Community Action in a Climate Change Regime

Managing Bio-diversity

a compilation of research papers

Regional Centre for Development Cooperation

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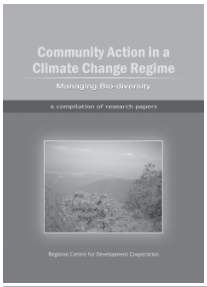

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Managing Bio-diversity

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Foreword

As the world braces to observe 2011 as the 'International Year of Forests', the mankind is reminded again of the sheer necessity to not only have a rethink on our relationship with forest resources but also to re-invent people's action in management of such resources. The realisation that in our quest to 'development' we have rode roughshod over the forest resources is creeping in with increasing intensity. While forest resources, as a whole, have been abominably dealt with, people who have traditionally been respectful in dealing and living with the forest resources have largely been excluded not only from the so called development arena but also have been forced to severe their bonding with the forests. This devilish connivance has led to destructions of such magnitude that the humanity, with its advanced learning, is again impelled to lean back on the age old practice of establishing cordial and respectful relationship with the forest resources.

While forest destruction has directly affected livelihoods of over 1.6 billion people worldwide, the indirect affect of it has been quite phenomenal. The most notable of all ramifications has been on changes in global and local climates. Forest sector has been blamed as the second largest anthropogenic source of carbon dioxide emission to the atmosphere. Scientists have estimated that carbon emissions from deforestation and forest degradation accounts for about 20 percent of global anthropogenic carbon dioxide emission. Some other studies have reported a lesser percentage of emission from forest sector, particularly because emission from combustion of fossil fuel has risen rapidly. A paper by G.R. Ven Der Welf *et al*. (CO_2 *Emission From Forest Loss,* Nature Geo Science, Volume 2, 2009) mentions that carbon emissions from both deforestation and fossil fuel combustion suggest that in 2008, the relative contribution of CO_2 emissions from deforestation and forest degradation was substantially smaller, around 12%. But, there are no two opinions that forest sector is the second largest emitter of carbon gases to the atmosphere.

Because of large scale degradation, forest sector which should have been the principal source of carbon mitigation is now been alleged as one of the principal factor causing global warming. As degradation of forest resources are blamed for global warming, the same resources on other hand are increasingly becoming susceptible to climate change affects. Serious threats have been observed to forest bio-diversities causing further affects. While all these happen, enormity of people's sufferings - who depend overwhelmingly on forest resources for their livelihood - increase by leaps. And they are the ones who have the least capacity to adapt to modern coping mechanisms.

So we have manifold challenges. Simply put, we have to save our forests and biodiversity to reduce and stop emissions from the forest sector; and through that increase carbon mitigation scope from forest resources. And then we have to safeguard the livelihoods of billions of people who depend on forest resources.

The critical question that arises here is, HOW? Many experts argue that the simplest answer to that question lies in involving the communities in management of forest resources…, by devolving in them the rights and authorities. After all, who else can better manage the resources then those who they have the direct stakes ?

Regional Centre for Development Cooperation, like many other organisations and experts, believes in that theory. It believes that there are no alternatives to engaging the communities directly in forest management. And that comes naturally to the forest dependent communities. In a regime of unpredictable climate change related events, our resolve and determinations have to be much… much… stronger.

I am immensely happy in forwarding this book containing quality papers from known experts on the eve of the national workshop titled, "Guiding Forest Management on Biodiversity Conservation & Climate Adaptation" to be held at Bhubaneswar on 10th and 11th February 2011. It is a pleasure for RCDC to thank the contributors, OXFAM India which provided the financial support for publication of this book and in organizing the workshop, academicians, experts and well wishers who have given guidance and encouragement; and staffs of RCDC.

Kailash Chandra Dash
Executive Director

Preface

With renewed focus on forest sector as climate change causing agent, a victim of climate change, a potential agent of mitigating global warming, and the most important source of adaptation and mitigation of billion of vulnerable people worldwide, attention has again shifted back to engaging the communities and entrusting with them the management of forest resources.

However, Community Forest Management (CFM) is not entirely a new concept. Many of us - including experts, resource organisations, NGOs, community members - have been vocal votaries of CFM. Throughout the world many communities have taken up to forest management and have made noticeable achievements. A sustained thrust is needed to be built on those successes. This becomes even more imperative in a situation of worsening climate where community involvement in forest management - and to be more bold-community forest management – yields gains only.

Having so much of potential, ironically, CFM still faces resistances from some quarters. They still suspect the forest dependent communities as forest destroyers. Of course, those who suspect that way have their own agenda. The time has come to alley such apprehensions and misgivings and move forcefully towards saving our forest resources through increased community ownership and involvement.

This volume is a small but hopeful step in that regard. The volume compiles papers on evolving forest management practices with a perspective of biodiversity conservation & rediness to face climate change. The papers are to form part of a two day long national workshop titled "Guiding Forest Management on Biodiversity Conservation & Climate Adaptation" to be held at Bhubaneswar on 10th and 11th February 2011. These papers cover diverse issues relating to climate change and forest from a South-Asian perspective and includes academic researches, action researches and grassroots actions.

Some other papers could not be published here due to paucity of time and space. We acknowledge their contributions with thanks and hope that the workshop can accommodate all valued contributions on biodiversity and forest conservation and management; and add direction in making adaptations to climate changes.

Ghasiram Panda
Programme Manager – Sustainable Forest Management

Rights over carbon: The new gold rush?

The carbon stored in forests could be worth huge sums, but who has the right to cash in? And what does it mean for communities in Asia-Pacific?

Regan Suzuki
RECOFTC, Bangkok

With investors lined up on one side and vulnerable local communities on the other, the potential for disaster is growing. Law and order is urgently required in what is rapidly becoming the domain of 'carbon cowboys.' (outside investors profiting from the exploitation of poorly informed communities in carbon contracts.)

In Papua New Guinea, indigenous peoples are the legally recognized owners of 97% of the forests. But the Government's policy, while recognizing indigenous peoples' rights to land, is to reserve for the State the right to manage and trade the nation's carbon. The country's indigenous communities are finding themselves under increasing pressure to agree to deals that they often poorly understand.

The topic of carbon rights is not only abstract and difficult to understand, but involves an uneven playing field for buyers and sellers. Carbon credits allow someone who wishes to continue emitting carbon dioxide (or other greenhouse gases) to pay someone else, such as a forest owner, for emitting less. Reducing emissions is a restriction on the forest owner's freedom to maximize benefits from his rights over the forest, such as the option to log or to convert land to agriculture. In some ways, carbon rights can be understood as the forest owner's right to demand compensation for this restriction.

Within the context of climate change, carbon markets are already seeing the flow of billions of U.S. dollars, much of it to the developing world. In the first half of 2010, global carbon markets exchanged some 3.7 billion tons of CO_2 with a market value of about US$59 billion.

A small but growing portion of this market is linked to the forestry sector. Some of the world's most marginalized and disadvantaged groups are a critical link in the potentially lucrative forest carbon market chain. It is therefore essential that they have the information

needed to understand, exercise, and proactively assert their rights in connection with the forest carbon market.

For the most part, legal professionals are trying to situate carbon rights within the framework of property rights. This is based on civil or written law – a largely Western legal paradigm that places a strong emphasis on individual property rights. Some claim carbon to be a new and unprecedented form of property right (the basis of which is explained in the recent works of Charlotte Streck et al, among others). The expanding field of climate law is a key part of the push to define carbon rights. Local communities are clearly vulnerable where their rights are unclear, so even a poorly fitting private-property regime borrowed from the West provides greater protection than no legal rights at all.

But a hand-me-down framework of rights is not the best fit for local peoples in the Asia-Pacific. Throughout much of the region, land tenure remains unclear and contested. Long-standing customary rights over forest lands have been at best tolerated, and at worst trampled upon. Indonesia, for example, treats all forests in the country, whether on public or private lands, as under the legal ownership of the State. Indigenous groups such as the Dayak are allowed to continue their customary practices and inhabit their traditional homes – but with weakly recognized legal rights to do so, and always at the indulgence of the State.

