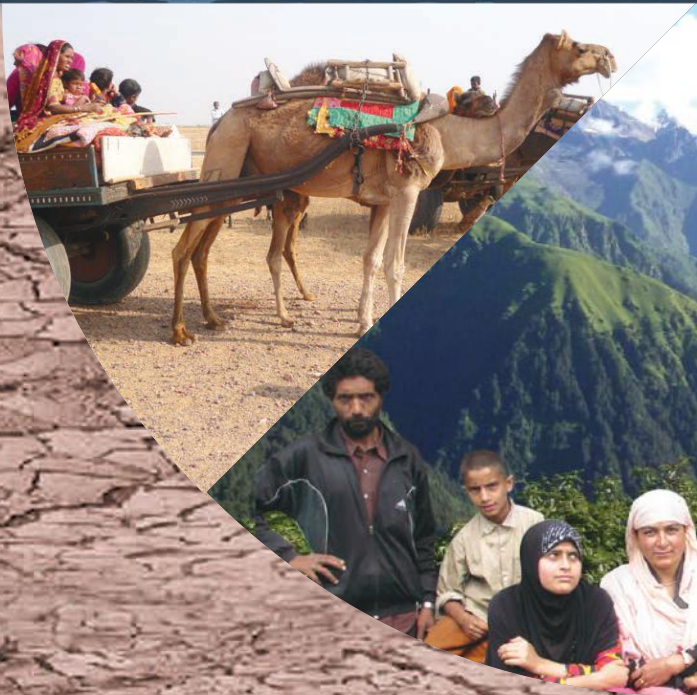


COMMUNITY CONCERNS ON CLIMATE CHANGE



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PREFACE

Climate change is the most urgent global challenge we experience. It is one of the complex problems mankind faces today. Seasons are shifting, sea levels are rising, crop patterns are changing and there are changes in flowering and fruit bearing in forests and groves. The life style and human needs are changing according to change in the climate. Although the impact of climate change is equal on earth, it affects poor and vulnerable communities more than the rich and wealthy. Tribal and Particularly Vulnerable Tribal Groups are most affected victims of climate change in the world. We are happy to bring this report “Community Concerns on Climate Change” which reflects community views on climate change and its impact on them. The report is a collection of tribal community views on climate change in Indian states.

This report is important to understand community concerns particularly when world leaders from 150 countries assembled in Paris for COP21 from 30th Nov. to 12 Dec 2015. COP21 is expected to develop common action points to check carbon emission and address problems caused by global warming. It is also pertinent to consider problems of the most marginalised people living in developing countries without any compromise to their resource utilisation. It is expected that countries will bind an agreement to implement emission pledges declared earlier. The formal target is at limiting global warming to 2° Celsius above pre-industrial. Rich countries had promised at least 100 billion every year to poor countries by 2020 for adopting climate change and reducing emission. These funds are needed to adopt green technology, renewable energy and shift low carbon paths of development. India has urged world leaders to come out with a comprehensive, credible and durable climate agreement. Various nations have already drafted their own 'intended nationally determined contributions'. (INDCs)

India is rich in natural resources and a large population depends directly or indirectly on these resources for their sustenance. These communities are tribal/indigenous people who have been dependent on natural resources for generations and remained miles away from the 'so called developed society'. They have been harbingers of protecting forest and water resources without possessing any for their own benefits. Unfortunately, the growing economy targets these resources to suit its needs and requirements; as a result, the dependent communities face the consequences. The report reveals their experience with such development. This reminds me a quote of Mahatma Gandhi – 'Nature has enough for our need but not for our greed' and our greed has put us at a crossroads where survival of mother Earth is at stake.

The findings of this report will guide all policy makers and activists involved in climate change action in different places and will help people adopt and mitigate climate change in their own locations. In our future course of action, climate change will be a critical area of intervention in Actionaid and this report will help as a guide towards that perspective. I extend my special thanks to the Leader, NR KA Hub and her colleagues to collect and consolidate this document at this critical juncture.

Sandeep Chachra
Executive Director
Actionaid India



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We are particularly grateful to all those community members whose personal narratives have enriched this study. We also thank members of civil society and local NGOs for their unstinted support.

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Bratindi Jena

Head, Natural Resource Knowledge Activist Hub
Actionaid India



ABBREVIATIONS

ADP	<i>Ad Hoc</i> Working Group on the Durban Platform for Enhanced Action
AWG-KP	<i>Ad Hoc</i> Working Group- Kyoto Protocol
AWG-LCA	<i>Ad Hoc</i> Working Group on Long-term Cooperative Action
C	Celsius
CCD	<i>Convention to Combat Desertification</i>
CFCs	Chlorofluorocarbons
CH ₄	Methane
CITES	Convention on International Trade in Endangered Species
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CO ₂	Carbon Dioxide
COP	Conference of the Parties
EEZ	Exclusive Economic Zone
EG	Eastern Ghats
ENVIS	Environmental Information System
F	Fahrenheit
FRA	Forest Rights Act
FRSD	Foundation for Research and Sustainable Development
Ft	Feet
GHGs	Green House Gases
HA	Hectare
HH	House Hold
HLWG	High Level Working Group
HNS	Hazardous and Noxious Substances
HP	Himachal Pradesh
HW	Hazardous Wastes
IMD	Indian Meteorological Department
INCCA	Indian Network on Climate Change Assessment
IPCC	Intergovernmental Panel on Climate Change
KM	Kilometre
M	Million
MP	Madhya Pradesh
MFP	Minor Forest Produce
MM	Millimetre
MoEF	Ministry of Environment and Forests
N ₂ O	Nitrous Oxide
NAMAs	Nationally Appropriate Mitigation Actions
NATCOM	National Communication
NGO	Non Government Organisation
NTFPs	Non-timber Forest Products
PRA	Participatory Rural Appraisal
PVTGs	Particularly Vulnerable Tribal Groups
REDD	Reducing Emissions from Deforestation and Forest Degradation
RET	Rare Endemic and Threatened
SANDRP	South Asia Network on Dams, Rivers and People
SAPCC	State Action Plan on Climate Change
SPM	Summary for Policy Makers
SQ KM	Square Kilometre
ST	Schedule Tribe
UN	United Nation
UNCED	United Nations Conference on Environment and Development
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
WG	Working Group
WWF	World Wildlife Fund



CONTENT

<i>Preface</i>	<i>i</i>
<i>Acknowledgement</i>	<i>iii</i>
<i>Abbreviations</i>	<i>iv</i>
Chapter 1	
INTRODUCTION	1
Chapter 2	
OVERVIEW	5
Chapter 3	
RESEARCH METHODOLOGY	11
Chapter 4	
STUDY FINDINGS	13
Chapter 5	
CONCLUSIONS AND RECOMMENDATIONS	26
REFERENCES	29





INTRODUCTION

Of all the problems human kind faces today, Climate Change is by far the most complex. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as: “A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which in addition to natural climate variability is observed over comparable time periods.” In other words, a long-term fluctuation in temperature and other aspects is known as climate change.

The UNFCCC makes a distinction between climate change attributable to human activities that alter the atmospheric composition and climate variability, attributable to natural causes. A changing climate leads to changes in the frequency, intensity, spatial extent, duration and timing of extreme weather and climate events and can result in unprecedented extreme weather and climate events. Global warming is a major environment problem caused due to Green House Gas (GHG) emission.

The complexity of the problem is attributed to its deeper global ramifications on a vast range of issues impacting the very survival of life on Earth. Warming of the climate system, as is evident now from observations of increase in global average air and ocean temperatures, widespread melting of snow and rising global average sea level is unequivocal. The incidence of climate-induced disasters has increased. A growing number of people are vulnerable to more frequent and intensified cyclones coupled with ‘super storms’, flooding, inundation and drought.¹ Developing countries experience the greatest risk and the greatest losses.² Addressing climate chaos by all countries, both individually and collectively, has become critical to human wellbeing and the prosperity of the present as well as the future generations.

In developing countries and countries in transition, poorer rural communities often depend entirely on ecosystem services and functions to meet their livelihood needs. The Global Assessment Reports on Disaster Risk

Reduction (UNISDR, 2009a, 2011) has recognised the importance of ecosystem services and functions for communities that are vulnerable to environmental and disaster risks. The erosion of these services and functions can contribute to the decrease of coping and adaptive capacities in terms of reduced alternatives for livelihoods and income-generating activities. Additionally, worsening of environmental services and functions could lead to an increase in the cost of accessing these services. For instance, time and travel to access drinking water in rural communities affected by droughts or salinization could increase (IPCC 2012).³

India is rich in natural resources. The plains of the Ganga, the Deccan Plateau, Thar Desert, the Himalayan Mountains, North Eastern region, extended coastline and the Western Ghats make a significant contribution to this richness. A large percentage of the Indian population, directly or indirectly, depends on natural resources for their sustenance. The growing economy targets these resources without regard to people’s needs. Since the last two decades, India’s aspiration to become one of the world’s fastest growing economies has resulted in rapid infrastructural development, which has impacted its vast natural resources. Unbridled pillage of water, land, forest, minerals and non-renewable energy sources has had a far-reaching impact on climate. In turn, climate variability has placed extra pressure on natural resources. Groundwater is dependent on highly variable monsoon rains for its replenishment. Frequent drought and flooding take their toll on natural resources.

Mountains are rich repositories of biodiversity and water. Downstream communities, both regional and global, depend on the mountains for ecosystem goods and services (Hamilton 2002)⁴. Mountains are likely to experience wide ranging effects on their environment, biodiversity and socioeconomic conditions as a result of climate change. Changes in the hydrological cycle may significantly change

¹ IPCC, 2012- Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (Eds.) ‘*Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*,’ Cambridge University Press: Cambridge. p. 7. Accessible at: http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml#SREX

² DMckinnon, M. (2012) Climate Vulnerability Monitor. A Guide to the Cold Calculus of a Hot Planet 2nd Edition, DARA and the Climate Vulnerable Forum (<http://www.daraint.org/wp-content/uploads/2012/09/CVM2ndEd-FrontMatter.pdf>)

³ Intergovernmental Panel on Climate Change, Fifth Assessment Report 2012

⁴ Hamilton, LS (2002) ‘Why mountain matters?’ World Conservation: The IUCN Bulletin 1/2002



precipitation patterns leading to changes in river runoff affecting hydrology and nutrient cycles along the river basins and ultimately agricultural productivity and human wellbeing. However, there has been little detailed research on climate change in the mountains; generalisations have been made from scattered studies carried out at sites, widely separated in space and time (IPCC 2007).⁵

Most of the research papers published in the last four to five years indicate that the planet is already experiencing climate change. The mean temperature of the Earth, it is estimated, has risen by 0.75°C in the last century. Some well known evidences of global warming are: 11 of the 12 years in the period 1995–2006 are among the 12 warmest years since 1850, retreat of glaciers, melting of the polar ice caps, increase in the area of summer time snow melt in Greenland and decrease in the winter hunting period of polar bears, rise of ocean levels, advancement in leafing time in trees and delay in autumnal leaf shedding and upward movement of woody species in mountains. Alpine plants and animals will have no place to move upwards as temperature rises. Nearly 40 percent of the world's people live in the mountains and river basins connected to them. In many regions, they represent much of the wilderness where species could migrate to escape warming. They are particularly important in tropical regions, being the only source of snow and snow melt water (S P Singh 2010).⁶

Climate Change in Different Geo-climatic Regions

India has different climatic regions. Each climate region contributes differently to the ecosystem from time to time. The Himalayan region, Eastern Ghats, Coastal region, Western Ghats and semi arid regions are major contributors to India's ecosystem.

Climate Change and the Himalayan Region

The Himalayas, also known as the 'Roof of the World', is the source of Asia's ten largest rivers. The basins of these rivers are inhabited by 1.3 billion people and contain seven mega cities. Continuing climate change it is predicted, will lead to major changes in the strength and timing of the Asian monsoon and inner Asian high-pressure system – the main systems affecting the climate of the Himalayan region. The impacts on river flows, groundwater recharge, natural hazards and the ecosystem, as well as on people and their livelihoods, could be dramatic, if not the same in terms of rate, intensity, or direction in all parts of the region.⁷

The Himalayan glaciers are the major source of the innumerable rivers that flow across the Indo-Gangetic plains. These glaciers cover about three million hectares or 17 percent of the mountain area as compared to 2.2 percent in the Swiss Alps. They form the largest body of ice outside the polar caps. Himalayan glacial snowfields store about 12,000 km³ of freshwater. About 15,000 of these glaciers form a unique reservoir which support perennial rivers such as the Indus, Ganga and Brahmaputra which, in turn, are the lifeline of millions of people in South Asian countries (Pakistan, Nepal, Bhutan, India and Bangladesh). The Gangetic basin alone is home to 500 million people, about 10 percent of the total human population of the region. Glaciers in the Himalayas are receding faster than in any other part of the world. If the Earth keeps warming at the current rate the likelihood of these glaciers disappearing by the year 2035, and perhaps sooner, is very high. The total area is likely to shrink from the present 500,000 to 100,000 km² by the year 2035 (WWF, 2005) (IPCC-2007). The reduction in the size of Himalayan glaciers will directly affect agriculture and the entire population living in the Indian plane. Perennial rivers will become seasonal and will have less water. Various studies suggest that warming in the Himalayas over the last 100 years has been much greater than the global average of 0.74°C (IPCC, 2007).

The Himalayas now display great climatic variability. The mountains act as a barrier to atmospheric circulation for both the summer monsoon and the winter Westerlies. The summer monsoon, lasting eight months (March–October) in the Eastern Himalayas, four months (June–September) in the Central Himalayas and two months (July–August) in the Western Himalayas dominates the climate (Chalise and Khanal, 2001)⁸. The east-west variation is based on the dominance of different weather systems, which in turn cause the monsoon to weaken from east to west. The monsoon penetrates northwards along the Brahmaputra River into the southeast Tibetan Plateau, but rarely as far as the Karakoram (Hofer and Messerli, 2006⁹; Rees and Collins, 2006¹⁰). The highest annual rainfall in the region occurs in Cherapunjee in India, amounting to more than 12,000 mm.

