation measures, evolving policy frameworks, and for building institutional capacity in the tribal areas of India.

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