Within the context of such an imperfect recognition of rights within dominant legal frameworks, is a property-rights based approach to forest carbon really appropriate? Unlike the West where private-property rights emerged out of traditional land management, customary land rights in the Asia-Pacific are often at odds with prevailing legislative frameworks.

A recent workshop on carbon rights in Manila, co-hosted by REDD-Net and CoDeREDD (a Philippine civil society network), came to the strong consensus that a strictly conventional approach to carbon rights in the case of Asia-Pacific is not appropriate. Instead, carbon rights need to be part of a more comprehensive package of rights and entitlements.

Civil society groups present a good example for approaches to defining carbon rights in their proposals for broader definitions of other indigenous rights. For example, the Forest Peoples Programme calls for a definition of land rights that goes beyond property rights to encompass civil, political, economic, social, and cultural rights. It seeks consideration of "so-called first-generation human rights (the civil and political rights of individuals in relation to the state); second-generation human rights (the economic, social, and cultural rights of individuals in relation to the state); and third-generation human rights (the collective rights

of peoples to self-determination and development in relation both to other peoples and to states)". All of these claims should similarly be applied in the case of carbon rights.

If, as explained above, carbon rights only have meaning in terms of restricting the right to benefit from and to manage forest resources, then these benefits and management rights must be recognized as the crucial issue. This surely puts the 'carbon rights' debate squarely in the territory of human rights law. To pave the way for fair and transparent demarcation of carbon rights, land tenure and access rights urgently need to be clarified and enshrined in legislation. Furthermore, local people must participate in the design of a policy architecture that will best protect their rights and entitlements.

Moving forward in the REDD+ debate, human rights must play an equal role to property rights as we tackle the questions 'Who will benefit?" and "Who should benefit?" from the trade in forest carbon credits. Unless this happens, REDD+ will serve to entrench inequitable structures for determining and distributing benefits.

■■■

Climate Change Impact in Bangladesh with Reference to Forest and Biodiversity[1]

A.B.M. Shamsul Arefin
ALRD, Dhaka

1. Context and Background

With 140 million people, Bangladesh is one of the world's densest nations and also one of the most vulnerable to the impacts of climate change. People in Bangladesh live precariously close to the risks of cyclones, floods and droughts. More than 100 million people living in rural areas, mostly poor, add the vuluerability factors.

Bangladesh's recent gains in the areas of economic growth and population control that could be reversed by climate change. The fourth report by the Intergovernmental Panel on Climate Change (IPCC) stated that Bangladesh would experience heavier monsoons and that the melting of Himalayan glaciers will cause higher river flows and severe floods. Rainfall will become heavier and more erratic while droughts will increase in frequency[1].

Bangladesh is frequently cited as one of the most vulnerable countries to climate change [2-5] because of its disadvantageous geographic location; flat and low-lying topography; high population density; high levels of poverty; reliance of many livelihoods on climate sensitive sectors, particularly agriculture and fisheries; and inefficient institutional aspects[6]. Many of the anticipated adverse effects of climate change, such as sea level rise, higher temperatures, enhanced monsoon precipitation, and an increase in cyclone intensity, will aggravate the existing stresses that already impede development in Bangladesh, particularly by reducing water and food security and damaging essential infrastructure[6]. These impacts could be extremely detrimental to the economy, the environment, national development, and the people of Bangladesh[7].

Bangladesh has developed some capacity for dealing with the impacts of climate change at the national level, and policy response options have been mobilised that deal with vulnerability reduction to environmental variability in general, and more recently, to climate

[1]Prepared by A.B.M. Shamsul Arefin, ALRD, Dhaka

change in particular. In addition, Bangladesh has for some time been recognised as a particularly vulnerable country by the international community, and has received disaster management and adaptation support in several sectors.

On the basis of the above background, this article is an endeavour to reveal the impact of climate change in Bangladesh and the strategies so far adopted by the government to combat these impacts.

2. Global Climate Change and Bangladesh

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 is in addition to natural climate variability observed over comparable time periods". In other words, the FCCC uses the term Climate Change to mean only those changes that are brought about by human activities.

The greatest environmental risks now arise from the intensifying global climate change which is adversely impacting both human and natural systems. Human systems include river and other water bodies, agriculture and forestry, coastal zones and marine systems including fisheries, human settlements, energy, and industry, insurance and other financial services, and human health. Natural systems include rainfall, glaciers, coral reefs and atolls, mangroves, boreal and tropical forests, polar and alpine ecosystems, prairie wetlands, and remnant native grasslands. The degradation of the environment in Bangladesh from human encroachment makes the impacts of climate change even more severe.

Global climate change is caused by global warming as a result of huge quantities of greenhouse gases emitted by developed countries over the past 150 years and more. The responsibility for climate change lies with those countries. Bangladesh and other developing countries have no responsibility, although some large and fast growing developing countries are now fast increasing their greenhouse gas emissions[9-10].

3. Impact of Climate Change in Bangladesh

It is now recognized internationally that Bangladesh is at the forefront of adverse climate change impacts. One key reason is the disadvantaged geographical location of Bangladesh at the bottom of the three mighty river systems-those of the Ganges, the Brahmaputra, and the Meghna, with a long coastal belt and much of the country low-lying and flat. The country has no control over its water resources as over 92 per cent of the annual run-off that flows through Bangladesh on to the Bay of Bengal enters the country from upstream

outside the country. Another key reason is that Bangladesh is the most densely populated country in the world, except for few city and tiny states. Therefore, the per land unit impact falls on the largest numbers of people, who are mostly poor[9]. The following paragraphs depict the present and potential impact of climate change on different aspects as follows:

a) Climate Change Impact on Forest

Bangladesh is characterized by both natural and plantation forests which, however, account for 17.5 percent of the total land in documents, but only 6-7 percent in reality. The notable natural forest ecosystems are tropical wet evergreen and semi-evergreen forest (hill forests), moist deciduous forestry (sal forest), tidal forest (mangrove forest), and village forestry. The plantation forests are now increasing under the auspices of social forestry programme to ensure peoples participation and their socio-economic benefits.

Because of the increased rainfall in monsoon, water runoff rate on the forest floor has increased. As a result, rapid soil erosion causes nutrient leaching, destroys micro-orgainism and reduces overall site quality for better forest growth in the previously dense hill forests of Chittagong, Chittagong Hill Tracts (CHT), Sylhet, and Cox's Bazar. Most of the forests are also likely to be affected from the absence of ecological memory that is the network of species for interaction between each other and environment, and building the capacity for reorganisation within or outside the forest patch after different perturbations.

Moreover, the increasing frequency of flood, as a consequence of climate change, and its prolongation also triggers the mortality of some home-garden species such as jackfruit, papya and bamboo mainly found in the plain land village forests[10].

b) Climate Change Impact on Mangrove Biodiversity of Sundarbans

Being the largest single tract of mangrove forests in the world, the Sunderbans, a World Heritage Site is already affected with climate change impacts, importantly from increasing salinity and extreme weather events like tropical cyclones. Though, the main causal factors of top dying is yet to be known, but, some researchers predict that top dying of sundari trees (Heritiera fomes) is likely to be the consequence of slow increase of salinity over a long period of time. Salinity increase also affects the species' combination and regular successional patterns in the Sundarbans as some non-woody shrubs and bushes replace the tree species, reducing the forest productivity and habitat quality for valuable wildlife. World Wildlife Fund for Nature Conservation (WWF) estimates that due to sea level rise, nearly 7,500 hectare of mangrove forest in the Sundarbans are likely to submerge. Many researches have shown that tropical cyclones destroy the mangrove forests to a large extent. For instance, in the recent cyclone, Sidr, has destroyed one-third of the Sundarbans[10].

c) Threatened Sundarban's Livelihoods

The rise in sea level and availability of less fresh water particularly during winter when rainfall will be less will cause inland intrusion of saline water. As a result, many mangrove species, susceptible to increased salinity, may be threatened. In addition, the highly dense human settlements just outside the mangrove area will restrict the migration of the mangrove areas to less saline area. The shrinking of the mangrove areas will have effect on the country's economy.