Devastating floods and landslides in Uttarakhand in June 2013, termed as the 'Himalayan Tsunami' appear to have been caused by climate change. Extreme unseasonal rains in North India, two to three weeks in advance of what was normal for this region, triggered this tragedy. As per the Indian Meteorological Department (IMD), Dehradun

⁵ Intergovernmental Panel on Climate Change, Fourth Assessment Report 2007

⁶ Singh Surendra P, Singh Vishal and Skutsch Margaret. (2010) Rapid warming in the Himalayas: Ecosystem responses and development options, Climate and development

⁷ Xu Jianchu et al. (2009) The Melting Himalayas: Cascading Effects of Climate Change on Water, Biodiversity, and Livelihoods, conservation biology, 15 May

⁸ Chalise, SR; Khanal, NR; (2001) An introduction to climate, hydrology and landslide hazards in the Hindu Kush-Himalayan region. In Tianchi, L; Chalise, SR; Upreti, BN (eds) Landslide Hazard Mitigation in the Hindu Kush-Himalayas, pp 51-62. Kathmandu: ICIMOD

⁹ Hofer, T., Messerli, B. (2006). Floods in Bangladesh: History, Dynamics and Rethinking the Role of the Himalayas. New York: United Nations University Press.

¹⁰ Rees, G. H., Collins, D. N. (2006). Regional differences in response of flow in glacier-fed Himalayan rivers to climate warming. Hydrological Processes, 20: pp 2157–2167.



received 340 mm of rainfall in a single day. Such extreme and unseasonal rainfall is indicative of global warming-induced climate change phenomenon. Due to a higher rate of melting of the glaciers and increased variability and irregularity of the monsoon, Uttarakhand in the Himalayan region has been recognised as a highly vulnerable zone.

Climate Change and the Eastern Ghat Region

The Eastern Ghats (EG) is a discontinuous range of mountains situated along the eastern coast of India. They stretch from the Mahanadi Basin in the north to the Nilgiri hills in the south, covering a distance of 1,700 km and spread over an area of 75,000 sq. km. The average elevation of this mountain range is about 600 m; the highest peak in the Shevaroy hills reaches up to a height of 1,700 m. The Eastern Ghats supports a rich array of tropical forests including pockets of moist deciduous, evergreen and semi-evergreen forests. This region experiences three prominent seasons: summer from March to June, the rainy season from July to September and a short and pleasant winter from December to January.

The Eastern Ghat region represents a common heritage; livelihood portfolios are shared by a great majority of people, especially in Odisha. Huge areas of diverse tropical forest are lost or degraded every year with dramatic consequences for biodiversity. Deforestation and fragmentation, over-exploitation, invasive species and climate change are the main drivers of tropical forest biodiversity loss (Morris, 2010).¹¹ The depletion of forest cover in the Eastern Ghats due to developmental activities, including dams, mining and climate variability has further accentuated the ecological imbalance and loss of the rich biodiversity of the region.

Climate Change and the Coastal Region

Climate change is now known to be a key driver of poverty in the coastal region adjoining the Bay of Bengal. The Intergovernmental Panel on Climate Change predicts that this region including South Asia is amongst the world's most vulnerable regions. Not only is mortality risk increased because of increased frequency and intensity of disasters, but alteration of the bio-physical and hydro-meteorological character such as changes in precipitation, increase in salinity intrusion and the rise in sea level leads to displacement of millions of people. The cyclonic pattern has been changing in South Asia where more than 750 million people (75

percent of the total regional population) have been affected by weather related disasters since 1990. Cyclone frequency over the North Indian Ocean between November and May has increased two-folds in the last 122 years (IPCC 2008). The World Bank¹² estimated that agriculture, on which majority of the population depends, will be severely affected by changes in the monsoon dynamics caused by changes in the conditions of the Bay of Bengal and the Himalayas. This projected sea level rise could flood the homes of millions of people living in the low-lying areas of South Asia. The trends on sea levels reveal a high variation along the Indian coastline with an increase along the Gulf of Kutchh, Odisha and West Bengal and decrease along the Karnataka coast, making these coastlines more vulnerable.¹³ Valuable coastal ecosystems like mangrove forests, coastal reefs and sea grasses will be at serious risk.

According to the IPCC, even the best-case scenarios indicate that a rising sea level would have a wide range of impacts on coastal environments and infrastructure. Effects are likely to include coastal erosion, wetland and coastal plain flooding, salinization of aquifers and soils, and a loss of habitats for fish, birds and other wildlife and plants. The Environmental Protection Agency estimates that 26,000 square kilometres of land would be lost should the sea level rise by 0.66 metres, while the IPCC notes that as much as 33 percent of coastal land and wetland habitats are likely to be lost in the next hundred years if the level of the ocean continues to rise at its present rate. Even more land would be lost if the increase is significantly greater, and this is quite possible. As a result, very large numbers of wetland and swamp species are likely to be at serious risk.

Climate Change and the Western Ghat Region

The Western Ghats (WG), spread across 63 districts in Kerala, Tamil Nadu, Karnataka, Maharashtra and Gujarat in peninsular India, have been declared as one of the world's 34 global biodiversity hotspots in by Conservation International. This hotspot is extraordinarily rich in plant species found nowhere else.¹⁴

The Western Ghats that occupy around six percent of the Indian landmass are one of the oldest mountain ranges in India, even older than the Himalayas. According to the High Level Working Group Report on the Western Ghats (HLWG/Kasturi Rangan Committee Report)¹⁵, the geographical area of the Western Ghats is over 1,64,280 sq. km. A high degree

¹¹ Morris RJ (2010). Anthropogenic impacts on tropical forest biodiversity: a network structure and ecosystem functioning perspective. *Phil. Trans. Roy. Soc. B* 365:3709-3718

¹² World Bank Group. (2010). *Economics of Adaptation to Climate change*. Washington DC: World Bank Group.

¹³ "Effect of Global Warming and Climate Change on Coastal Zones and Sea Level"- Prof. (Dr.) K. C. Jena et al.- Odisha Review- October 2011

¹⁴ "Climate Change in the Western Ghat Mountains: Impact and Adaptation", S P Anandan, Foundation for Research and Sustainable Development (FRSD)-2008

¹⁵ K. Kasturi Rangan et al (2013) Report of the High Level Working Group on Western Ghats, Ministry of Environment and Forests, Government of India



of endemism- more than 78 percent of amphibians and about 41 percent fish species and similar high RET (Rare, Endemic and Threatened) floral and faunal groups- are found in this region. Numerous tribal and forest dwelling communities inhabit these ghats. UNESCO declared 38 sites in the Western Ghats as World-heritage sites in 2012. Most of the east flowing or west flowing rivers originate from Western Ghats, making it the water tower of peninsular India. Rivers from the Western Ghats contribute almost 40 percent of the total drainage in India. Millions depend on rivers such as the Krishna, Godavari, Cauvery, Malaprabha, Ghataprabha, Bhima, and Tungabhadra for water and ecosystem goods and services. Severe impacts on natural resources specifically on water and biodiversity in the Western Ghats as a result of climate change are anticipated.¹⁶

An increase in annual temperature in this region is predicted. So is an increase in flooding varying between 10 to over 30 percent, of existing magnitudes. This has severe implications for the existing infrastructure.¹⁷

Mining, hydropower, irrigation and mini hydroelectric projects, are adversely affecting the water cycle, forests, sedimentation, and biodiversity of the region leading to the displacement and impoverishment of a very large number of people. These problems compound climate change challenges. The region is expected to experience an increase in temperature regimes, rainfall and extreme events due to climate change. There is also a high probability of significant decrease in the duration of precipitation, which is likely to induce changes in hydrological regimes, especially an increase in evapo-transpiration and run off.¹⁸

Climate Change and India's Semi-Arid Regions

Rajasthan's desert, the Rann of Kutchh and the semi-arid regions of Punjab and Gujarat constitute the arid regions of North India. The Southern arid regions lie in the rain shadow of the Western Ghats, covering the states of Maharashtra, Karnataka and Tamil Nadu. However, in terms of being prone to drought, the semi-arid region is actually much larger. Ninety-nine districts, most of them large in size, across 14 states have been declared as drought prone districts. Over 75 percent of the cropped area of the country (i.e. 131 million ha out of 174 million ha) lies in the semi-arid tropics.

Water is scarce in these regions. The groundwater table and rainfall is low and the water run off is high. Annual rainfall is between 100 and 400 mm or 400 and 800 mm. The northern arid regions are entirely dependent on groundwater and above-the-ground tanks, ponds and other traditional stores of water. No rivers flow through these regions. For the pastoralists or the goat/cattle keepers, water-scarcity, feed-scarcity and related disease in animals are major problems. Dwindling pasturelands and common grazing lands put further pressure on farming and animal husbandry.

Pastoral groups that manage significant proportions of national livestock herds are particularly vulnerable to climate change. The number, distribution and productivity of permanent pastures and water points, which are so critical for livestock survival during the dry season, are bound to decline. Scarcer resources, coupled with current levels of demographic growth, are likely to lead to stronger competition and conflict between pastoral communities and other groups.

¹⁶ Climate Change in Western Ghats: 4X4 Report and Beyond- SANDRAP-2013- <http://sandrp.wordpress.com/2013/07/26/climate-change-in-western-ghats-4x4-report-and-beyond/>

¹⁷ 4X4 Climate Assessment report-2010-Ministry of Environment and Forests (MoEF)- Indian network on Climate Change Assessment (INCCA)

¹⁸ United Nations Framework Convention on Climate Change. (2012) Second National Communication on Climate Change





CHAPTER 2



OVERVIEW

Global Scenario

Concern about global warming has been growing since the early 1980s. Research findings confirm an increase in the atmospheric concentrations of GHGs behind the 'greenhouse effect', which causes global warming and climate change.

While the symptoms of global climate change may be obvious to even the casual observer, determining the precise rate, causes, impacts and solutions to this global phenomenon requires the talents of thousands of scientists worldwide. Distilling the wealth of scientific studies into a clear and defensible set of policy-relevant findings is what the Intergovernmental Panel on Climate Change (IPCC) is mandated to do. Formed in 1988 by the World Meteorological Organisation and United Nations Environment Programme, the IPCC periodically brings together hundreds of climate researchers worldwide to produce state of-the-science summaries of climate change trends, processes, impacts, and potential adaptation and mitigation strategies.¹⁹ The fourth series of IPCC summaries was released in 2007.²⁰ The Fifth IPCC Assessment Report and the latest to date followed in 2013. The IPCC data, considered alongside data from projects such as the National Assessment of the Potential Consequences of Climate Variability and Change (National Assessment)²¹ and the billions of observations gathered by a diverse network of weather and climate-related monitoring stations, provide an increasingly clear picture of climate change both globally and in the United States.

The First IPCC Assessment Report - 1990²²

The conclusions of this report which includes (i) the reports of the three IPCC working groups on science,

impacts, response and strategies, and (ii) the Policymaker Summaries of the IPCC Working Groups and the IPCC Special Committee on the Participation of Developing Countries, clearly indicates that climate change is happening and that it has a clear impact on planet earth's natural resources.

There is a natural greenhouse effect, which even now keeps the Earth warmer than it would be. In addition, emissions resulting from human activities are substantially increasing atmospheric concentrations of carbon dioxide, methane, chlorofluorocarbons (CFCs) and nitrous oxide, which make up greenhouse gases. These increases will enhance the greenhouse effect and add to the warming of the Earth's surface.

In developing countries, climate change contributes to the migration of impoverished people from rural to urban areas, from coastal lowlands, particularly densely inhabited delta areas, to inland areas and possibly across national boundaries. The most vulnerable populations in these countries, are farmers engaged in subsistence agriculture, residents of coastal lowlands, populations in semi-arid grasslands and the urban poor, especially women, pushed into squatter settlements, slums and shanty towns.

In extremely flat deltaic areas, rise in sea level would cause shores to retreat several kilometres, displacing hundreds of villages and obliterating the lands and natural resources on which millions of people depend for their subsistence. Small Island countries would lose a significant part of their land area with a sea level rise of just 1 m. Any sea-level rise will allow waves to topple over the coral reefs, increasing coastal vulnerability to erosion and storms.

¹⁹ Intergovernmental Panel on Climate Change, <http://www.ipcc.ch/>

²⁰ The fourth assessment report is known as AR4; earlier assessments were published in 1990 (first), 1995 (second), and 2001 (third). IPCC researchers are organised into three working groups. Working Group I focuses on the physical science of climate change, documenting trends in atmospheric conditions, temperature, precipitation, and storms; working Group II focuses on assessing the impacts of current and projected climate changes in many substantive areas; and Working Group III examines opportunities for adapting to these changes and for mitigating (i.e., reversing) those activities and processes responsible for the undesirable changes in climate

²¹ The National Assessment was called for by the Global Change Research Act of 1990. 15 U.S.C. 2921 et seq. It was administered by the U.S. Global Change Research Program

²² IPCC FAR Overview Chapter, 1990, https://www.ipcc.ch/ipccreports/1992_percent_20IPCC_percent_20Supplement/IPCC_1990_and_1992_Assessments/English/ipcc_90_92_assessments_far_overview.pdf



Evidence now available from different studies indicates that changes in climate would have a fundamental effect on the availability of water and on livestock and agriculture. Increased pests and diseases resulting in a decline of crop production may be severe in some regions.

The 4th IPCC Assessment Report ²³

The average near surface air temperature of the Earth increased by 0.74°C (1.33°F) in the last century (1906-2005). Temperature increase, though spread over the globe, is not uniform; regional variations are common and often significant. Higher northern latitudes have a greater temperature increase. In the last 100 years, average Arctic temperatures have increased by twice the global average rate. Satellite measurements of lower- and mid-tropospheric temperature show warming rates similar to those observed in surface temperature. Increases in sea level are consistent with warming of the earth's surface. Global average sea level rose at an average rate of 1.8 [1.3 to 2.3] mm per year in the period 1961 to 2003 and at an average rate of about 3.1 [2.4 to 3.8] mm per year from 1993 to 2003. Since 1993, thermal expansion of the oceans has contributed about 57 percent of the sum of the estimated individual contributions to sea level rise, with decreases in glaciers and ice caps contributing about 28 percent and losses from the polar ice sheets contributing the remainder. From 1993 to 2003 the sum of these climate contributions has been consistent within uncertainties with the total sea level rise that has been directly observed. Satellite data since 1978 shows that annual average Arctic sea ice extent has shrunk by 2.7 (2.1 to 3.3) percent per decade, with larger decreases of 7.4 (5.0 to 9.8) percent per decade in summer. Mountain and glacier snow cover, on an average, have declined in both hemispheres. Since 1900, the maximum extent of seasonally frozen ground in the Northern Hemisphere has decreased by about 7 percent, with decreases in spring going up to 15 percent. From 1900 to 2005, precipitation has increased significantly in eastern parts of North and South America, Northern Europe and Northern and Central Asia whereas precipitation has declined in the Sahel, the Mediterranean, Southern Africa and parts of Southern Asia. Globally, the area affected by drought has increased since the 1970s.