Many industries which depend on raw materials from the Sundarbans will be threatened with closure and create large unemployment. Climate change is real a threat to ecosystem and biodiversity. The Sundarbans may be completely inundated by a 1 m rise in sea level. Increase in temperature and sea level rise will seriously affect the Sundarbans' ecosystem and bio-diversity. The area may shrink and many flora and fauna species may face extinction. Water stress during winter and excess water during summer will have effects on ecosystem and bio-diversity. A wide range of mammals, birds, amphibians, reptiles, crustaceans, and above all the Royal Bengal Tiger will face extinction. The coastal length covered by mangrove forest will be exposed to cyclones and storm surges.

In addition, more than half a million people, dependent on forest products in the Sundarbans, would also be exposed to economic uncertainties as Sundarbans, the biggest mangrove forest in the world consisting 6,200km² of forest and riverine areas faces extinction threats. It has been listed as World Heritage Site and is the most important ecosystem and protective natural barrier against the calamities like tidal surge, cyclone etc. This gift of nature would simply be submerged by the rising sea[11].

d) Climate Change Impact on Mangrove Ecosystem

Top dying of Sundri tree (Heritiera fomes) and salinity increase due to lack of freshwater flush during the dry months. These are causing the negative effects in the ecology of Sundarbans.

It has been found beyond reasonable doubts that the Sundarbans mangrove forest would be the most severely affected by climate change. Due to a combination of high evapotranspiration and low flow in winter, the salinity of the soil would increase. As a result the growth of freshwater loving species would be severely affected. Eventually the species offering dense canopy cover would be replaced by non-woody shrubs and bushes, while the overall forest productivity would decline significantly. The degradation of forest quality might cause a gradual depletion of rich diversity of the forest flora and fauna of the Sundarbans ecosystem. As a consequence of salinity penetration in the Sundarbans, ma-

jority of the moderately saline areas will be transformed into saline areas, while relatively freshwater areas would be reduced to only a small pocket along the lower Bales war river in the eastern part of the forest.

Threatened Species

There are 375 species of birds, 55 species of mammals and 83 species of reptiles and amphibians in the Sundarbans. Besides, more than 150 species of fish, 50 species of shrimp and other invertebrates also live there. It is the largest habitat of the most endangered Royal Bengal tiger, salt water crocodile, the leatherback sea turtle, python, king cobra and spotted deer. Besides, wild boar, rhesus monkey, dolphins, snake bird/darter, stork and ibis, sea eagle, vulture, finfeet, skua, forest eagle owl, swamp partridge, bustard quail, trogon, pigmy woodpecker, brown wing kingfisher, racket tailed drongo, ground thrush, forest wagtail, streaked spider hunter, nuthatch, scarlet minivet, ring lizard, sea snakes, green frog and other species live in the Sundarbans are presently at a threatened stage.

Threatened Flora

There are shon grasslands at a number of places like Hiron Point, Kochkhal, Jamtoli of Katka, Rash Mela of Alorkol in Dublar and Kalar chars. Besides, mangrove vegetation of the Sundarbans would be seriously affected by sea level rise. The pnematophores (roots of mangrove plants) regularly go under water twice daily during high tide for 1-3 hours. In the inter-tidal period trees in mangrove and coastal mud flat areas use to respire by specially growing roots called pneumatophores. Each tree has thousands of such pnumatophores growing up about 10 cm to 1m high in the air and spreading 2-5m around the base. These air roots are smaller in golpata, hantal, goran, etc. and longer in sundri, gewa, amur, keora, etc. If the sea level rises from 0.5 to 1m the pneumatophores will remain under water permanently and trees will die due to problem of respiration and sand deposition[12].

e) Climate Change Impact on Wildlife

Deer will be the worst sufferer due to food shortage and habitat loss. During high tide deer usually move to high lands in the forests. Otherwise, remain standing in the water until the tidal water recede. There will be no dry land left in the forest after sea level rise.

Wild boars can better tolerate water. But without food their fate will be the same as deer. Monkey is semi arboreal and may continue to survive longer than deer and boar. But when trees will start dying due to inundation their fate will also be the same due to lack of food and shelter. Carnivores like tigers, fishing cats, cevets, otters, etc. will face the similar problem: loss of habitat due to inundation and shortage of food due to lack of herbivores in the forest.

Tigers are the world's most endangered species and survive only in a few places including the Sundarbans of Bangladesh in very small number. Tiger is a good swimmer and may move from one place to another but the prevailing condition will not be favourable. Tigers of the Sundarbans usually move to higher places during high tide, But in a situation of complete and prolonged inundation their existance too become further harder. Birds: Resident and migratory terrestrial birds of the Sundarbans and coastal areas will create excess pressure and ecological problems on the existing fauna and flora where they will fly. Aquatic birds like herons, gulls, terns, owls, nightgers, wagtails, pratincles snipes, sandpipers, finfoot, culew, whimbrels, spoonbils, wild ducks will also lose their habitats along the coastal belt. Hole nesting birds like woodpeckers, kingfishers, swallows have better chance to survive for more time. They use to feed on the insects from wood and fish from water and flying insects from air, respectively, and all will breed in the tree holes. But changed climate will also affect their food chain.

Crocodiles become more dominant because of expansion of habitat in the forests for preying on fishes and animals as food. But in absence of these food species how will crocodile survive? Leatherback is the largest sea turtle of the world and is critically endangered. The leatherback turtles including other sea turtles lay eggs on the sandy beaches along the coastal zone mainly St. Martin's Island, Sonadia, Kutubdia, Moheshkhali, Cox's Bazar, Inani, Shapari dip of Teknaf and the Sundarbans every year from September-October to March-April. Thousands of sea turtles come to shallow water areas of the Bay for mating and laying eggs on the beaches nearby. They will certainly lose their breeding ground due to inundation by sea level rise. There will be no exiting beach for egg laying along the coast[12].

f) Impact on Food Sovereignty in Bangladesh

Climate change will have a massive impact on food production and may jeopardize food security in many regions. Warmer temperatures will affect crops and crop production. Changes in rainfall patterns will be as important. Climate change will also influence the availability of water for human consumption and for food production. Loss of land through sea level rise and other consequences like erosion caused by wind and water will also affect the agriculture production. All the previous Intergovernmental Panel on Climate Change (IPCC) impact assessments recognized Bangladesh as one of the most susceptible to the negative impacts of climate change. It is anticipated that the consequences of climate change will increase livelihood insecurity, malnutrition, unemployment, lack of safe drinking water and water-borne diseases in Bangladesh and about one third of the population would be vulnerable to climate change and sea level rise[13].

g) Impacts in the form of Flood and Cyclone

One of the most frequently visiting climatic disasters in Bangladesh is flood. Some of the abnormal floods occurred in the last two decades saw a death toll of livestock, reduction in livestock reproduction, submergence of pasture for long and thus shortage of livestock feed. The number of rainy days is increasing by about 20 days a year. On an average, about a quarter of the country's land mass is currently flood-prone in a normal hydrological year which may increase to 39% while the frequency of a catastrophic flood could increase under climate change scenarios (Climate Change Cell, 2006). Prolonged flood will cause a serious loss of biodiversity especially of the wild species.

The most devastating climatic disaster in Bangladesh is severe tropical cyclone with storm surge. Due to rapid climate change, the Bay of Bengal, a northern and extended arm of the Indian Ocean often becomes rebellious and severe cyclone sweeps over the coastal belt.

Sidr

Sidr was the strongest cyclone to hit Bangladesh since the Cyclone of 1991. Plants and animals of the Sundarbans suffered enormous devastation. This largest mangrove forest in the world with an area is the safe abode of 425 species of trees, herbs and creepers; and 246 species of animals. About 26.5 percent of the Sundarbans was damaged. Experts say that the forest would take about 40 years to recover completely. Sidr was a practical evidence of climate change. The intensity of Sidr was much greater than anticipation due to high sea water temperature (27°C). As Sidr came with very high storm surge, it washed away thousands of small or large wild species. That caused a colossal loss of biodiversity in the affected area.

Aila

After Sidr, Aila swept over the coastal region of the country on May 25, 2009. The storm with storm surge hit the coastal districts with 8 to 13 feet high tidal surges, breaching flood protection embankments at 75 points, submerging at least 75 villages and leaving a vast trail of wreckage of properties and loss of biodiversity both wild and domestic species. (BSS, May 30, 2009). At least 58,450 domestic animals faced the fate of death let alone wild species (The Daily Star, May 27, 2009).

4. Climate Change Adaptation in Bangladesh

The government has developed several strategies and mechanisms to respond to address these risks. The core policy, strategy, and action thrusts have been outlined in the Outline Perspective Plan, National Adaptation Program of Action (NAPA), Bangladesh Climate Change Strategy and Action Plan, adopted in July 2008 and amended in 2009. Adaptation

to the impacts is the main focus of these plans. The basic approach is to address economic development and climate change issues in an integrated fashion so that the resilience of the people is increased and climate change impacts managed through effective adaptive activities. A major emphasis is placed on disaster risk reduction. Following are the developed plans, policies and initiatives of the government of Bangladesh prepared at different stages to meet immediate and long term requirements

a) National Adaptation Program of Action NAPA 2005

It is well recognized both in the scientific and negotiating community that Bangladesh would be one of the most adversely affected country to climate change. Low economic strength, inadequate infrastructure, low level of social development, lack of institutional capacity, and a higher dependency on the natural resource base make the country more vulnerable to climate stimuli (including both variability as well as extreme events).

The National Adaptation Programme of Action (NAPA) is prepared by the Ministry of Environment and Forest (MOEF), Government of the People's Republic of Bangladesh as a response to the decision of the Seventh Session of the Conference of the Parties (COP7) of the United Nations Framework Convention on Climate Change (UNFCCC). The preparation process has followed the generic guiding principles outlined in the annotated guideline prepared by LDC Expert Group (LEG). The basic approach to NAPA preparation was along with the sustainable development goals and objectives of the country where it has recognized necessity of addressing environmental issue and natural resource management with the participation of stakeholders in bargaining over resource use, allocation and distribution. [14].

b) Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2008

The BCCSAP is the main basis for the Government's efforts to combat climate change over the next ten years. The plan lays out a 10-year program to build the capacity and resilience of Bangladesh to meet the challenges of a changing climate and adapting to the local effects of climate change over the coming decade. The plan envisions a financing need of about $5 billion during the first 5 years through 2014. The BCCSAP is built on these six pillars to adapt the climate change impact on the following issues: 1) Food security, social protection and health, 2) Comprehensive disaster management, 3) Research, 4) Research and knowledge management, 5) Mitigation and low carbon development and 6) Capacity building and institutional[15]

c) Bangladesh Climate Change Strategy and Action Plan 2009

The Climate Change Strategy and Action Plan 2009 is the revised version of the initial document with the same title prepared in 2008. The initial document had been developed in 2008 by the then Government of Bangladesh in consultation with civil society, including NGOs, research organizations, the private sector and development partners. The BCCSAP 2009 will be reviewed and revised as further experience and knowledge are gained in implementing adaptation and related research programmes as well as new development priorities that may emerge in future[16].

d) Outline Perspective Plan of Bangladesh (2010-2021)

Outline Perspective Plan of Bangladesh (2010-2021) is a strategic articulation about the development vision, mission, goals and objectives towards a prosperous Bangla in 2021. It specifies the key milestones along the way and highlights major intents around strategic architecture, resources, competencies, and capacities. This plan clearly identifies major 18 subsectors to build a developed and prosperous Bangladesh among which 10 subsectors are directly linked to mitigation and adaptation of climate change of Bangladesh[9].

e) Forest and Wildlife Regulations and Policies in Bangladesh

The forest and wildlife of Bangladesh are governed by the following rules, laws and policies[17]:

- National Forestry Policy, 1994
- Social Forestry (Amended) Rules 2010
- The Forest Act 1927 (as amended up to 2000)
- Bangladesh Wildlife (Preservation) Order, 1973
- Bangladesh Spotted Deer Rearing Policy-2009
- Compensation Policy for Causalities Caused by Wildlife
- Brick Burning (Control) (Amendment) Act, 2001

Among these regulatory measures government of Bangladesh has recently taken an initiative to amend the 'Forest Act 1927' and 'Wildlife Protection Order 1973' in compliance to cope with the effect of global climate change.

f) Climate Change Trust Fund Act, 2010

The government of Bangladesh has taken initiative to formulate an act named "Climate Change Trust Fund Act, 2010" to use climate change fund judiciously and transparently so that benefits reach the affected people properly. The government has already allocated Tk 7 billion to build this fund. The cabinet approved the draft Climate Change Trust Fund Act, 2010. The draft will soon be finalised and sent to the law ministry for vetting[17].

But it is obviously true that in Bangladesh the impact of climate change is too adverse to fight with this small amount of allocation while it is already proved by all these initiatives that the country has the mandate and goodwill to serve its citizen and adapt the impact by all means.

5. Policy Interventions and Community interests

It is stated earlier that Bangladesh Government has recently taken initiatives to amend the 'Forest Act 1927' and 'Wildlife Protection Order 1973' in compliance to cope with the effect of global climate change. While on the way to amend these Acts, strong voices were raised among the CSOs, environmental NGOs including ALRD, BELA, environmentalists, lawyers, journalists and concerned specialists as it was found a motto of USAID backed IPAC (Integrated Protected Area Co-management) project that doesn't cover the rights of the indigenous communities and people who are dependent on the forest. It was unanimously agreed with the objectives of updating these two regulations but it was felt that the decision should be taken with the consultation and consent of respective forest dependent communities, civil society representatives and indigenous peoples as committed in UNCBD and UN Declaration of the Rights of Indigenous Peoples.

Later on BELA (Bangladesh Environmental Lawyers Association) emphasized on exercising authorities under section 28 of the Forest Act, 1927 and framing rules to facilitate "village forest management" that requires the powers of the government on reserve forests to be handed over to nearby communities as it became a successful model in some of other neighbouring countries like India and Nepal.

It was also proposed before Govt. to change the name of the "Bangladesh Wildlife (Preservation) Order, 1973" also, as it entails not only wildlife, but also flora and fauna and was suggested a proper name which might be "Bangladesh Biodiversity Conservation and Management Act-2010". On the other hand ALRD with some other human rights organisations like BELA, BLAST (Bangladesh Legal Aid and Services Trust), ASK (Ain O Salish Kendra), Nijera Kori etc. are working together in the form of mutual understanding, networking and alliance building. These organisations specially ALRD is taking positive initiatives through capacity building, information dissemination, knowledge management, providing training, legal assistance by their network to the people who are either already affected or within potential threatened by climate change. These organisations are mobilising and sensitising their grassroots network raise their voice to participate in the decision making to adapt and address climate change impacts most effectively.

6. Concluding Remarks

This paper is an exploratory discussion to disclose the vulnerability of Bangladesh caused by climate change with particular reference to forest, biodiversity, ecosystem, tropical cyclone, flood, cyclone etc. With these presentations and potential impact, the initiatives and endeavours of the Government of the People's Republic of Bangladesh to adapt climate change impact has also been reflected. More research is needed to arrive at a more reliable assessment so that a better response mechanism can be developed in this aspect.

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Impact of climate change with special reference to Mangrove forests of India - A Review

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Climate is probably the most important determinant of vegetation patterns globally and has significant influence on the distribution, structure and ecology of forests. The Third Assessment Report of IPCC (Intergovernmental Panel on Climate Change, Geneva, Switzerland, 2001) indicates that forest ecosystems could be seriously impacted by future climate change. Even with global warming of 1-2°C, most ecosystems and landscapes will be impacted through changes in species composition, productivity and biodiversity and ultimately these have implications for the livelihoods of people who depend on forest resources for their livelihoods.