The report assesses the impact of climate change on eco systems, coasts, health, etc. An unprecedented combination of climate change, associated disturbances (e.g. flooding, drought, wildfire, insects, ocean acidification) and other global change drivers (e.g. land use change, pollution, fragmentation of natural systems, over- exploitation of resources) is likely to exceed the resilience of many ecosystems this century. Even small local temperature increases (1 to 2°C), are expected to decrease crop

productivity, in turn increasing the risk of hunger. Increases in the frequency and severity of floods and droughts are projected to adversely affect sustainable development.

Societies across the world have a long record of adapting and reducing their vulnerability to the impacts of weather and climate related events such as floods, droughts and storms. Adaptation alone is not expected to cope with all the projected effects of climate change, especially not over the long term, as most impacts increase in magnitude.

Latest IPCC Findings: Trends and Projections²⁴ Human activity is continuing to affect the Earth's energy budget by changing the Earth's emissions and atmospheric concentrations. The most compelling evidence of climate change derives from observations of the atmosphere, land, oceans and cryosphere. Unequivocal evidence from in situ observations and ice core records shows that the atmospheric concentrations of important greenhouse gases such as carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) have increased over the last few centuries. Projections for the next few decades show spatial patterns of climate change similar to those projected for the later 21st century but with smaller magnitude.

Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions. Changes in many extreme weather and climate events have been observed since about 1950. There are more land regions where heavy precipitation events have increased than where it has decreased. Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90 percent of the energy accumulated between 1971 and 2010.

Transitioning to a carbon-free society, because it involves nearly every sector of society and because carbon is emitted all over the place, is complicated. The process will not be easy. The basic choice remains the same as that presented to humankind by the discovery of the hole in the ozone layer. This choice cannot be characterised as just another environmental issue. As author Ross Gelbspan puts it, "The climate crisis is far more than just an environmental issue. It is a civilisational issue."²⁵

Ramsar Convention, 1971

This convention is designed for the protection of wetlands. It recognises the economic, cultural, scientific, recreational values and ecological functions of wetlands. Under this Convention, state parties must designate at least one national wetland of international importance as a natural

²³ IPCC 4th Assessment Report 2007

²⁴ IPCC 5th Assessment Report, 2013

²⁵ Oil, blood and the future, Paul J Nyden, Canadian Content, August 2005



reserve, assess the impact of any change of use of wetlands and manage and make wise use of migratory stocks of waterfowl (bird).

World Heritage Convention, 1972

This Convention highlights the universal value of our cultural and natural heritage and advocates international support for maintenance of World Heritage sites. As a result of this Convention, a state party has an obligation to identify, protect, conserve and transmit the unique cultural and natural heritage of a country to future generations. Sites that are nominated by states are enlisted as World Heritage.

London Dumping Convention, 1972

This convention was designed to control the dumping of wastes in the sea. It requires states to limit the dumping of substances such as radioactive material, biological and chemical warfare agents, persistent plastics, heavy metals and toxic organics. In 1993, bans on the ocean disposal of low level radioactive material and industrial wastes were adopted. A protocol was added in 1996 and seven more substances were listed. These substances can be dumped only after getting the necessary permission.

Marpol Convention, 1973/78

This convention is aimed at preventing or reducing discharges (international or accidental) from ships into the seas. It greatly limits the amount of oil spill and ship generated waste, which can be discharged into the sea. There is a complete ban against dumping in areas designated as special areas, for example, in the Caribbean Sea and Gulf of Mexico.

CITES, 1973 (Convention on International Trade in Endangered Species)

Under this convention, parties are expected to identify species that are, or may be, threatened by trade. They should also identify those species that may be threatened unless the trade is regulated. The former should be listed in Appendix-I and the latter in Appendix-II. Commercial trade in species listed in Appendix-I, for example, dolphins and whales is forbidden. While not banned, trade is strictly regulated in respect of species listed in Appendix-II.

Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased. Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. (Summary for Policy Makers (SPM) IPCC, 5th Assessment Report 2012)

World Charter for Nature: general principles

The genetic viability on the Earth shall not be compromised; the population levels of all life forms, wild and domesticated, must be at least sufficient for their survival, and to this end necessary habitat shall be safeguarded. All areas of the Earth, both land and sea shall be subject to these principles of conservation; special protection shall be given to unique areas, to representative samples of all the different types of ecosystems and to the habitat of rare or endangered species. Ecosystems and organisms, as well as the land, marine and atmospheric resources that are utilised by man [sic], shall be managed to achieve and maintain optimum sustainable productivity, but not in such a way as to endanger the integrity of those other ecosystems or species with which they co-exist. Nature shall be secured against degradation caused by warfare or other hostile activities.

Source: UN 1982

Law of the Sea Convention, 1982 (Parts V & XII)

It seeks to protect and preserve the marine environment. It directs States to take measures to prevent, reduce and control marine pollution, and protect fragile ecosystems, monitor risk/effects of marine pollution etc. A state may not cause damage by pollution to the other States. It should notify other states where marine environment is in imminent danger. Over exploitation of living resources by coastal States in EEZs (Exclusive Economic Zone), should not be permitted.

Vienna Convention on the Protection of the Ozone Layer, 1985 & Montreal Protocol, 1987

Ozone is a protective layer of the atmosphere. It shields the Earth from the Sun's harmful radiation. We all know that CFCs deplete ozone. The Vienna Convention, 1985 and The Montreal Protocol sets firm targets for the states for phasing out CFCs. It has permitted developing states to delay their compliance with the Protocol. It has also provided for the transfer of necessary technology to developing states. The Convention restricts the trading of ozone depleting substances.

Basel Convention (On the control of Trans-Boundary Movements of Hazardous Wastes), 1989

Hazardous Wastes (HW) cause severe damage. Developed states often export HWs by to developing States. This convention seeks to minimise the level of HW from its source of generation. Export to countries, that prohibit HWs is dis-allowed without their explicit consent or if there is reason to believe that the importer will not manage these wastes soundly. The exporting state prior to exporting the HW must ensure the availability of disposal



facilities in the importing state. State parties should develop and prescribe guidelines for environmentally sound management of HW.

Agenda–21

This is a massive 800-page document adopted by the Rio Conference. It outlines 115 specific programmes as part of an Action-Programme for attaining sustainable development. Its recommendations are classified into different areas such as socio-economic issues to protect and promote human health, conservation and management of resources such as combating deforestation, desertification and drought. The document also recommends promotion of sustainable agriculture, rural development, strengthening networks consisting of women, NGOs, business, scientific and technological community, farmers through financial resources, transfer of environment friendly technology, training, international legal instruments and mechanisms. Though it is considered a key document it is not binding.

Climate Change Convention, 1992

Aimed at stabilising GHG emissions, this Convention lays down general commitments to limit GHG emissions, gather relevant information and develop plans to mitigate and adapt to climate change and cooperate in research and development which are applicable to all state parties (annexed as well as non- annexed).

Biodiversity Convention, 1992

Biodiversity is essential for ensuring sustainable development. This is the first global treaty, which adopted a comprehensive ecosystems approach. The convention outlined 3 objectives:

1) Conservation of biodiversity; 2) Sustainable use of the components of biodiversity and; 3) Fair and equitable sharing of the benefits of using biodiversity.

Initially the Northern countries wanted to declare biodiversity as a Common Heritage of Mankind. But the Southern countries refused because they wanted to retain sovereign supremacy over their biodiversity.

UN Convention on Combating Desertification, 1994

Through this Convention, states are directed to prioritise the combat of desertification and mitigation of the effects of drought through the development and implementation of national programmes in this regard. The CCD, as it is popularly called, endorses and employs a 'bottom- up' approach to international environmental cooperation. Its activities related to the control and alleviation of desertification and its effects are to be closely linked to the needs and participation of local land users.

HNS Convention, 1996

(International Convention on Liability and Compensation for Damage in connection with the carriage of Hazardous

and Noxious substances): This convention provides for liability and compensation for damage resulting from maritime accidents involving the carriage of hazardous and noxious substances.

Principles in Environmental Laws and Agreements

Environmental threats and challenges of the last three decades has led to the emergence of an increasing number of new concepts, principles and norms in environmental law. The Stockholm Conference on the Human Environment in 1972 and the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 contributed greatly to the advancement of environmental law. International environmental law rests on eight principles:

1. **Principle of State Responsibility:** A state incurs responsibility if it commits a breach of international obligation, say, not to pollute an international river. An international obligation stems primarily from an international treaty, custom or judicial decision.
2. **Principle of Good Neighbourliness:** According to the most basic principle of international law, every state has absolute authority to use and enjoy its own territory. Nonetheless, according to the customary principle of good neighbourliness, a state has to use its property in such a way that its action does not injure and harm the property or the legal interests of another state.
3. **Principle of Cooperation:** Global environmental problems cannot be managed without state cooperation, a principle that holds well in dealing with environmental problems.
4. **Principle of Sustainable Development:** Principle 4 of the Rio Declaration describes sustainable development as a tool that meets the needs of present generations without compromising the ability of future generations to meet their own.
5. **Principle of Polluter Pays:** The polluter has to pay for the consequences of pollution and has the responsibility of bearing the costs of rectifying the environmental damage resulting from pollution. This principle has special importance in the relationship between Northern and Southern countries.
6. **Principle of Precaution:** Some kinds of environmental damage are irreversible in nature. In such cases, scientific uncertainties about the possible harm will not be acceptable as a reason for postponing preventive actions (prevention is better than cure!).



7. Principle of Intergenerational Equity: This principle requires us to remember that Earth is not the exclusive property of the present generation of human beings but a common endowment for all mankind to be held in trust for generations to come. This is a principle of fairness.

8. Principle of Common but Differential Responsibility: It is well recognised that the ill effects of environmental degradation will eventually affect all countries. Therefore, all states have a common responsibility for protecting the environment. Nonetheless, the share of the contribution cannot be equal since countries do not have equal capacity to maintain the environment. The states that pollute more and have higher capacity have a major responsibility in maintaining environmental quality.

Furthermore, there is lack of recognition of the role, which traditional people may play in their adaptation to climate change in the future. For example, in the Fourth Assessment Report of the IPCC Working Group II (IPCC, 2007) on impacts, adaptation and vulnerability there is little mention of the contribution of indigenous people to adaptation and mitigation of climate change. Indigenous and other traditional people are only rarely considered in academic, policy and public discourses on climate change, despite the fact that they will be greatly impacted by impending changes. Symptomatic of the neglect of indigenous peoples, the recently released IPCC II 2007 report²⁶ summary on climate change impacts makes only scarce mention of indigenous people, and that too only in Polar Regions and merely as helpless victims of changes beyond their control.

Long-Term Negotiations

Montreal: Convened in Montreal, Canada, in 2005, CMP 1 (Conference of the Parties serving as the Meeting of the Parties of the Kyoto Protocol) decided to establish an Ad Hoc Working Group on Annex I Parties' Further Commitments under the Kyoto Protocol (AWG-KP) in accordance with Protocol Article 3.9, which mandated consideration of Annex I parties' further commitments at least seven years before the end of the first commitment period. COP 11 created a process to consider long-term cooperation under the convention through a series of four workshops known as "the Convention Dialogue."

Bali: COP 13 and CMP 3 in Bali, Indonesia, in December 2007 resulted in the Bali Roadmap on long-term issues. COP 13 adopted the Bali Action Plan and established the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA) with a mandate to focus on mitigation, adaptation, finance, technology and a shared vision for long-term cooperative action. Negotiations on

Annex I parties' further commitments continued under the AWG-KP. The deadline for concluding the two-track negotiations was set as 2009 in Copenhagen.

Copenhagen: The UN Climate Change Conference in Copenhagen, Denmark, took place in December 2009. More than 80 countries provided information on their national mitigation targets and actions. This high-profile event was marked by disputes over transparency and process.

Cancun: The UN Climate Change Conference in Cancun, Mexico took place in December 2010, the outcome of which was the Cancun Agreements. This agreement recognised the need for making deep cuts in global emissions in order to limit the global average temperature rise to 2°C above pre-industrial levels. It took note of emission reduction targets and Nationally Appropriate Mitigation Actions (NAMAs), and aspects such as reducing emissions from deforestation and forest degradation in developing countries, the role of conservation and sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+).

Durban: The next UN Climate Change Conference took place in Durban, South Africa, from 28 November to 11 December 2011. The Durban outcomes covered a wide range of topics, notably the establishment of a second commitment period under the Kyoto Protocol, a decision on long-term cooperative action under the Convention and agreement on the operationalisation of the GCF. Parties also agreed to launch the new ADP with a mandate "to develop a protocol, another legal instrument or an agreed outcome with legal force under the Convention applicable to all parties."

Doha: The Doha, Qatar, UN Climate Change Conference in from 26 November to 8 December 2012 resulted in a package of decisions, referred to as the "Doha Climate Gateway." This package included amendments to the Kyoto Protocol to establish its second commitment period and agreement to terminate the AWG-KP's work in Doha. The parties also agreed to terminate the AWG-LCA and negotiations under the Bali Action Plan and to consider loss and damage, "such as an institutional mechanism to address loss and damage in developing countries that are particularly vulnerable to the adverse effects of climate change."

Bonn: ADP 2 met in Bonn, Germany, from 29 April to 3 May 2013 prior to the Bonn Climate Change Conference, 3-14 June 2013. India had stressed the importance of the need for developed country parties to meet their commitments under the Convention in the pre-2020 period to bridge the

²⁶ IPCC II REPORT summary <http://www.ipcc.ch/SPM13apr07.pdf>

ambition gap on the grounds that if they did not meet their commitments in the pre- 2020 period, equity in the post-2020 period would be seriously affected.

Warsaw: The 19th Conference of the Parties (COP19) to the United Nations Framework Convention on Climate Change (UNFCCC) and the 9th Session of the Conference of the Parties serving as the Meeting of the Parties (CMP8) to the Kyoto Protocol were held at Warsaw, Poland from 11 November to 22 November 2013. COP 19 brought together representatives from governments, international organisations and civil society. A roadmap with clear milestones for finalising a global agreement, capitalisation and operationalisation of the Green Climate Fund and enhancing the mitigation ambition for pre-2020 as well as post-2020 period on equity reference framework was the main agenda.