Mangrove forests perform valued regional and site-specific functions. Reduced mangrove area and health will increase the threat to human safety and shoreline development from coastal hazards such as erosion, flooding, storm waves and surges, and tsunami, as most recently observed following the 2004 Indian Ocean tsunami. Mangrove forests loss will also reduce coastal water quality, reduce biodiversity, eliminate fish and crustacean nursery habitat, adversely affect adjacent coastal habitats, and eliminate a major resource for human communities that rely on mangrove forests for numerous products and services. Mangrove forests destruction can also release large quantities of stored carbon and exacerbate global warming and other climate change trends. Mangrove forests can also be provided with an economic value based on the cost to replace the products and services that they provide, or the cost to restore or enhance mangrove forests that have been eliminated or degraded. Accurate predictions of changes to coastal ecosystem area and health, including in response to projected relative sea-level rise and other climate change outcomes, enable site planning with sufficient lead time to minimize and offset anticipated losses.

India is a mega-biodiversity country where forests account for about 20% (64 million ha) of the geographical area. With nearly 200,000 villages classified as forest villages, there is obviously large dependence of communities on forest resources. Thus it is important to assess the likely impacts of projected climate change on forests and develop and imple-

ment adaptation strategies for both biodiversity conservation and the livelihoods of forest dependent people.

Indian coasts fall within the bounds of the tropics, which measures about 7516.6 km and are distributed among nine coastal states and four Union Territories. Of this, over 22.6% of the total length of the coasts of India is of islands (Andaman and Nicobar, Lakshadweep and Diu Islands). The climate along the Indian coast varies from one that of true tropical region in south to that of sub-tropical and arid environment in Kachchh in northwest. On the east coast, there are deltas of the Ganges, Krishna-Godavari, Mahanadi, which support large area of river estuaries and excellent growth of tidal forests.

Mangroves are salt-tolerant plants and grows in intertidal regions of the coastal area. The specific regions where these plants occur are termed as 'mangrove ecosystem'. According to Forest Survey of India (FSI), out of 4, 87,100 ha of mangrove wetlands in India, nearly 56.7% (2, 75,800 ha) is present along the east coast, and 23.5% (1, 14,700 ha) along the west coast, and the remaining 19.8% (96,600 ha) is found in the Andaman and Nicobar islands. The coastal habitats, especially mangrove forests in India have strong linkages with coastal environment and are considered important areas for sustenance of the coastal communities. The Sundarbans, a "World Heritage Site" in India and Bangladesh, account as the largest single mangrove forest unit globally. The area under Sundarbans was large in the past, but has been reduced to the present level due to degradation that took place during last two hundred years. Logging operation, aquaculture, reclamation of swamps, paddy cultivation on the east coast of India and salt production on the west coast are the main reasons for degradation, resulting into shrinking of tidal forests throughout the Indian coast.

Among various types of coastal wetlands, tidal mudflats (23,620 sq. km) and mangrove forests (4,871 sq. km) have major share. India harbours some of the best mangrove forests in the world which are located in the alluvial deltas of rivers such as the Ganga, the Mahanadi, the Godavari, the Krishna and the Cauvery as well as on the Andaman and Nicobar groups of Islands.

Mangrove forests of India take major role in ecological and economic services in mangrove ecosystems. They are important because:

- They contribute to the stabilization of the shoreline and prevention of shore erosion
- The dense network of support roots, breathing roots and stilt roots give mechanical support to the tree and trap the sediments

- The mangrove detritus is consumed by the juveniles of a variety of bivalves, shrimps and fishes, which migrate into the mangrove environment for better feeding and protection
- Mangroves provide shelter and serve as breeding grounds for a wide variety of aquatic species.
- Mangrove provide nesting sites for many shore birds, lizards, turtles other animals.
- Mangrove forests are good sources for firewood for locals
- Their wood makes a superior kind of charcoal, are sources for tannins, resins, medicines, etc.

Climate and mangrove forests

Climate change components that affect mangrove forests include changes in sea-level, high water events, storminess, precipitation, temperature, atmospheric CO2 concentration, ocean circulation patterns, health of functionally linked neighboring ecosystems, as well as human responses to climate change. Of all the outcomes from changes in the atmosphere's composition and alterations to land surfaces, relative sea-level rise may be the greatest threat. Although, to date, it has likely been a smaller threat than anthropogenic activities such as conversion for aquaculture and filling, relative sea-level rise is a substantial cause of recent and predicted future reductions in the area and health of mangrove forests and other tidal wetlands.

Climate change threats

Global sea-level rise is one of the more certain outcomes of global warming, it is already likely taking place (12-22 cm occurred during the 20th century), and several climate models project an accelerated rate of rise over coming decades. The range of projections for global sea-level rise from 1980 to 1999 to the end of the 21st century (2090-2099) is 0.18-0.59 m. Recent findings on global acceleration in sea-level rise indicate that upper projections are likely to occur. 'Relative sea-level change', the change in sea-level relative to the local land as measured at a tide gauge, is a combination of the change in eustatic (globally averaged) sea-level and regional and local factors. The former is the change in sea level relative to a fixed Earth coordinate system, which, over human time scales, is due primarily to thermal expansion of seawater and the transfer of ice from glaciers, ice sheets and ice caps to water in the oceans. The latter is the result of vertical motion of the land from tectonic movement, the glacio- or hydro-isostatic response of the Earth's crust to changes in the weight of overlying ice or water, coastal subsidence such as due to extraction of subsurface groundwater or oil, geographical variation in thermal expansion, and for shorter time scales over years and shorter, meteorological and oceanographic factors. The rate of change of relative sea-level as measured at a tide gauge may differ substantially from the

relative sea-level rate of change occurring in coastal wetlands due to changing elevation of the wetland sediment surface. Additional variability might be caused by differences in local tectonic processes, coastal subsidence, sediment budgets, and meteorological and oceanographic factors between the section of coastline where the coastal wetland is situated and a tide gauge, especially when the tide gauge is distant from the wetland.

Mangrove forests vulnerability to sea-level rise

Mangrove forest systems do not keep pace with changing sea-level when the rate of change in elevation of the mangrove sediment surface is exceeded by the rate of change in relative sea-level. There are several interconnected surface and subsurface processes that influence the elevation of mangroves' sediment surface. Mangroves of low relief islands in carbonate settings that lack rivers were thought to be the most sensitive to sea-level rise, owing to their sediment-deficit environments.

Between 1906 and 2005, the global average surface temperature has increased by 0.74 8C (_0.18 8C). The linear warming trend of the last fifty years (0.13 8C per decade) is nearly twice that for the last 100 years. This rise in globally averaged temperatures since the mid-20th century is considered to be very likely due to the observed increase in anthropogenic greenhouse gas atmospheric concentrations. The range in projections for the rise in global averaged surface temperatures from 1980 to 1999 to the end of the 21st century (2090-2099) is 1.1-6.4 8C. Increased surface temperature is expected to affect mangrove forests by (i) changing species composition; (ii) changing phenological patterns (e.g., timing of flowering and fruiting); (iii) increasing mangrove productivity where temperature does not exceed an upper threshold; and (iv) expanding mangrove ranges to higher latitudes where range is limited by temperature, but is not limited by other factors, including a supply of propagules and suitable physiographic conditions.

Mangrove forests in India are extremely sensitive to global warming because strong temperature dependence of physiological rates places many tropical species near their optimum temperature. Increased species diversity at the community level will add to the competitive ability of mangrove forests communities as a whole. Outside the present latitudinal limits for mangrove forests, comparable saline coastal environments are generally occupied by salt marsh vegetation. It is likely, given the more herbaceous nature of the vegetation in these communities that mangrove forests will compete such species in the medium to long term and that a gradual replacement of salt marsh vegetation by scrubby mangrove forests, first of Avicennia and later of Rhizophora may be expected to occur (Pernetta, 1993).