As of the present day, the planet is not on track to limit climate change. According to the World Bank and other international institutions, the world will be warmer by 4 to 6°C by the end of this century as compared to pre- industrial levels.²⁷ Yet international community remains uncertain and divided on how it will manage increasing climate impacts and related loss and damage.²⁸ While there is an increasing acceptance of the necessity to reduce emissions and provide resources to enable vulnerable communities to adapt, there is no consensus as to what should happen when neither of these are enough to prevent loss, damage and disaster.

Lima convention-COP20

The 20th session of the Conference of the Parties (COP20) took place from 1st to 14th December 2014 in Lima, Peru. The meeting completed the third of a four year round of negotiations to conclude in Paris. It began with a sense of momentum for creation of Green Climate Fund and announcement by countries their post 2020 emission targets. However the meeting quickly bogged down and the parties put aside the elements document to haggle over the more immediate issues of how their intended contributions to the Paris agreement are to be submitted. Adopting the Lima call for climate action, parties to the UNFCCC agreed on arrangements for bringing forward their intended nationally determined contributions (INDCs) to the Paris agreement. In Lima, the COP decided on the composition of the mechanism's executive committee and adopted an initial two-year work plan outlining a detailed set of activities to better understand unavoidable climate impacts and to

identify and promote risk management strategies and other responses.

Environmental Legislation in India

India was the first country to impose a constitutional obligation on the state and citizens to protect and improve the environment as a primary duty. As per Article 48A of the Indian Constitution: "The state shall endeavour to protect and improve the environment and to safeguard forests and wildlife of the country." Article 51 A goes on to state: "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures."

In June 2008, the Prime Minister released India's first National Action Plan on Climate Change outlining existing and future policies and programmes to address climate mitigation and adaptation. The plan identified eight core "national missions" running through to 2017. Ministries were expected to submit detailed implementation plans on Climate Change to the Prime Minister's Council by December 2008.²⁹

Social Justice and Climate Change in India

Indian society is founded on class and caste. These two structures mediate resources and access to resources. Access of the poor to social services provided by the government is dependent on their caste, class and ethnicity. Clearly the vulnerability of people at the wrong end of the caste and class ladder leads to their deprivation from the social justice. Though climate change affects everyone, the effect on the poor and marginalised is most drastic.

International Climate Negotiation and India

India ratified the UNFCCC in 1993 and the Kyoto Protocol in 2002. Under the Convention, India and other developing countries had to undertake legally binding commitments to reduce GHG emissions. Since the major proportion of the problem (and historical responsibility) was caused by emissions from developed countries, the burden of emission reductions is not placed on India and other developing countries. Nevertheless, rapid industrialisation in India and other emerging economies such as China and Brazil, the 'fairness' of Kyoto is now being challenged.

²⁷ World Bank (2012) Turn Down the Heat: Why a 4°C Warmer World Must Be Avoided. <http://climatechange.worldbank.org/content/climate-change-report-warns-dramatically-warmer-world-century>. See also International Energy Agency (2011) World Energy Outlook 2011, Factsheet, page 1: <http://www.iea.org/weo/>

²⁸ http://unfccc.int/adaptation/cancun_adaptation_framework/loss_and_damage/items/6056.php for information on loss and damage under the UNFCCC

²⁹ Government of India, 2008 "National Action Plan on Climate Change" Prime Minister's Council on Climate Change



RESEARCH METHODOLOGY

This research is based on a compilation of human stories, facts and evidence provided by a variety of community groups. The sections of people from across India who depend on natural resources of all kinds for their sustenance and survival

Study Objectives

The key purpose of the study was to gain an in-depth understanding of community observations and insights on the impact of climate change on natural resources. This will help in lobby advocate and influence Central and State government laws, policy and programme implementation related to forests, water, the environment and common property resources

Study Universe

The study covered seven states - Himachal Pradesh, Jharkhand, Madhya Pradesh, Gujarat, Maharashtra, Odisha

and Rajasthan and a variety of climatic zones - Himalayan, coastal, arid, and the Western and Eastern Ghats. Five villages, in two districts of each state were covered bringing the total number of villages up to 70 and districts to 14. In addition, eight Nicobari villages - Enam, Pulobhabi, Champin, Tapong, Chhota-innaka, Trinket, Katchal and Mus in Car Nicobar, Great Nicobar and Nancowry group of the Andaman & Nicobar Islands were included to examine the impact of climate change on the biological diversity of these islands

Sampling Criteria

The study used stratified, purposive, random sampling. Resource rich belts (forests, mineral deposits, pasture lands and coast) with a substantial tribal presence were purposively selected. The tribal groups covered in the study included the Wasaba, Kathodi, Rabari, Oraon, Birhor, Santal, Bhill, Bhilla, Saharia, Gaddi, Gujar, Kanayat, Kutia and Dongaria Kondh communities.

Sl No.	State	District	Tehsil	Village
1.	Maharashtra	Nandurbar	Taloda	Malda, BadaDhanpur, Bhute, Veerpur, Kansai
		Dhuliya	Sirpur	Kharekhan, Satipani, Nawagaon, Khamheda, Joyda
2.	Rajasthan	Pratapgarh	Pipalkhunt	Bori, Jaitaliya,
			Arnod	Nandi Kheda
		Udaypur	Khairbada	Parsaad
		Bansbada	Chhotisarwan	Waada
		Bikaner	Kolayet	Charnwala, Bajju, Godu,
		Jaisalmer	Jaisalmer	Nachna
		Jodhpur	Bap	Shekhaser
3.	Gujarat	Taapi	Songarh	Budhwada, Limbadi, Satkashi
		Surat	Umarpada	Andhlikuin, Jhumabadi
		Kutchh	Bhuj	Jaatawada, Khawda, Sanosara
			Rapar	Brajwani, Bhutakiya

Sl No.	State	District	Tehsil	Village
4.	Odisha	Kalahandi	Biswanathpur	Ambaguda, Chacha
		Rayagada	Kalyansinghpur	Buduni, Tikarpada
			Muniguda	Serakapadi
		Kendrapada	Rajnagar	Bagapatia, Hatina, Pentha, Badkot, Udyana
5.	Himachal Pradesh	Chamba	Bharmour	Brahmani
			Chamba	Chambi, Dhar, Jadera
			Holi	Garoh
		Kangra	Bajinath	Gunehad, Kandal, Karnathu
			Multhan	KothiKohar, Poling
6.	Jharkhand	Ranchi	Angara	Dahua, Jarwadih, NayaTorang, Chandidih, Aasari
		Bokaro	Gomia	Swangbasti, Khudgadda, Gomia, Swanguttri, Swangnewminus,
7.	Madhya Pradesh	Shivpuri	Karera	Dangipura, Karmai Kala, Amola,
			Pichhor	Dhala
			Shivpuri	NayaBalarpur
		Alirajpur	Sondua	Badaamba, Khodamba, Akidia
			Katiwada	Kalibel, Kumbhi

Study Tools

Open-ended questionnaires, case studies and in-depth interviews to collect qualitative information were used in the study. Participatory Research Appraisal (PRA) tools such as Timeline, Trend Analysis, Seasonal Calendar, Venn Diagram, Cause – Effect Analysis and Vulnerability Matrix were used where necessary to provide a deeper understanding of the situation. In addition, wide-ranging information from journals, books, research reports, studies and websites were examined.

Research Team

A team of local fellows was brought on board to collect field data in order to overcome language barriers while working with diverse communities.

Study Limitations

- The study is based on the perceptions of the community. While identifying the change there is every possibility of over and/or under statement of the facts.
- Coverage of fourteen communities in seven states spread across a large geographical area was over ambitious.
- The duration of the research project was too short to cover collection of primary data from the villagers widely spread over the length and breadth of the country.

Data Analysis

The qualitative data collected with the help of unstructured interview schedules was processed manually. To find out levels of variations, community specific analysis was undertaken.



STUDY FINDINGS

The impacts of climate change can be grouped under three broad headings: ecological, social and economic. The ecological impacts of climate change include shifts of vegetation types and associated impacts on biodiversity, change in forest density and agricultural production, expansion of arid land, decline in water quantity and quality, stresses from pests, diseases, wildfire, increase in hazardous incidents and seacoast erosion. Salient social impacts include changes in employment, equity, risk distribution, human health and relocation of populations. Economic impacts consist of increased risk and uncertainty of forest or agricultural production, alteration in crop productivity and forest produce, reduction in the supply of ecosystem goods and services and increased cost of utilities and services. Populations are most likely being affected by climate change through impacts on the necessities of life such as water, forest, housing, transportation, food, natural ecosystems and health systems. Profiles of the states studied are described in brief with special reference to features related to climate change.

State Profile

Himachal Pradesh

Himachal Pradesh, a hilly and mountainous state in North India, takes its name from the Himalayas. The climate of this state varies from semi-tropical to semi-arctic as the altitude increases. Such a big variation in climate and rainfall is because of the wide difference in geo-physical features. Annual rainfall ranges from 1,500 mm to 1800 mm.³⁰

The Scheduled Tribe population of the state - 92,126 as per the 2011 census- is concentrated in the districts of Kinnaur and Lahaul-Spiti, Pangi, and Bharmour and parts of Chamba and includes Bhot, Bodh, Gaddi, Gujjar, Jad, Lamba, Khampa, Kanaura, Kinnara, Lahaula, Pangwala, Swangla, Beta, Beda, Domba, Gara and Zoba tribes. The state contributes 4.8 percent to national forest cover.³¹

Trend analysis of annual rainfall data over the last 25 years reveals an increase of about 47 percent in some of the high altitude districts and a decrease of about 16 percent in other districts. Increase in rainfall in the period June to September is leading to an increase of in-flow into rivers and an increase in the occurrence of floods. A significant decreasing trend in monsoon precipitation has been captured (Bhutiya et.al. 2009).³² Temperature in this region is said to have risen by about 1.6°C over the last century, a trend which is affecting the State's apple production. Forests in Himachal Pradesh, especially at higher altitudes, are highly vulnerable to climate change.³³ Himachal Pradesh urgently needs to deal with threats from the retreat of its glaciers, extreme weather events, changes in food production and security, water stress and an increase in the incidence of drought, floods and vector borne diseases.

Rajasthan

Situated in the western part of India, Rajasthan receives little rainfall and faces severe water scarcity.

Rajasthan has 10 climatic zones ranging from arid in the west to flood prone in the east. The state contributes 4.19 percent to national forest cover. The average rainfall of Rajasthan is 574 mm with significant variation across different parts of the state.³⁴ The western region has frequent dry spells, punctuated by an occasional heavy downpour in some years due to passing low-pressure systems.

There are distinct temperature range variations seasonally throughout the state, revealing the most typical phenomenon of warm-dry continental climate. The major portion of the state consisting of the arid west and the semi-arid mid-west has an average maximum of 45°C in summer. Rajasthan has a significant tribal population with the highest concentration in Banswara district followed by

³⁰ Himachal Pradesh Development Report, Himachal Pradesh – A profile, Planning Commission, Government of India, 2012

³¹ State of Forest Report, Forest Survey of India, 2013

³² Bhutiya, M.R, V.S Kale and N.J Pawar, 2007. Long-term Trends in Maximum, Minimum and Mean Annual Air Temperatures Across the Northwestern Himalaya During the Twentieth Century, Climatic Change

³³ Climate change Himachal Pradesh's perspective: ENVIS News letter- Volume II-2008

³⁴ Rajasthan State Action Plan on Climate Change, 2010, [http://www.nicra-icar.in/nicrarevised/images/State percent 20Action percent 20Plan/Rajasthan-SAPCC.pdf](http://www.nicra-icar.in/nicrarevised/images/State%20Action%20Plan/Rajasthan-SAPCC.pdf).

Dungarpur and Udaipur districts respectively. According to the 2011 census the total ST population of Rajasthan is 9,23,8534. Mina is the most populous tribe followed by Bhil Garasia, Damor, and Dhankaand Saharia.

Frequent occurrence of cold and hot waves has been observed. The highest number of cold waves in the last three decades - after Jammu and Kashmir - has occurred in Rajasthan. Alwar, in Eastern Rajasthan, holds a record for the highest maximum temperature. In the period 1901-2002, Rajasthan had 48 drought years of varying intensity. Climate variability and emerging climate change in semi-arid areas in Rajasthan pose a considerable threat to the natural resources that sustain fodder production for livestock. In the absence of appropriate management practices, pasture land are at considerable risk. Further degradation is expected as a result of poor precipitation and concentrated rainfall events interrupted by longer dry spells. Many places in Rajasthan have witnessed flash floods due to heavy rainfall resulting in unprecedented loss of life and property.³⁵

Gujarat

Bordered by Pakistan to the west and the Arabian Sea to the southwest, Gujarat took its name perhaps from the Gujjars, who ruled the state in the 8th century BC. The State falls within a sub-tropical climate zone. Summer temperature varies from 36°C in the coastal region to 43°C in the interiors. Gujarat receives its rainfall from the southwest monsoon (June to September), its maximum intensity being in the months of July and August. The annual rainfall varies between 300 mm in the north and northwest, gradually increasing to 2500 mm in the south. Tribals – the Bhil, Bhil Garasia, Dholi Bhil, Dungri Bhil, Dungri Garasia, Mewasi Bhil, Rawal Bhil, Tadvil Bhil, Bhagalia, Bhilala, Pawra, Vasava, Vasave, Rathwa and Nayak are found in 43 talukas in 12 districts.

In the last 40 years, Gujarat has experienced 12 years of drought and four major scarcity situations. The district of Kutchh, which occupies 24 percent of the geographical area of the state, has always been a drought prone region. A recent study observed that in the period 1978-2008, more than 90 percent of Gujarat's agro-climatic zones experienced more years with below average rainfall.³⁶ It is anticipated that Gujarat will experience rising temperatures and increased rainfall variability,³⁷ characterised by extremes in both rain and heat.

Maharashtra

Situated in the Deccan Plateau, Maharashtra accounts for 9.4 percent of the total geographical area of India. The Western Ghats, which runs parallel to the coast at an average elevation of 1,200 meters from which several important rivers originate, forms one of the three watersheds of the country.