It is also expected that average global rainfall will increase with marked regional variations (IPCC 2001). If this happens, climate change is likely to lead to an increase in species migration pole wards. This may result into better environment for mangrove forests in semi-arid region like Gulf of Kachchh. In absence of accurate prediction on extent and rate of climate change, it is not possible to develop a model for likely scenario of mangrove forests in India. Many species are sensitive to fast changes, especially to anthropogenic disturbance and sea level rise. If pace of sea level is high, these species may not be successful to compete and may loose in favour of hardy and great coloniser, especially Avicennia marina, A. alba, Acanthus ilicifolius and Suaeda sp. in semi-arid in Gujarat and, A. officinalis and other species in the moist region. It is expected that species diversity may suffer in some areas, especially in Andaman and Nicobar Islands.

Sensitivity and adaptability of the species in the critical ecosystem become important to assess the vulnerability of a species. Tidal forest of India support about three and half dozen species of core mangrove forests and majority of them may be sensitive to medium to high rate of changes and they be categorized as highly vulnerable species because they can survive for long period in only a relatively stable environment. Adaptive capacity of some of them can be improved by management intervention, especially by planting them in suitable areas after assessing the trend and rate of environmental changes. In case of climate change and sea level rise, loss of some species in one area, especially on islands, can be compensated by planting them in the area of higher latitudes, although over all loss can not be recovered.

Human responses

Anthropogenic responses to climate change have the potential to exacerbate the adverse effects of climate change on mangrove forests ecosystems. For instance, we can expect an increase in the construction of seawalls and other coastal erosion control structures adjacent to mangrove forests landward margins as the threat to development from rising sea-levels and concomitant coastal erosion becomes increasingly apparent. Seawalls and other erosion control structures cause erosion and scouring of the mangrove forests immediately fronting and down current from the structure. Or, for example, areas experiencing reduced precipitation and rising temperature may have increased groundwater extraction to meet the demand for drinking water and irrigation. Increased groundwater extraction will increase sea-level rise rates relative to mangrove forests surfaces, increasing mangrove forests vulnerability. Increased rainfall could lead to increased construction of storm water drainage canals to reduce flooding of coastal upland areas, diverting surface water from mangrove forests and other coastal systems, reducing mangrove forests productivity.

Adaptation and Management Options

Inter-tidal mudflats, saline and less productive coastal lands provide opportunity to raise coastal forests as a multiple use ecosystems (sink for carbon; barrier against cycle, storm and salty winds, coastal land stability; sustainable agriculture behind shelter belt and basic needs of coastal community). Strict protection of existing mangrove forests against encroachment and cutting and its expansion by regenerating potential inter-tidal areas through plantation of suitable species, including vulnerable and threatened species appears to be necessary management options. The response of tidal vegetation to climate change will vary from area to area and hence area specific plan based on inputs of continuous monitoring of changes should be prepared for implementation.

Conclusion

To date, relative sea-level rise has likely been a smaller threat to mangrove forests than non-climate related anthropogenic stressors, which have likely accounted for most of the global average annual rate of mangrove forests loss, estimated to be 1-2%, with losses during the last quarter century ranging between 35 and 86%. However, relative sea-level rise may constitute a substantial proportion of predicted future losses: Long term monitoring is needed to determine if these are long-term trends or cyclical short-term patterns, and whether this is a global or regional phenomenon.

Present mangrove forests cover in India is only about 26 % of the area of treeless inter-tidal mudflats. At present hyper saline area of high tidal mudflats is not suitable for mangrove forests but scenario may change with sea level rise. Large such areas, especially in semi-arid region of Gujarat, are expected to provide adequate scope for adjustment and adaptation of mangrove forests against sea level rise. If rainfall improves in western part of India, as projected in the Northern Hemisphere, the large high tidal mudflats in the Gulf of Kachchh and Gulf of Khambhat can be used for regenerating suitable species to improve species diversity and also to compensate loss in other areas. Deltaic region of the Sundarbans also have scope for adjustment of mangrove forests against sea level rise but human habitation in the landward may prove barrier and limiting factor. In absence of accurate regional data on climate change, it is difficult to conclude likely impact on short and long term basis. Very high level of sea level rise may be devastating for most of the mangrove forests in Indian sub-continent. Mangrove forests of Andaman and Nicobar Islands are matter of concern for even low rate of sea level rise.

Reduced mangrove forests area and health will increase the threat to human safety and shoreline development from coastal hazards such as erosion, flooding, and storm waves and surges. Predicted mangrove forests losses will also reduce coastal water quality, re-

duce biodiversity, eliminate fish nursery habitat, adversely affect adjacent coastal habitats, and eliminate a major resource for human communities that traditionally rely on mangrove forests for numerous products and services. There is a need to better plan our responses to climate change impacts on mangrove forests, especially in its identification through regional monitoring networks, and coastal planning that facilitates mangrove forests migration with sea-level rise and incorporates understanding of the consequence of shoreline changes. The resistance and resilience of mangrove forests to sea-level rise and other climate change impacts can be improved by better ''no regrets'' management of other stressors on mangrove forests area and health, strategic planning of protected areas including mangrove forests and functionally linked ecosystems, rehabilitation of degraded mangrove forests, and outreach and education directed at communities residing adjacent to mangrove forests.

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Understanding Farmers' Perception on Climate Variability and Change in Western Orissa

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Introduction

There is strong evidence that climate change will affect the Indian agriculture and it is one of the crucial issues for future agricultural growth in India. The sensitivity of crops to climate variability and a high dependence of a large number of populations on agricultural activities in India, in part, have placed agriculture in the centre of climate change impact analysis (NATCOM, 2004, ICAR, 2005; Aggarwal and Mall, 2002; Kumar and Parikh, 2001; Saseenddran et. al., or 2000, Sinha and Swaminathan, 1991, Aggarwal and Kalra, 1994). India is a vast country having various agro-climatic and agro-ecological zones. The impacts of climate variability and change will be different in regions and within regions with similar exposure to climate hazards. The sensitivity of particular farm households to climate impacts will vary considerably as will the capacity of agricultural producers to adapt, in relation to a wide variety of socioeconomic, institutional, and psychological variables (Brklachich et al., 1997).

Any changes in the climate would affect the livelihood of millions of small and marginal farmers in India. This sector is particularly vulnerable to current climate variability, including years of low and erratic rainfall. Several studies have shown that in general, the mean monsoon intensity and variability is expected to increase (Ashrit et al 2001; Chung et al 2006; Kumar et al 2006). There is a general consensus among studies that major agricultural production areas are likely to be adversely affected by climate change. (Dinar, 1998; Kumar and Parikh, 2001) The productivity of different crops will be affected. Rice and wheat yields could decline considerably due to climatic changes (IPCC 1996; 2001; Kumar and Parikh, 1998). However, many of the impacts of climate change on agriculture will depend on the degree of adaptation, which itself will determined by the other socio-economic factors such as income level, market access, governance, availability of informa-

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tion. Various studies show that with adaptation, vulnerability in the agricultural sector can largely be reduced (Rosenzweig and Parry 1994; Smith 1996; Smit and Skinner, 2002). The research on adaptation to climate variability and change in among farmers in India is largely confined to the impact of climate change on the production of different crops and very few studies exists (TERI 2003, World Bank 2008; O'Brien et al 2004) on how farmers are adapting to climate variability and change and what type of adaptation actions they are taking at the household level. However, perception regarding climate variability and change plays an important role in forming expectation among farmers on whether to take adaptation action or not.

Theoretical research has highlighted the importance of expectations formation with regard to climate and whether expectations lag behind reality in determining the transitional costs associated with climate change. (Maddison, 2007) The literature on adaptations also makes it clear the perception is a necessary prerequisite for adaptation. This paper attempts to understand the perception of farmers' on climate variability and change in two districts of western Orissa and to collate the data with district level rainfall and temperature data analysis. While perception analysis has been carried out by several studies in Orissa, very few studies exists on collating rigorous meteorological data analysis of the region and perception analysis of farmers. This is an attempt towards that.

The rest of the paper is divided into four sections first section gives and overview about the state of Orissa and its socio economic conditions, the second section describes the climate risks and climate variability and change in Orissa, third sections describes about study area and methodology of our research, the fourth section analyses the perception regarding climate variability and change among farmers in the study region.