Rainfall in the state varies considerably. More than 30 percent of the state falls under the rain shadow area and receives scanty and erratic rains. Rainfall is heavy in the coastal region, scanty in the central part and moderate in the eastern parts of the state. Annual rainfall in the coastal belt is found to vary between 1,600-4,800 mm, while in the interior/central belt, the rainfall is less than 600 mm.³⁸ The Konkan region, covering the entire Western Ghats, is known to receive the most rainfall. Geographically, the state can be divided into five main regions: Vidarbha (north-eastern region), Marathwada, Khandesh, Northern Maharashtra (Desh) and Western Maharashtra (Konkan). The climate, depending upon the location, varies from continental to typical maritime. The maximum and minimum temperature varies between 27°C to 40°C and 14°C to 27°C respectively. The tribal population as per 2011 census is 10,510,213. The major tribes are the Gond-Madia, Bhil, Koli, Warli, Katkari and Oraon. The state contributes 5.02 percent to national forest cover.³⁹

Maharashtra is prone to drought, floods and cyclones. Low rainfall areas are under constant risk of droughts while high rainfall zones - eastern and western Maharashtra - are prone to flash floods and landslides. The state is highly dependent on land and agriculture. The coastline is more than 840 km. Both these conditions leave the State's people susceptible to changing weather patterns. There is a significant decreasing trend in rainfall starting from January and extending up to May indicative of a major shift in the rainfall pattern. Twelve percent of the state's population lives in drought-prone areas of which the Deccan Plateau constitutes 50 percent. Deficient rainfall is reported once in five years. Severe drought conditions occur once in every 8-9 years.⁴⁰ The frequency of droughts in the semi-arid tropics is high and resource poor rain-fed farmers are often unable to cope with the effects of these extreme events.⁴¹ In future, due to changes in climatic conditions, agriculture will be more uncertain compounding the risk of rain-fed agriculture even further.

³⁵ Ibid 7

³⁶ A. Rathore, and Y. Jasrai, 'Evaluating temperature and precipitation variability over Gujarat, India from 1957-2007' in *International Journal of Scientific & Engineering Research*, Vol 4(5):956-962 (2013), p 956

³⁷ R.V. Cruz, H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li and N. HuuNinh, *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, (Eds.), (Cambridge, 2007)

³⁸ Climate Change and Maharashtra, ENVIS News Letter April-May 2010 http://envis.maharashtra.gov.in/envis_data/newsletter/climatechange/Links/cc_and_mah.html

³⁹ State of Forest Report, Forest Survey of India, 2013

⁴⁰ National Disaster Reduction Portal, Maharashtra, NIDM, 2014

⁴¹ Vulnerability to Climate Change: Adaptation Strategies & Layers of Resilience, Naveen P Singh, MCS Bantilan, K Byjesh, VUM Rao, GGSN Rao, B Venkateswarulu and N Manikandan, ICRISAT, 2012



Madhya Pradesh

Surrounded by the states of Chhattisgarh, Gujarat, UP, Rajasthan and Maharashtra, Madhya Pradesh (MP), which lies in the heart of India, is a land-locked state. Eleven different agro-climatic zones are identifiable in this a bio-diverse region. Geographically, forests make up a third (31 percent) of the state and 9.38 percent of the geographical area of the country⁴². Ten important rivers, including Narmada, crisscross its terrain. The state is rich in floral and faunal biodiversity. Annual rainfall varies from 800 mm to about 1,800 mm. The annual temperature ranges from 22.5°C to 25°C. Scheduled tribes constitute 21.1 percent of the State's population as per 2011 census.

Some of the projected climate risks for MP are: increase in maximum and minimum temperatures, changes in spatial and temporal distribution of the monsoon, increase in frequency and intensity of rains, loss of rainy days and extended summers. Not only will climate change affect the State's natural resources in times to come it will also impact human health and the availability of safe habitats. Indeed, climate risks have the potential to hamper sustainable development of the State.⁴³

There are four types of forests in MP and it is predicted that changing climate may affect their composition and distribution. These changes may also alter the productivity of NTFPs/fodder/fuel wood, which are basic sources of livelihood for forest dependent communities. Shifts in habitat and search for favourable weather may induce migration of wild animals and subsequently increase the incidences of human-wild conflicts. Water scarcity is expected to become an ever-increasing problem in the future. The rain-fed nature of MP's rivers has made them highly susceptible to variations in the distribution and rainfall patterns.⁴⁴

Jharkhand

The Chota Nagpur Plateau consisting of a series of plateaus of different elevations, the most important ones being- the Ranchi plateau, the Ramgarh plateau and the Hazaribag plateau- was carved out of the state of Bihar to form the state of Jharkhand in the year 2000. Bihar in the north, Odisha in the south, West Bengal in the east, and Chhattisgarh in the west bound this land locked state. The Koel, Subarnrekha, Damodar, Barakar, Ajo, Mor, Konar and Bokaro rivers flow through the state. The climate is tropical with hot summers and cold winters. Average annual rainfall is 1,400 mm. The temperature varies between 40°C to 47°C. Thirty-two tribes constitute 28

percent of the State's population (2011 census). The main tribal groups are the Baiga, Asur, Banjar, Bedia, Bathaudi, Binjha, Bhumij, Birjia, Birhor, Chick Baraik, Chero and Gorait. Jharkhand is predominantly an agrarian state; 80 percent of the population continues to depend on agriculture and allied industries.⁴⁵ Agricultural practices are largely traditional and productivity is low.⁴⁶

Shifts in the weather pattern and rise in temperature are affecting sectors of the economy that depend on natural resources (i.e. vegetation, water, rains and land) the adaptation to which demands additional resource allocation.

Agriculture in Jharkhand is heavily dependent on the monsoon. The major part of the State's agriculture production is confined to the kharif season (June-September) when most of the annual rainfall occurs. Increase in the frequency and severity of extreme weather events like heat waves (unexpected rise in temperature in summer months from mid-February onwards), hail storms (decreased frequency but increased severity), drastic decrease in pre-monsoon convectional rainfall and cold wave/frost in winter further restricts agriculture productivity in the state. Mono cropping, which dominates in most parts of Jharkhand, is not possible in seasons other than monsoon because of undependable rains. As this already is a low rainfall region, the water sector in Jharkhand that is completely dependent on rainfall, is severely impacted.

Odisha

The state of Odisha bounded by Andhra Pradesh in the south, West Bengal in the north, Jharkhand in the north-west and Chhattisgarh in the west, lies in the east along the Bay of Bengal. It has a tropical climate, characterised by high temperature and humidity, medium to high rainfall and a short and mild winter. Odisha has ten agro-climatic zones. The normal rainfall of the state is 1,451.2 mm. Floods, droughts and cyclones occur almost every year with varying intensity. The temperature ranges between 40-46°C. In the coastal districts, the climate is equable but highly humid and sticky. The summer maximum temperature ranges between 35-40°C. Low temperatures are usually between 12-14°C. The temperature of the state is gradually increasing as is contrasting weather conditions - heat waves and cyclones droughts and floods. Twenty-four percent of the State's population is tribal. Odisha has the largest number of tribes, as many as 62 prominent among which are the Kondh, Santal, Saura, and Bonda. About 37 percent of the State's geographical area is covered by forest.⁴⁷

⁴² India State of Forest Report, 2011

⁴³ Ibid 17

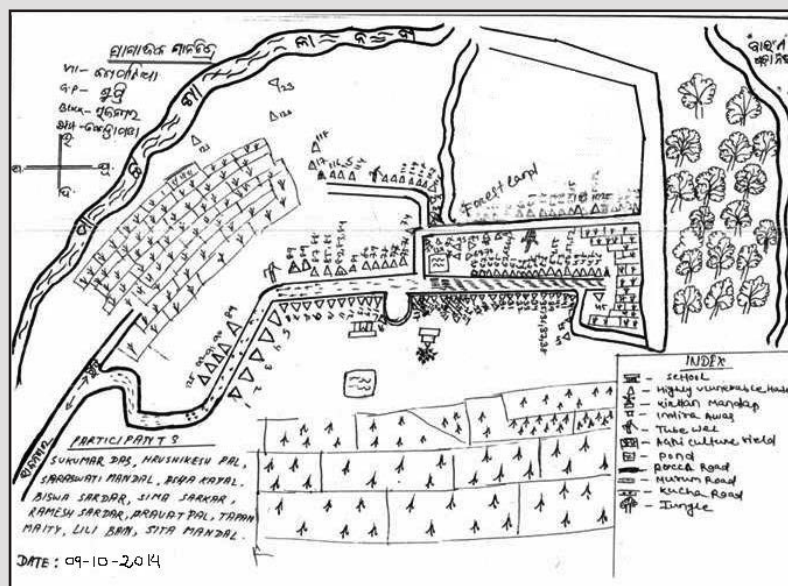
⁴⁴ Draft MP State Action Plan On Climate Change- February 2012

⁴⁵ www.jharkhand.gov.in/new_depts/ap201011/industries201011.pdf

⁴⁶ Jharkhand Action Plan on Climate Change, Government of Jharkhand, 2013

⁴⁷ India State of forest report 2011





Social and resource map of Bagapatia Village, drawn through Participatory Rural Appraisal (PRA) in 2014 Kendrapada District, Odisha

Fluctuating weather conditions in the state suggest that it is reeling under climatic chaos. Ninety-five of the last 105 years have been declared disaster affected. For more than a decade now, Odisha has experienced contrasting and extreme weather conditions - heat waves and cyclones droughts and floods. In the last four years alone, natural calamities have claimed more than 30,000 lives. Not only have natural calamities become more frequent, areas that were never considered vulnerable are now being hit. Apart from more frequent extreme weather events like floods and droughts, climate change impact will include an increase in sea level leading to economic loss and disruption of life. With sea level rise, the coast will experience increased levels of inundation and storm flooding, accelerated coastal erosion, seawater intrusion into fresh groundwater and intrusion of tidal waters into river systems. Big cities situated on the coast, flood plains and river deltas supporting a large number of people and industries, can expect increased flood damage causing loss of structures and property. A disappearing shoreline will also mean some loss of social amenities. The area populated by the tribals is similarly affected by climatic variability, as there is already pressure from the corporate sector on water, land and forest resources.

Study Findings

Evidence suggests that climate change is affecting the distribution and quality of India's natural resources, which will ultimately threaten the life and livelihoods of the most poor and marginalised sections of India's population. This study takes an in-depth look at community observations and insights on the issue.

The study respondents were not aware of the term "Climate Change" and of the global discourse around the

phenomenon this term represents. Nonetheless, they were very much aware of the changes taking place in local weather and climate patterns. Most of the respondents reported a decrease in rainfall in the last 30 years. Vulnerable people intuitively understand nature and are well able to gauge the changes taking place in climatic conditions. They also clearly perceive how these changes are affecting their life and livelihoods.

Climate Change and Natural Resource Depletion

This section of the report presents a summary of the impact of climate change on natural resources and its effect on life, livelihood and physical environment in the study locations. This highlights current knowledge about climate change among the most vulnerable people and the way they see nature and its impact.

The communities this study covered are experiencing changes in their water sources, forest cover and common and agricultural lands and they feel more vulnerable than ever as a result of these changes.

In Odisha, salinity intrusion into ground and surface water systems and on to agricultural lands is reducing availability of fresh water, decreasing crop yield, and increasing the incidence of diseases. Coastal villages earlier affected by the super cyclone now suffer from both water logging and salinity problems. Erosion of riverbanks in varying degree is making poor households landless. The village shown in the adjoining social map is next to two rivers that flow into the sea. Frequent inundation and erosion of these rivers and the ingress of saline water is contaminating fresh water and making the land uncultivable. Many farmers grow their crops on

land close to the sea or river. Unexpected changes in the behaviour of the river and sea are leading to a significant number of farmers in all the study villages to abandon agriculture and to migrate.

Fisherfolk in Odisha are also experiencing a decline both in the size of their catches and in the variety of fish they catch. They attribute this decline to an increase in the roughness of the sea, the reduction of mangroves and changes in climatic conditions.

Changes in the Island Ecology (Andaman & Nicobar Islands)

The Andaman and Nicobar Islands in the Bay of Bengal are peaks of a submerged mountain range arching from Burma in the north to Sumatra in Indonesia in the South. The Andaman Islands, with over 325 islands covers 6,408 km² and the Nicobar Islands, with more than 24 islands (12 inhabited) cover an area of 1,841 km². The Nicobar group of Islands, a group of small islands, is divided into Great Nicobar, the Nancowry group of Islands and Car Nicobar for administrative purposes. With few exceptions, these islands are covered with lush, green tropical rainforests. The forests are home to six ancient groups of tribes namely the Great Andamanese, the Onge, the Jarawa, the Sentinelese, the Nicobarese and the Shompens. These tribes depend on the forests for their existence and have a wealth of knowledge about the occurrence and use of various medicinal plants and forest produce.

The average annual rainfall of the islands ranges from 3,000 to 3,500 mm⁴⁸. The Great Nicobar gets a little more rain than the other islands. Rainfall is moderate in the months of May and June and heaviest in July, August and September. March and April are the driest months of the year. In these months, there is a scarcity of water; water levels in the wells drop and dry dust covers the islands. From about the middle of October to the middle of November and from the last week of April to the middle of May, the velocity of the wind increases and blows in every direction. The weather is typically cyclonic. Navigation of ships in this period is dangerous. Since the last two decades, the incidence of erratic cyclonic storms in this period is on increase.

Since 1870, global sea level has risen by about 20 cm at an average rate of 1.7 mm/year. According to the latest figures, in recent decades the rate has risen sharply to 2.5 mm/year.⁴⁹ The rise in sea level is mainly a result of thermal expansion of the oceans due to global warming as well as increased water inflows from melting glaciers and ice caps. The locals shared the situation of the island “before Tsunami and after Tsunami”. According to Dr. Justin, the Director of the Anthropological Survey of India, not a single death among

“We don’t know about climate change”, says Mr. James, resident of Nancowry Island. According to him, the island is expected to experience a range of environmental, social and economic effects including threats to natural habitat, loss of habitable and agricultural land, coastal erosion, decreased food and water security and adverse impacts on human health. The island states contain a highly unique range of biological diversity with over 4,000 species of endemic plants and animals like spotted deer, megapode bird and some of the largest and most diverse coral reefs. Now everything is under threat.

the five indigenous tribes – the Jarwas, Onges, Shompens, Sentinelese and Great Andamanese, was reported. The world was astonished to learn that what saved these people was their traditional knowledge of warning systems interpreted through changes in the behaviour of birds and marine animals. For instance, a change in bird calls indicates that something is wrong. In some places, animals moved to safer ground probably having sensed vibrations or changes in air pressure prior to the wave’s arrival. Tribal people fled for safety at these indications.

“We don’t know about climate change”, says **Mr. James**, a resident of Nancowry Island. According to him, the island is expected to experience a range of environmental, social and economic effects including threats to natural habitat, loss of habitable and agricultural land, coastal erosion, decreased food and water security and adverse impacts on human health. The island states contain a highly unique range of biological diversity with over 4,000 species of endemic plants and animals like spotted deer, megapode bird and some of the largest and most diverse coral reefs. Now everything is under threat.

The tsunami submerged large tracts of agricultural land. Only hilly areas were spared. After the Tsunami, the Nicobarese cleared the forest on high land and established new habitations there. Clearance of the forests led to

According to Mr. Donald Samuel, Chief of Katchal Island, “Land, water and forest are their birth rights and tribal identity and when their lands and resources disappear or are changed due to climatic variability, development or human activities then they suffer badly”. He argues that the climate change is due to lack of sustainable practice. Due to the influx of population force to tribal areas, the tribal land is under threat now.

⁴⁸ <http://www.and.nic.in/stats>

⁴⁹ Climate change and coastal mega cities of India, Harshal T Pandve, Indian journal of occupational and environmental medicine, Vol. 14, No. 1, January-April 2010.



According to Mr. Portifer Joseph, the 1st Captain of Trinket Island, "The day-to-day human activities are the main source of creating a big disaster like Tsunami. So many trees are being cut for developmental activities for the construction of road and buildings. We were told to clear the jungle for the construction of permanent shelters, as a result many acres of land cleared and thousands of trees were cut in each village during the rehabilitation phase but nobody knows its future impact on our tribal life."

severe soil erosion. Inundation of coastal areas led to the formation of saline marshes and consequently the formation of acid sulphate soils in the some islands.

With permission from the owner of the land or the Captain/Tuhet head, the tribes raise plantations. Aware of the impending sea level rise, in the middle of May, the Nicobarese select about an acre of land in a suitable and safe place where they store seeds like coconuts, mango, banana, papaya and Nicobari potato for use during the plantation season. Recent introduction by the administration of cash crops such as cashew nut, rubber and oil palm is changing the topography of the Nicobar Islands. This, say the local residents, does not help tribal lives and livelihoods and poses threats to the coast.

Most communities are dependent on fishing. Every family owns a fishing canoe, which is made locally. Fish abound in the reefs. In recent times, climatic variability has led to an increase in salinity and water temperature and the destruction of the reefs. The Nicobarese are very fond of eating fish. They go out in their canoes whenever possible to fish in the deep sea. From January to April, when the sea is calm, it is quite common for the men to be away for 1-2 days at a stretch fishing miles away from the shore. People are now afraid to go to sea, as it is no longer calm.

The Nicobarese prefer to use rainwater for drinking purposes. During the rainy season rainwater is stored for use over the rest of the year. Drinking water is available in all the inhabited islands of the Nicobar group except in Chowra Island. This island depends entirely upon rainwater, as it does not have a single surface water source. Fresh water is under threat due to erratic rainfall. The administration has constructed three big tanks with roofs to catch and store rainwater during the rainy season. A water user's committee has been formed to manage drinking water. The demand for drinking water structures has increased after the Tsunami since people have started residing in raised constructions.

Sea Level Rise

The catchment area of the Bay of Bengal, the world's largest bay, is home to 400 million people. Coastal communities in

the Bay of Bengal are experiencing climate change in terms of saline intrusion in water bodies and soil, increased frequency and intensity of tidal surge, coastal erosion, the sea pushing in closer to the shore and an increase in cyclonic events. Although the nature of these changes across the coast follows a similar pattern, the degree varies according to localised physical characteristics. Life and livelihoods (ground water, surface water, agriculture, grazing land and fish catch) of the majority of people living close to the coast are impacted by these changes. Agriculture is the primary source of livelihood. There is a significant reduction in crop yields in most areas. Farming is not a viable option any longer forcing people to migrate, to work as day labourers or rely on safety nets. Sharecropping, upon which the majority of the people depended in the past is no longer available as landowners have turned to shrimp farming thanks to increasing salinity. Homestead gardening, fishing and animal husbandry that used to supplement the income of rural households has declined.

Increase in Disaster Frequency

Respondents in coastal Odisha said that they are experiencing multiple hazards such as cyclones and sea level rise, flooding, drought, tidal surges, and coastal erosion. The Bay of Bengal remains the major source of these hazards while localised factors influence the intensity of floods and droughts

All the study villages have been affected by several disasters in the last 15 years: the cyclone of 1971, the super cyclone in 1999 and tropical storms- Phailin in 2013 and Hudhud in 2014. Salinity is the biggest problem. It has rendered water and soil unusable. The frequency of drought is also increasing in all the study locations with major consequences for crops, livestock and poultry.

The increased frequency and intensity of the hazards has intensified the risk exposure of coastal communities already in the top high-risk list of the country. It has been observed that an increase in localised and low intensity hazards (sea tide) can increase vulnerability to high impact hazards (cyclone and floods) as disaster protection infrastructure such as embankments is weakened. This has been well observed in Pentha village of Kendrapara, Odisha.

Saline Ingress and Impact on Food Production

Poor crop yields in coastal regions is largely due to saline ingress into fresh water sources and soil. Increased salinity in soil and water in Bagapatia village in Kendrapada district of Odisha has totally destroyed land fertility in this village. Farmers have reported a decrease in paddy production in recent years due to the lack of fresh water and the non-availability of traditional saline resistant paddy variety. Farmers are also not able to grow winter crops.



Homestead based gardening and fruit production provides extra income and supplements the nutrition of almost all rural households. In many villages, people are not able to grow kitchen gardens due to regular flooding, tidal surges and salinity.

Climate Risk on Livestock and Pasture Commons

The pasture common in Rajasthan tend to be situated in highly sensitive ecologically contexts. Specific topographic and climatic characteristics of the region add to the risk of loss of vegetative cover and soil erosion. Recurrent drought has led to significant loss of tree cover on common lands, which in turn has led to a decline in fodder availability for livestock. In addition, when heavy monsoon rains hit the terrain after a long dry period, the run off washes away a large amount of silt and sand. Soil cover is lost and the land loses its productivity.

A situation analysis of the villages in Rajasthan revealed that lack of fodder limits people's livelihood options. Recurrent droughts in recent decades have added to the stress on stated that in the last decade their livestock population has shrunk by 50 percent due to fodder and water shortage. Many villagers have had to sell their livestock at very low prices, because they could not afford to feed them during a drought. The major loss has been in the cow population. Other social and economic pressures such as encroachment for housing and other purposes have added to the stress on pasturelands. The livestock population has substantially declined in both Rajasthan and Maharashtra for the reasons discussed above. In coastal Odisha, the people have not been able to recover domestic animals they lost during the super cyclone and subsequent cyclones. Livestock, in addition to providing a livelihood for many poor people also provides them with nutrition in the form of milk and meat.

Jagdish Bhai Kher from Hintiya village of Sabarkantha district, Gujarat, depends solely on livestock for his livelihood. He feels quite vulnerable now. He opined that livestock is no longer a viable livelihood option in the drier parts of Gujarat. Changes in the precipitation pattern have lead to decreasing grass on pasturelands and to loss of livestock and livelihoods. The number, distribution and productivity of permanent pastures and water points, which are so critical for survival of livestock during the dry season, are now declining. Diminishing resources coupled with current levels of demographic growth are leading to stronger competition and conflict between pastoral communities and other groups. In the longer term, pastoralists will be obliged to diversify their livelihoods, both within the pastoral system and outside it. Many of them have shifted to areas where fodder is still available.

Sekhasar village of Phalodi, district Jodhpur is one of the hottest places in Rajasthan. **Punja Ram Singh** of this village

states, "Our lives depend on domestic livestock. Over time, the heat has increased and rainfall has become erratic and insufficient. We no longer find enough green grass to feed our cattle. Managing drinking water for our livestock in the summer months is another big challenge. Our cattle fall sick more often than before. More of our sheep and goats die now than in the past. I lost 70 livestock recently to some unknown disease. This is a very big loss. I may have no choice but to migrate to the city".

Young **Lisma Ram** from Sangori village of Jodhpur district belongs to the Rewari (nomadic) community of southern Rajasthan. He spoke of his concerns regarding the shortage of pastureland and fodder for his family's livestock. He blames the sharp decrease in rainfall for the scarcity of pastureland and fodder.

In his view, the present situation is not conducive to keeping animals. His entire community depends upon livestock; it is their principal livelihood. Many members of his community are shifting away from livestock. He believes that multinational companies are partly responsible for the shortage in pasturelands because they have set up solar projects on what used to be pasturelands. If the Government does not take put a stop to such diversion of pasturelands, the animals, particularly sheep and cows, will vanish from the region. The new era of progress is transforming every thing – culture, occupations and people's thinking, he said.

Impact on Water Resources

It is observed that climate change has predominantly affected water resources- both in terms of its scarcity and its excess. Most states are now water-scarce largely because of the high variability in rainfall. They depend heavily on groundwater for irrigation, industry and domestic use. Yet groundwater extraction has grown substantially and exceeds recharge in some areas. Water-intensive crops and over- exploitation of available resources, combined with poor water management are prime causes for the decrease of groundwater levels. In Gujarat, villagers noted that 20 years ago water was available at 15-40 feet below ground. Now they have to drill as deep as 200-500 feet to find water. The same story was repeated in the study villages in Maharashtra. Such sharp declines in groundwater levels could lead to irreversible salinisation, which would put an end to agriculture in the area. Ground water sources in Odisha are contaminated with salinity. Reduced rainfall and flash floods owing to climate change are leading to poor recharge of ground water, salinisation and ultimately a reduced amount of water the impact of which is particularly felt by rural and tribal communities.

Chunnial from Botiya village in Sabarkantha district of Gujarat feels he is a victim of nature's wrath. Water is scarce in his region. Rainfall and the groundwater table are low and the water run- off is high. Small land holdings combined



with irregular rainfall has led to low productivity of lands, disguised unemployment and increasing vulnerability. Under current agricultural practices, many dry land farmers are unable to earn their livelihood the year-round. For the pastoralists, the excessive and prolonged heat is leading to a scarcity of water and fodder and a higher incidence of disease in their animals. Degradation of pasturelands puts further pressure on the livestock and cultivable land. Inter-cropped, traditional varieties of crops have a better chance of surviving a bad and erratic monsoon and ensure the farmer of his food security. Current practices of crop diversification and intercropping systems are also being challenged by adverse weather events; crop pests or insect attacks are on the increase.

Climate change is impacting the pastoral economy of the entire arid zone in India. Rural people often rely on a combination of rain-fed agriculture, livestock rearing, collection of MFPs and other income generating activities to sustain themselves. People are now less able to insure themselves in the face of the extra challenges they confront owing to climate change. Adverse weather in the form of a prolonged dry season or delayed onset of the monsoons has considerable negative effects on crop yields making people's lives much harder. These shocks affect everyone in a given environment and are therefore harder to diversify locally. For the nomadic and semi-nomadic people in the region, migration in its many forms and patterns—seasonal and distress, rural-to-rural, rural-to-urban—is common in this area. They migrate to other irrigated areas where agricultural wage labour is available or to urban areas where employment as wage labour for the construction sector is available. Climate variability has been, and continues to be, the principal source of fluctuations in food production in this area.

Sixty-five year old **Kaadu Huika** from Tikarpada village of Rayagada district of Odisha is from Niyamgiri Hill. He recalls with dismay how bountiful nature was in his childhood and what little remains of those resources today. Niyamgiri, he said, used to be the source of many rivers and streams; more than 100 streams -big and small - took their source in this hill. Bansadhara and Nagavali, two major rivers of Odisha and Shakta Nala and Barsha Nala - big perennial streams-also originate from Niyamgiri. Kaadu Huika recalled: "This mountain used to be shrouded in clouds and it rained throughout the year. The situation has changed completely. Now it rains for only one month in the rainy season. Since we settled near the streams, we always had water at our doorstep. Today we go long distances to fetch drinking water. The ground water table has also dropped. Massive soil erosion that is taking place is causing land and forest loss. Previously we used to cultivate some land by clearing the forests near a water source. Since the water we need to cultivate our crop is on decline, we are now forced to clear larger areas in the forest. Traditional water storage systems are almost defunct. We do not get sufficient water to irrigate

our land and to quench the thirst of our cattle. We have been seeing how climatic changes and other developmental activities have robbed us of water. Without water what livelihoods can we have, what is left of life?"

Shantaa Bai hails from Bharmiya village of Sabarkantha district, Gujarat. She said: "In the past the streams surrounding our village used to hold water up to Holi. These same streams are now almost dry. The competition for water is destroying relations among farmers. Women of the village must now travel a long distance to collect water for household use".

Impact on Agriculture

Delay in the onset of the monsoon and erratic rainfall can have a deleterious effect on cultivation. Too little or too much rain at the wrong time can affect the cultivation cycle from sowing to harvesting. Severe hailstorms that occurred for the first time in recent history in February 2015 hit the entire state of Maharashtra, most of central India and parts of Andhra Pradesh and Haryana. Wheat and horticulture crops were affected the most. Farmers who cultivated grapes, oranges, mash melons and bananas suffered severe losses. Many lost the entire crop. Though a hailstorm after winter, especially in early February, is not unusual, the hailstorms in February this year were unusually intense and could have been the result of changes in climatic conditions.

People have observed that pest attacks on crops and fruit trees are on the rise. Climate change poses a threat to the control of pests, plant diseases and invasive weeds. Climate factors that aid in pest and disease invasions are mostly temperature related and include increasing average temperatures, warmer winters, changes in precipitation patterns and water shortages. Higher temperatures are also likely to result in more pests.

As a result of a rise in temperature in the mountains of Himachal Pradesh, apple cultivation has moved to higher altitudes, adversely impacting the indigenous varieties of trees that were located there earlier. A variety of garlic has replaced apple orchards. This shift, it is feared, will exacerbate the adverse impact on the cultivation pattern in the area even further, since apple cultivation provided tree canopy cover that aided in maintaining the local temperature.

People belonging to the Bhil tribe in Madhya Pradesh cultivated maize, peas, dal and several varieties of jawar (Sadi, Chachri, Kedi, Dhani, Chikni, Motli and Bhuyadi) in the past. Villagers recall that they also grew an abundance of vegetables. Since the last 4-5 years, they buy vegetables in the market. Untimely rain during the flowering and harvesting period has severely impacted production of these crops and in turn has debilitated their economic base which to begin with was never very robust.