1. Socio-Economic Condition in Orissa

Orissa, with a population of 36.7 million (2001) and the third lowest population density among the major states of India, is among the poorest of India's poor states. About 87 percent of the population lives in rural areas. The Human Development Index for the major states of India has ranked Orissa among the bottom five since 1981. Agriculture employs about 80 percent of the population, but its contribution to the Gross State Domestic Product (GSDP) is only about one third. Small and marginal holdings predominate. Available data on the poverty headcount ratio is 47.2 percent (1999-2000), as compared to 26 percent in India as a whole[3]. Ninety percent of the poor people live in the rural areas of

[3] GOI, Planning Commission, 1999-2000. Alternative poverty rates calculated in Deaton (2003) suggest a poverty rate of 43.3 percent in Orissa compared to 29 percent in India as a whole.

Orissa making poverty an overwhelmingly rural phenomenon. Inequalities are sharpest between the relatively better off coastal areas and the more remote and inaccessible inland areas. Coastal areas have a poverty rate of 32 percent showing a decline during the 1990s while in the inland southern region (where almost 75 percent of the state's poor live) the poverty rate is 87 percent, an increase from 69 percent in 1992-1994. Overall, the rural poverty rate is 48 percent compared to the urban poverty rate of 43 percent. Orissa's proportion of scheduled tribes (ST) (22 percent) and scheduled castes (SC) (16 percent) is significantly higher than that of India as a whole and poverty among these two groups is strikingly higher than among other population groups.

While the state of Orissa is suffering from economic underdevelopment the state also have high regional inequality. While the coastal districts are more economically developed, the inland districts of the western and southern region of the state are highly backward. The following table shows the high concentration of poverty in some regions of Orissa. The following table clearly shows the regional concentration of poverty in Orissa in the Southern and Northern region as compared to Coastal region. Thus, it is clear that the state of Orissa is underdeveloped with a high level of poverty and regional economic inequality.

Table-1

Orissa Region Wise (NSS) Trends in Rural Poverty Ratio, 1983-84 to 2004-05

Region	1983-84	1987-88	1993-94	1999-2000	2004-05
Coastal	57.90	48.40	45.30	31.80	27.4
Southern	80.80	83.00	68.80	87.20	72.7
Northern	75.20	61.00	45.80	49.80	59.1
Orissa	65.29	55.58	48.56	48.01	46.9

Source: Food Security Atlas of Rural Orissa (pp14), 2008

Apart from the economic backwardness of the state, it is also suffering from regular floods, droughts and cyclones. As the state is an agrarian state with 80 percent of the people depending on agriculture climate plays a very important role in the economy of the state and large number of farmers. With almost 60% of land devoted to rain fed agriculture and with a water-dependent crop, rice, as its main crop, the agriculture sector is vulnerable to the vagaries of climate-induced weather changes. Given that the agriculture is largely rain fed, the behavior of the monsoon has the potential to impact the prevailing systems and practices in a negative way. Under these circumstances adaptation to climate variability and change in agriculture will play an important role in managing the climate risks in the state.

The changes of rainfall and temperature pattern following global warming and associated changes in circulation is matter of concern (IPCC, 2001). Ghosh and Majumdar (2006) using fuzzy clustering techniques from the General circulation Model (GCM) examined the future rainfall scenarios for Orissa. Their findings predict that there is a possibility of decrease in rainfall during the dry period of September to February. They have indicated an increase in the hydrological extremes such as droughts and floods for the entire Orissa. Another study by Ghosh and Majumdar (2007), using statistical downscaling method has found an increasing trend in the probability of severe and extreme droughts for Orissa meteorological subdivision with a decrease in the probability of near normal condition. Earlier analysis shows increasing rainfall trends over coastal Orissa (Senapati and Mishra, 1998) and decreasing rainfall trend in the Orissa meteorological sub division (Naidu et al, 1999). Rao (1995) found that the surface air temperature in this area is increasing at a rate of 1.10 per century, which is more than double of the entire India. At this point time there are large uncertainties regarding the impacts of climate change at the regional level in India due to lack of studies on the impact of climate change at the state level. With this limitation our study will try to explore the adaptation strategies among farmers in two of the drought prone and poorest districts in the state. The next section describes briefly about the study area.

2.1 Study Area and Methodology

In order to study the impact of climate change and variability on agriculture and adaptation strategies among farmers' two districts coming under different agro climatic zones in the Northern part of Orissa were selected as the study areas: Bolangir district in the western central table land and Nuapada district in the Western Undulating zone. Another important criterion for selecting these districts was the availability of rainfall data to examine the trends and pattern in rainfall and temperature in the study area.

Bolangir district is located in the West central table land zone of Orissa. It covers an area of some 6,924.3 square kilometers with a population of 1,336,000, giving a population density of 193 per square kilometer (2001 Census data). Agro-climatic data indicate three rainfall zones, with progressively lower rainfall occurring from southeast of the district to North West. Predominantly the district has red sandy and red loamy alfisols, with a predominance of red loam. Agro-climatic data indicate three rainfall zones, with progressively lower rainfall occurring from southeast of the district to North West. Over 1400mm is received in the southeast tip of the district, a further belt of 1200-1400mm running from north east to south covering about a quarter of the district and lower rainfall of generally less than 1200 mm received by two thirds of the district in the central and west areas. The mean normal annual rainfall in the district is 1614 millimeter and mean maximum summer temperature is 40 degree Celsius.

Nuapada adjoins Bolangir district to the west and is itself the furthest central west district in Orissa, bordered by Madhya Pradesh. It covers an area of some 2,497 square kilometers (district map, 1994) with a population of 530,000 (population census, 2001). Population density is official 188 per square kilometer (ibid.). Agro-climatic data indicate three rainfall zones, with lower rainfall to the south of the district (below 1000mm), a higher belt in the middle (above 1200mm) and 1000-1200mm occurring to the northern quarter and a small section, some 10% of land area, to the south eastern edge. The mean annual normal rainfall is 1352 mm and the mean maximum summer temperature is 37.8 Degree Celsius.

Following the selection of districts, research sites were selected from each district in consultation with local NGO's, block[4] level government officials and agricultural officers. Two villages in Nuapada district and one village from Bolangir district were selected for household level survey[5]. In Bolangir district Mahurundi village was selected from Khaprakhol block and Khamtarai and Kirkita villages were selected from Khariar block of Nuapada district.

Mahurundi village in Bolangir district is located in 4 kilometers away from the block headquarter of Khaprakhol. While the other two villages Kirkita and Khamtarai in Khariar block of Nuapada districts are located 18 Km and 20 Kilometers away from the block headquarter. Residents of these villages rely on agriculture as the main source of livelihood, most of the farmers are small or marginal farmers, and the proportion of large farmers is less. The main crops which are in these villages are rice, cotton and pulses. However, prevalence of cotton cultivation is low in surveyed villages of Nuapada district and higher in the surveyed villages of Bolangir district. The Mahurundi village is economically better than other villages of Kirkita and Khamtarai in Nuapada district. Drought is a common phenomenon in these villages and the surveyed blocks are coming under the Drought Prone Area Programme (DPAP) of the Government of India. Another important feature of the villages is that there is a high level of migration among landless laborers and small and marginal farmers. However, the level of migration is higher in Kirkita than other two villages.

2.2 Data Collection

Primary data were collected from May to august in 2010 through in-depth household survey with a structured questionnaire having both open ended and closed ended questions. Apart from that we also relied on focus group discussion among farming community and discussion with local level government officials on the issues. While most of the

[4] Block is the administrative unit lower than the district

[5] Originally two villages were selected from each district, but as the work is in progress we are presenting findings from three villages only.

people are aware of the problems of related to lack of less rainfall in recent years in the study region and recurring drought and erratic rainfall, they have very less knowledge on climate change as a problem.