There has been a sharp decrease of snowfall over the past few years during September to December, which are important months for temperate crops. The snowfall has shown increasing trends during January and February, which reveal delay of snowfall during winter months. March to May has shown decreasing trends of snowfall in Himachal Pradesh. Snowfall in the past two decades has decreased due to an increase in temperature/ change in climate and it has had a severe impact on apple production and other fruits and vegetables. The decrease in snowfall during early winter season and early withdrawal of seasonal snowfall has contributed towards less productivity in Himachal Pradesh.

The study reveals that agricultural production is strongly dependent upon the amount and distribution of annual rainfall. The bulk of rainfall occurs during the South West monsoon, between the months of June to September. The intensity and distribution of rainfall during this period plays a pivotal role in determining the success of water-intensive crops like rice. Rainfall intensity and distribution has varied substantially in recent times. Most parts of the study area received less rainfall in June this year than in June of the previous year. June is a critical month for Indian agriculture because paddy is sowed in this month. The availability of water at this time directly impacts the success or failure of the paddy crop. Even if rainfall is only average in a particular monsoon season, overall it may be considered a normal monsoon, if the distribution of rainfall from June to September is normal.

Seventy-two year old **Phoolji Retam** from Kanvala village of Sabarkantha, Gujarat has been keenly observing the changes taking place in climate conditions and the impact of these changes on life in his village. He understands climate change as change in the weather pattern over a long period of time. He sees a close inter relation between agriculture and rainfall. The changes he has observed have significantly impacted all natural processes. Previously, he said, the rains would arrive in his village every year around the 10 to 12th June. Today, the rains come as late as July. Till date, farmers have not changed their agricultural practice as a result of which they face heavy agricultural losses. Only those farmers who have deep bore wells are able to save their crops. He also talked about changes in the precipitation pattern and observed that heavy rainfall in winter at the time of harvesting has an unfavorable impact on cotton and paddy production.

A large part of the area is hilly and upland agriculture is completely dependent upon rainfall. Mixed cropping was practiced in the past but due to consistent crop failure,

these farmers have stopped farming their land. Many have been compelled to migrate or engage in agricultural wage labour or in construction work. Farmers with bore-wells sell water to other poor farmers.

Currently the water level in the Heran river, the lifeline for residents of his village has fallen considerably. People now depend on ground water but the ground water table has also gone down.

The state of Gujarat has a large semi-arid zone, which makes the state relatively more vulnerable to climate change. Agricultural growth, food security and human health could be under threat in Gujarat.

Narayan Sawant from village Pipalgaon Malka of Maharashtra is a tribal farmer who has been facing serious crop losses because of erratic rainfall and extreme weather. His agriculture productivity, especially of millets has reduced. Last year, his paddy crop was completely flattened due to an untimely spell of rain in late October. His family had to go without grain for a year whereas in the past they would have had grain from the previous year's crop, which would have seen them through half the year. This year, half the village lost their paddy crop due to heavy spells of rain and a prolonged monsoon. "Kohla (millet) will keep my family alive this year" he said. Narayan added that earlier the village practiced mixed cropping (grain, millets, legumes) that involved no costs, was less laborious, gave an assured crop from land considered inferior and yielded more nutritious and varied food than conventional crops. Tribal farmers who had converted to conventional agriculture are now returning to mixed cultivation in the face of increasingly erratic rainfall patterns and crop losses as climate change makes its presence felt.

In his experience, mixed cropping is more resilient to environmental stress and gives an assured yield in both low and excessive rainfall conditions. The only danger to millet crops is sudden, heavy rainfall at the very start of the season because the seeds get washed away. In recent years, there have been repeated instances of the monsoon starting late with sudden heavy showers; many villages lost their millet seeds due to this. Communities have adapted by setting up stronger seed networks between villages. A decade or so back, if farmers in a village lost their seeds they gave up cultivation that year. Now, they arrange to get seeds from other villages so as to continue cultivation the following year. Narayan said: "If only government agencies had bothered to study shifting/mixed cultivation practices and had promoted millets instead of turning their backs on it, it would have helped with the climate adaptation process. As a result of their apathy we are compelled to use our own limited resources to find ways to adapt to changing climatic conditions."



In recent years, climate change has reduced the productivity of agriculture, animal husbandry and forestry. All forms of livelihood linked to these sectors have been adversely impacted.

Impact on Forest Resources

Increased monsoon rainfall and flooding of forest floors in Madhya Pradesh, Odisha, Jharkhand and Himachal Pradesh has increased the water run-off rate leading to rapid soil erosion, nutrient leaching, destruction of microorganisms and an overall reduction of forest growth in what previously were dense forests. The mortality of forests, particularly village forests, is on the decline.

According to the local residents, forests were very dense 60 years ago and were filled with numerous varieties of trees. The time of sowing, bearing of fruit and harvesting, were times of great celebration. Forest dwellers would collect various types of wild fruit and leaves and eat them with relish; trees were used to build houses, some trees were used for medicinal purposes and some for fuel. Now that forest cover is decreasing so alarmingly due forest fires, landslides and flash floods, forest dwelling communities are losing the underpinnings of their cultural identity and source of their livelihood.

Impact on Minor Forest Produce Collection

Minor Forest Produce (MFP) forms a significant part of the annual income of tribal communities in the study areas. Mahua, a flower that is distilled to make liquor or dried and eaten during lean times is a Non-Timber Forest Produce (NTFP) that is very important to the tribals. Unsustainable

harvesting of these and other commercially valuable NTFPs in past years have resulted in a sharp decline in their availability. A complex combination of developmental activities in the mountains and climate change are affecting the rate of NTFP extraction. The people see a clear link between the rate of NTFP extraction and the degree of agricultural stress. In a drought year, when agricultural productivity is low, the tribals tend to extract and sell more NTFPs to meet the food security needs of their households. Since NTFPs have a ready and accessible local market, income from NTFPs helps compensate for a lean harvest. The flowering season of many of the major NTFPs coincides with the agricultural post-harvest period in March.

Tribal people in the study area have observed a significant change in the flowering of the Mahua tree. The fruiting and flowering period is shifting gradually from mid-March to mid-February reflecting a discernible change in the local forest ecology. The agricultural season usually ends in mid-February, a time when farmers are preoccupied with harvesting their produce. The early onset of Mahua flowering at same time as the harvest period leaves the community with little time for to collect this NTFP. Such situations have a direct implication on the food security of the region. As the availability of major NTFPs diminishes, the number of livelihood alternatives for meeting subsistence needs is also on the decrease.

The Dongria and Kutia Kondh communities from the study area in Odisha spoke of another shift in flowering time, that of the mango tree. Mango trees generally flower in spring time. In recent years because of the increase in temperature, mango trees are flowering later- towards summer, affecting mango production. People attribute this

Resource	20 years ago	10 years ago	Now
Tubers	8 varieties	Reduce in size	4 types
Fruits	12 types	Deforestation high	5 types
Millets	16 types	2 varieties introduced	10 types
Medicinal plant	20 types	Deforestation	12 types
NTFP produce	Ample available	Reduced	Deforestation and quantity is low
Disease	Change of climate related (cold, cough, malaria)	New diseases come across due to change of food habits	Paralysis, stomach problem, expenses on medicine
Medicine	Dependent on nature on herbs	Lack of transfer of indigenous knowledge to younger generation	Now almost all are purchasing medicine from shop
Wild Animals	12 types	6 types	4 types but rarely seen
Streams	Two big rivers, 100 perennial streams	Most are dried up	6 in number and existing but not perennial
Environment	Fresh, without pollution	Changes felt	Corporate houses pollute the environment
Economy	No cash value. Barter system and exchange of agriculture product	Introduction of schemes, programmes and dependant on outsiders	Exploitation by traders from outside. Low bargaining power

Source: Primary Data 2013

change to changes in weather conditions. Similarly, tubers such as Mundi, Pita, Bhata, Rasi, Gachha, Dangu, Batata, Karadi, Kuti, Sukuni and Kudka that used to be available in the past in plenty and in large sizes are hardly found these days. People also said that in the past when temperatures were lower and suitable for herbs, these herbs were used to cure fevers, skin diseases, cuts, stomach upsets, coughs, snake bites etc. These herbs are barely found these days. Forest fires are another major cause for the loss of rare and important herbs in the forest. Mushrooms, more than ten varieties of which the tribals could count - Gandhari, Mati, Baunsha, Khamani, Bali, Pita, Jaam, Srabani and Manda - are still just about found. One mushroom variety - Bating – however is rarely seen and nobody knows how it disappeared. Mushrooms are a source of nutrition to mountain communities. They grow in moisturised soils. Changing climatic conditions and increasing dry spells is leading to the extinction of mushrooms on the forest floor. The construction of a time line with the Dongria Kondh communities in the Niyamgiri area of Odisha gave a lucid picture of the impact of climate change on natural resources in this area.

Chakari Majhi from the Kutia Kondh community in Ambaguda village of Niyamgiri hill in Kalahandi district, Odisha, provided a ringing articulation of the community's dependency on forest produce and told of how she and her community are suffering now owing to the deterioration and disappearance of forests. The tribals, she said, consider the forest to be their mother, who like all mothers gives them all the resources they need. "We live in lap of the Mother Forest. She gives us food, water, shelter, peace and prosperity. She has changed and I don't know why. She gave us access to abundant resources in the past. How will the next generation survive in the face of depletion of life-dependent resources and increasing population? Fuel wood, household materials and other minor forest produce contribute to and sustain our lives and livelihoods. Forests help in meeting our spiritual, aesthetic and entertainment needs". Previously, she stated she was able to collect 100 kg of Mahua flowers each year, but now due to untimely rains the flowering is much less and she is only able to collect 40 kg annually. Chakari feels that both climate change and development projects are affecting MFP production but she cannot assess the independent impact of each of these factors on MFP. She has observed that there is a decrease in rainfall and an increase in the severity and frequency of droughts. In this region there is a large forest-dependent population. Over the last half-century, the climate has been changing and these changes have effected the forest ecosystem quite gravely and will continue to do so with increasing effect in the future.

Kantibai Kavjibai Bhagora resides in Sunsar, a small village in Bhiloda Taluka of Sabarkantha district, Gujarat. Sixty-five percent of the population of Sunsar village is Scheduled Tribe (ST). Almost all the households in Kantibai's village depend on agriculture and the collection of forest produce.

In Kantibai's observation, the quantity and variety of forest produce has declined in a major way in the last 10 to 15 years. Gund, Mad, Musli, Tendu leaves and wild fruit, which used to be available in great abundance in the past, are hardly found anymore. Extensive patches of bamboo are on the verge of extinction. Increasing temperature and destruction of indigenous forest species has led to the decline of forest wealth. Yield of Mahua flowers and fruit, which requires a cold climate for optimal production, has been seriously reduced due to the increase in temperature. The poorest families who are most dependent upon Mahua now migrate as wage labourers. Kantibai herself suffers because of low Mahua productivity. "Previously I collected more than 100 kilograms of flowers in a season. Now the most I collect is 20 kgs. We make cake, roti and liquor from Mahua". Increasing temperature is also impacting agriculture. For example, it is not viable to grow wheat anymore because it requires cold temperature, which is no longer the case.

Trilochan Maiti of village Gupti from Kendrapara district, Odisha lives near the mangrove forests of Bhitarkanika National Park. In his observation, the Sundri trees are vanishing because of the increase in salinity and the lack of freshwater flush in the dry season. This has a very negative effect on Bhitarkanika's mangrove forests. Due to the low flow of water in winter and rise in sea level, salinity is on the increase. Species that thrive on freshwater are disappearing. Non-woody shrubs and bushes have now replaced species like the Sundri, which has a dense canopy. As a result, overall forest productivity has declined significantly. Trilochan's village and other nearby villages have been transformed into saline areas. As a consequence of salinity penetration in Bhitarkanika, the freshwater area has been reduced to a small pocket. Mangroves act as a natural protective barrier from the wrath of the sea and cyclones. Life-saving mangrove forests are now completely threatened by changing climatic conditions.

Menjari Purty aged about 80 years from Kulaburu village in Jharkhand, points out that the State's forests are like a basket filled with many varieties of major and minor forest produce, on which the tribal people of the state have survived for generations. She said, "We collect forest produce for our basic needs. What is left over is sold or bartered. Some forest produce gives us cash. Lac is one of them. It not only provides us with a livelihood, but it also helps in conserving vast stretches of forest and biodiversity associated with lac cultivation. Tribal women in my village are involved in the production and sale of lac, which is produced by a tiny insect found in trees such as Palash (*Buteamonosperma*), Ber (*Zizyphus mauritiana*), Peepal (*Ficus religiosa*), etc.

In the past few years, lac trees have been affected by bouts of short, unseasonal, heavy rain followed by extremely



cold weather including fog and frost around mid- March, at a time when the insects are ready to produce lac. As a result of the extreme cold, the insects die. This has been happening since the last decade and has caused a huge reduction in the production of lac. Consequently, the local lac industry has started importing lac from Thailand. Many people are greatly affected due to this and are migrating or working as daily wage labourers.

Menjari Purty emphasized the need of NTFP focused forest management to help forest dependent communities adapt to climate change. The lac insect is sensitive to temperature, humidity and rain. Fog and lightning hamper lac production. Untimely fog and increasing temperature in Jharkhand has had an adverse impact on lac cultivation in the State.

Specific Impact on Women and Children

Climate change impacts such as degradation of bio-diversity, rising food insecurity and increasing incidence of disasters have particularly affected women and children in all the study locations. Women experience climate change impacts in three specific areas: direct impact on their economic activities, increase in hardship and reproductive health.

Climate change has considerably hampered women's economic activities in most study villages. Many women reported loss of control over their income due to changes in the biophysical environment. Other development factors such as imposition of new forest conservation laws and expansion of commercial shrimp farming has only exacerbated existing hindrances. Women also mentioned a further increase in workload owing to having to manage food for their families. In Bagapatia in Odisha, women used to make mats from leaves they collected from the mangrove forests. Given the depletion of mangrove forests, they can no longer produce these mats. Similarly, the negative impact of climate change on homestead-based agriculture enforces women to take up hazardous income generating options such as the collection of shrimp fry⁵⁰ from the estuaries.

Women and young children are obliged to collect water for the needs of the entire family from increasingly distant sources. This has increased their hardship quotient.

Women's food and water intake has reduced leading to deterioration in their nutritional health. As drinking water becomes scarcer, women are drinking less water. Staying for prolonged periods in saline water while collecting fish fries not only causes physical stress and social insecurity, but also puts a strain on women's reproductive health.

Changing gender roles make women more vulnerable and less capable of adapting to climate change. The consequences such as increase in unpaid care work as in collection of water and fuel, marginalisation in labour markets, girls dropping out of education, deterioration of reproductive health (due to lesser intake of food and water) and increase in unplanned migration and trafficking of women and girls is disproportionate for men and women. Women get less information than men; their increased workload prevents women from participating in formal decision-making.

Women in villages that were part of the study in Odisha, recalled that more women die during cyclones, because generally they are the ones available at home to rescue children and save the household's belongings, especially valuables.

Shakuntala Rout from Udyana village in Kendrapada district of Odisha is a poor woman who collects shrimp fries from the saline waters of the estuaries for a living. She is a widow, she is landless and is looked down upon by the community for the work she does. Wild fry collection is definitely a poverty driven occupation. Her earnings are based on demand and supply of shrimp fry implying that she could be without a daily income if the market for fish fries is down. As a result of staying in saline water for long stretches of time, she has developed skin problems. Since alternative economic activities such as sharecropping and agricultural labour are on the decline due to climate change, her choices are limited and therefore she must continue to collect fish fries even if her skin hurts.

Many men who are landless or belong to poor households are migrating to cities simply because the natural resource base upon which they depended for a livelihood have dwindled and can no longer provide them with an adequate income. This has put extra pressure on women to look after the family even if that would mean engaging in risky economic activities. It was noticed both in the coastal and tribal belts, that young girls and women are being trafficked on the false promise of jobs and substantial financial rewards.

People have limited participation in decision-making processes at the village level and beyond. Vulnerable households participate even less in these processes. This is important to note because in the future the participation of vulnerable households in climate change policy and action will be crucial to their survival.

Simra Bai belongs to village Akhadana, under Phalodi Tehsil in district Jodhpur of Rajasthan. She rears livestock. In a discussion on the current changes affecting pasturelands and livestock, she talked of the major challenges she faces as

⁵⁰ Shrimp farms need to collect wild shrimp larvae (or fry) from coastal rivers and marshes



a woman. She said, “About ten years back, there was plenty of grass close to the village and taking sheep and goats out to graze was not difficult. Now I have to walk miles outside the village before I find some grass for the herd. These days I fear going out with the herd alone because of the vehicles that fly past. There are all kinds of people about and theft of goats and sheep during noontime has become common. So now, after I finish my household chores I ask a few girls to accompany me while I graze my livestock”. Since her husband has migrated, grazing the cattle is an addition to her household work and she considers it a double burden.

Displacement and Migration

In all the study locations, considerable disruption of people’s livelihoods is taking place due to disasters, the loss of household assets and/or a decrease in agricultural productivity due to saline intrusion, inundation by tidal waters or failure of the monsoon. This disruption is leading to increased out-migration. Lack of pre-disaster migration data makes it difficult to accurately present the degree to which migration is taking place. Migration is a common response to poverty in rural parts of Bangladesh and Odisha. Climate change has become an additional dimension of this phenomenon. While many are partial/seasonal migrants, moving to cities during the dry season, others have been temporarily displaced so they live on roadsides or embankments due to loss of their houses and assets in a disaster. This situation is acute in Madhya Pradesh and Odisha. Communities have little capacity to adapt to changes in rainfall and temperature due to financial constraints and lack of knowledge. More households are turning to moneylenders or migrating as casual labour. The sea has gradually engulfed Satabhaya’s village of in Odisha’s coastal Kendrapara district. The village is at present surrounded by seawater and only a few families continue to live in the village. Seven villages were known to exist here until a few years ago. Now most of the villagers are migrating to other places. Those who remain are in search of a safer place to re-settle

Sukumar Sardar from Bagapatia village, district Kendrapara, remembers the cyclone of 1971. His village was completely destroyed. Subsequently the village was rehabilitated. The sea used to be about 4-5 km away from his village. It is gradually coming closer. He has been observing the changes that are taking place on the coastline, close to where he lives. Although the nature of change across the coast follows a similar , the degree of change varies according to localised physical characteristics. The major changes according to him include salinity intrusion in water and soil, increased frequency and intensity of tidal surge, the sea coming closer and increase in cyclonic events. Two rivers, Baunsagada and Patsala, near his village are being rapidly eroded. Erosion is affecting land ownership particularly of the poorest households many of whom have become landless due to erosion. Villages in

nearby panchayats like Satabhaya and Brahmana Sahi are most vulnerable due to their close proximity to the sea. Several villagers are migrating or changing their livelihoods. The ‘sea coming inward’ has become a phenomenon that is making the local people extremely fearful and anxious about the future. They would not like to loose their ancestral homes and lands to the waves.

Climate Change Adaptation and Coping Strategy

Decrease in rainfall, diminishing water and forest resources, frequency of floods, drought and cyclonic storms in consecutive years has made it difficult for communities to sustain their livelihoods. When faced with water shortages, farmers tend to reduce crop size. Farmers living in hilly terrains, stop cultivating on the hills. These changes drastically impact incomes and food security.

In the past, when wells ran dry, households would deepen these wells or dig new wells. But now, in addition to the energy and cost of such actions, there is no guarantee that they will get enough water. Some people think that shifting sowing dates and using more climate resistant crops/plants could help.

Those who have tried have not succeeded. They have incurred major losses. Generally, farmers are hesitant to make changes in their cropping patterns due to the unpredictability of rains. Shifting to non-hybrid seeds, which require less water come with the disadvantage of long transition times; an unviable economic proposition. Most prominent coping strategies include shifting into labour work on local farms or seasonal migration and in many cases borrowing heavily from moneylenders. People foresee that they will have to increasingly go out to work as casual labourers as crops produce less or fail entirely. This strategy faces obvious risks as larger farms too face the impacts of climate change. More people are migrating now than before leaving the elderly, women and children behind. Seasonal migration comes with pitfalls.

People’s vulnerabilities to current climate variability and related depletion in natural resources are more likely to exacerbate their vulnerability to predicted climate changes. Climate change impacts existing inequalities between different gender and economic groups . These inequalities limit people’s abilities to access adaptive resources such as information, funds and influence over climate change policy and actions. This study indicates that the depletion of natural resources as a result of climate change has a much higher impact on the people living at the bottom of the wellbeing ladder. Other areas of vulnerability include access to natural resources, fragile physical environments, limited community and institutional preparedness and the lack of knowledge on ways to adapt to climate change.





CHAPTER 5



CONCLUSIONS AND RECOMMENDATIONS

The potential impacts of climate change on natural resources include increased risks of depletion of these resources and its subsequent impact on rural communities. Such crisis is visible in agriculture, forest, water commons, fisheries and pastureland. This increases conflicts between and within communities, over scarce resources. Increased risks to human health and adverse weather events are also visible. Climate change, directly or indirectly, is affecting all sectors and regions of the country albeit at different times and in different measure. Admittedly, there is a scarcity of information and literature on how differential socio-economic and demographic factors will react to the biophysical changes accompanying climate change. Rural households, based on the region to which they belong, attain their livelihoods through agriculture, non-farm activities, livestock rearing, fishing, labour and migration. Though agriculture is a common denominator across all regions, several communities have a substantial livelihood stake in rural non-farm sectors as well.

The IPCC defines vulnerability as ‘a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity and its adaptive capacity’. Many population groups in several parts of India are highly vulnerable to climate change. Livelihoods are most vulnerable in regions such as the Himalayas, the arid and semi-arid areas in Rajasthan and Gujarat, coastal areas in Odisha and forest areas in Madhya Pradesh, Jharkhand and Odisha and the Western Ghats in Maharashtra. Small Islands like the Andaman & Nicobar are extremely vulnerable due to high exposure of the population and infrastructure to sea level rise and the resultant increase in storms. Vulnerable groups include women, children, indigenous people, coastal dwellers, and mountain and island dwellers of which indigenous populations are undoubtedly the most vulnerable.

In the study areas, crop yields have declined largely due to rising temperatures and extreme weather events. This has led to increased food prices, food insecurity and a heightening of the threat to those livelihood activities upon which much of the population depends.

India’s backward districts – 200 in number - ranked by the Planning Commission are distinguished by their large-scale practice of rain-fed agriculture, which is highly vulnerable to climate change impacts on the monsoons. In most agro-climatic regions, farmers have stopped cultivation of millets, which are often the best suited to many of India’s agro-climatic zones and have switched to paddy or wheat, crops on which climate change is projected to have serious adverse implications.

The study regions have a long history of coping with extreme changes in weather. Communities in the Himalayan region have coped with the flash floods and land slides, people in arid regions have learned to cope with less rainfall and drought and coastal people know how to cope with seacoast erosion and cyclonic storms. Vulnerable communities collectively and individually develop their own ways to deal with exceptional circumstances caused by the depletion of natural resources due to climate change. Coping strategies are very specific to culture and are governed by a range of available resources, experiences and value systems. However, the coping strategies people know and are now using are challenged by climate unpredictability.

Though India’s policies on climate change are reasonably progressive and even though the Indian government has encouraged discourse on climate change, there is much to be desired in terms of clear targets and methods of implementation. It is not quite apparent if the NAPCC or State Climate Change Action Plans are in line with India’s action commitments and if these targets are going to be met at all as the reality on the ground suggests otherwise.

Recommendations

The study regions have a large share of environmentally vulnerable people. These people are concentrated in upland areas of the Himalayas, the dry land areas of Gujarat and Rajasthan, in the flood-affected wetlands and the coastal areas of Odisha and the forests of Madhya Pradesh, Maharashtra and Odisha. These areas and the people living in these areas, most of who live under poverty, deserve special policy formulation in keeping with their vulnerability and poverty.



The study reveals that climate change mostly affects small farmers. Climate change policy must keep the situation and needs of small farmers in focus. Traditional adaptive knowledge and organic farming should be promoted to make agriculture more sustainable in the wake of climate change.

Institutions related to agriculture and horticulture in all vulnerable regions, should be expanded and strengthened to improve agricultural productivity, water management and market access under adverse climate conditions.

Eco fragile areas like the Himalayan region, arid belts, coastal region, the Western Ghats and forest areas are especially prone to disaster. Special plans and policies should be developed for these regions. Carrying capacity should be the only basis for approving developmental projects for these areas.

Coastal and mountain communities are under constant threat of displacement. Their comprehensive rehabilitation to safer places must be part of climate change policy and implementation framework.

Social protection policy should be revamped in context of the climate change. The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) for instance, should be used for plantation work and construction of dykes in coastal areas to support mitigation and adaptation.

Saline water intrusion in coastal regions, low and erratic rainfall in arid regions and landslides and sand/stone casting in the Himalayan region will increasingly render agriculture inadequate in sustaining livelihoods. A shift to rural, non-agricultural activities is necessitated. Non-distress migration could also be an option.

The vulnerabilities of women and children need special focus. A basket of strategies that include water source management, investments on clean drinking water, female education, promotion of entrepreneurship especially of women and improvement of health facilities would achieve this purpose.

Forest degradation acts both as a driver of climate change and vice versa. Forest resources are fast diminishing due to climate change. Better management of forest resources is critical. Community management and conservation as prescribed under the Forest Regulation Act, 2006, is the only solution and the Central government should pressurize states to implement this law without dilution of its full intent.

If the deterioration of forest resources is to be arrested, the indigenous character of forests must be reinforced. The issuance of community rights that are enshrined in the Forest Act, 2006 would ensure this.

There should be minimum interference in the ecology of rivers and measures to make them pollution free should be taken. The Himalayas, the major source of water in India, should get better attention and a policy to protect its ecological health should be formulated as soon as possible. Ground water recharge and management also needs urgent attention.

As observed in many places where the study was conducted, the sea is rapidly moving in towards human settlements putting the inhabitants under tremendous pressure. Measures to prevent such intrusion and to protect mangroves should be given priority.

Ensuring the security of property and other rights of farmers, forest dwellers and tribal communities and strengthening environment, social and disaster protection policies are necessary to ensure adequate adaptation to climate change.

Technical and political constraints including spatial and temporal uncertainties associated with the forecasts of regional climate, low levels of awareness among decision makers of likely local and regional impacts, limited national capacities in climate monitoring and forecasting and lack of coordination in the formulation of responses, are some major obstructions that need to be worked upon.

Poverty has been identified as the largest barrier to developing the capacity to cope and adapt. Insufficient information and knowledge on the impacts of climate change and responses of natural systems to climate change will continue to hamper effective adaptation particularly in the study areas.

The slow change in the political and institutional landscape in response to climate change and the existing legal and institutional framework in the states and at the national level remains inadequate to facilitate implementation of adaptation.

Improving access to high quality information about the impacts of climate change, reducing the vulnerability of livelihoods and infrastructure to climate change, promoting good governance, including responsible policy and decision-making and empowering communities and other local stakeholders so that they participate actively in vulnerability



assessment and implementation of adaptation would be important ways to address climate change related problems

Putting in place early warning and information distribution systems to enhance disaster preparedness and mainstreaming climate change into development planning in all sectors and at all levels should be immediately instituted.

The security of pasture commons and restoration of degraded and common lands is essential and a policy that addresses pastureland management is very much required.

Afforestation, reforestation and better forest management (involvement of forest dependent communities in the development and implementation of robust management plans) are mitigation options that should be considered with some urgency.

Improvement in inter-state, regional and international cooperation on climate change issues would enhance

funding and strengthen adaptation and mitigation strategies including climate information, forecasting, research of new weather patterns and techniques to reduce land, forest and water source degradation.

Traditional community knowledge can make an important contribution to adaptation and mitigation. Breakthroughs are known to have happened based on the exchange of experiences between communities. This requires the establishment of learning platforms. There is also an urgent need to work on long-term, scaled-up, predictable, capacity building support to communities to adapt to the changing climate and to reduce the increasing damage to and loss of natural resources.

At the time of climate change policy formulation, programme design, implementation and evaluation, it is imperative to differentiate the impacts of climate change on women, indigenous people, farmers and fisher folk among others and the contributions of these groups to mitigation and adaptation.



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Actionaid Association,
R- 7, Hauz Khas Enclave,
New Delhi – 110016
Phone: 91-11-4064 0500