Households were selected through simple random sampling but care was taken to include all types of farmers such as large, small and marginal farmers on the basis of quantity of land holdings. In total 106 samples were collected from three villages. A total of 35 samples were collected from Khamtarai village, 39 samples from Kirkita village and 32 samples were collected from Mahurundi village. Due to lack of rainfall and temperature of data at the station level for the villages we used district level data aggregated from available station level data to see the trends and pattern of rainfall for the last hundred years. Rainfall and temperature data were collected from Indian Meteorological department, Pune, India. Our analysis of perception regarding climate change is limited by the fact that we don't have rainfall and temperature[6] data at the village level, so we had to compare the perception of regarding climate change with the district level data.

3. Climate Data Analysis

The study region of Bolangir and Nuapada districts is one of the drought prone regions in India having the frequency of drought varying from every three to four years with more than a 50% of chance of occurrence of at least one severe drought in 10 years (Pandey et al, 2007). Our analysis of climate data in the study districts started with the historical analysis of occurrence of droughts in the study region.

In this study, monthly and yearly data varying from 30 to 100 years have been used for the two districts to study past drought events. Rainfall is considered to the primary indicator of drought and is the basis for most drought watch systems because it describes meteorological better (Alley, 1984). Meteorological drought is related to deficiencies in rainfall compared to the average mean annual rainfall in an area. The India Meteorological Department (IMD) defines drought in any area when the rainfall deficiency in that area is ?26 % of its long term normal. Further, if the rainfall deficit is between 26-50%, the drought is classified as 'moderate', and 'severe' if the deficit exceeds 50%. The same method has been used in this study to find out the drought years in the study region. The following table describes the frequency of occurrences of drought in the study districts.

[6] Temperature data neither available village wise nor district wise, there are only two temperature recording station in the study area, both are in Bolangir district.

Table-1

Drought Occurrences in the Study Districts

Name of the district	Record length	Mean Annual Rainfall (MM)	Moderate drought years	Severe drought years	Maximum departure below mean Annual
Bolangir	1902-2005	1404.1	1903, 1912, 1935, 1941, 1965, 1973, 1974, 1979, 1996, 1998, 2000, 2002	1975	1975(-50.7%)
Nuapada	1907-2002	1244.7	1923, 1941, 1948, 1954, 1957, 1965, 1979, 1987, 1996, 2002	1974	1974(-52.4%)

The above table shows that droughts in the study area over the last hundred years. It can be seen from the table that, occurrences of moderate drought is more dominant than severe drought in the study region. Further, both the districts have suffered from regular meteorological drought in the last century. However, it can be seen from the table that, the mean annual rainfall is less for Nuapada district (1244.7 mm) than the Bolangir district (1404.1 mm). Other important point which should be mentioned here that, Bolangir district has suffered from more regular droughts after 1965 than the Nuapada district, in case of Bolangir it is 8 times and for Nuapada district it is 5 times. However, nothing can be concluded about the increasing or decreasing frequency of droughts except from the fact that drought and erratic rainfall is an important climatic risks for the farmers in the study region. Climate change is likely to worsen the problem further.

3.1 Trends in Rainfall and Temperature

To identify the trend in the climatic variables with reference to climate change the Mann-Kendall (MK) test has been used by many researchers with rainfall and temperature data. MK test is a suitable choice for trend analysis of non-normal series (Yue and Pilon, (2004). However, presence of positive or negative autocorrelation affects the detection of trend in the series (Hamed and Rao, 1998; Novotny and Stefan, 2007). In our study before applying the MK test, the data series was tested for serial correlation. If the lag-1 autocorrelation (r1) was found to be non significant at 95% confidence level, then the MK test was applied to the original data series, otherwise the MK test was applied to "pre-whitened" series obtained as (x2-r1x1,x3- r1x2,....., xn-r1xn-1). For the present study we have used two non-parametric tests i.e. Mann-Kendall test (MK) and Spearman's Rho and one parametric test linear regression to see the trend in climatic variables. Apart from the analysis of trend we also used three statistical tests to step change in mean (Distribution-Free CUSUM,

Cumulative Deviation and student's t test). The step-change tests also identify the year of step change. It is attempted to check whether any significant jump has taken place in the rainfall and temperature pattern.

Before doing any trend analysis it is important and useful to see the general trend in rainfall and temperature in the study region. The following two graphs show the trend in rainfall in the two districts. It can be seen from the graph that while for Bolangir district the trend in rainfall is not significant, there no trend. However, for Nuapada district there is decreasing trend in rainfall in the last hundred years.

The results shows that among the four district Nuapada district shows a significant decreasing trend in annual rainfall for the period of 1907-2002 at 95% confidence level. The negative S-value confirms a decreasing trend in rainfall in Nuapada district. The other two test of spearman's Rho and Linear regression also shows a significant decline in rainfall at 95% confidence level. After trend analysis for district wise rainfall pattern we conducted the same tests for different stations in the study region. Only those stations having more than 50 years of data was chosen for analysis. Due to large gaps at station level only three stations, Bolangir, Titilagarh and Komna (Nuapada) was selected having a data records for more than 50 years. Among the three stations only Titilagarh station having data for the period 1917-2005 shows a significant decline in rainfall for the whole period this station is coming under Bolangir district. While the MK test and Spearman's Rho test shows negative trend at 95% confidence levels, linear regression shows negative trend at 99% confidence level.

The trend in annual mean maximum and highest maximum temperature for the stations is shown in table 4. It can be seen from the table that among the two stations Titilagarh station shows a significant increasing trend in both mean maximum and highest maximum temperature. While MK test and spearman's Rho test shows increasing trend at 95% confidence level, linear regression shows increasing trend in temperature at 99% confidence level for trend in highest maximum temperature. For mean maximum temperature all the three tests shows increasing trend at 95% confidence level.

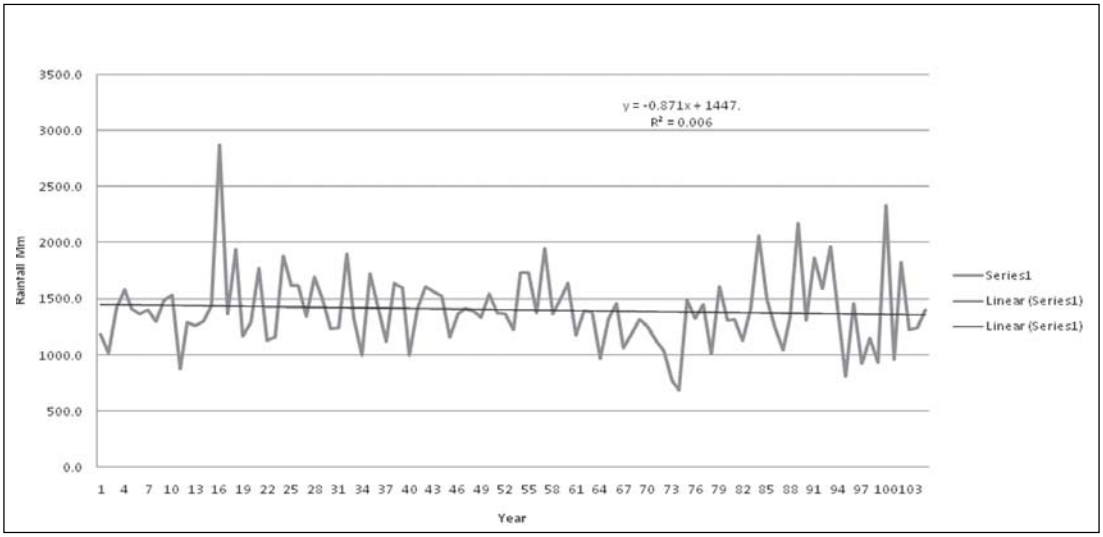
The results of the change point analysis through CUSUM test and difference between mean through Cumulative deviation (CD) method and student's t-test is shown in the above table. Our analysis shows the most probable change year for annual rainfall is 1964 for Bolangir district with decreasing trend in rainfall. For Bolangir district other Cumulative deviation and students t-test fails to detect any changes. For Nuapada district the most probable change year was found to be 1970 with CUSUM test and 1945 with CD method

showing a decreasing trend in annual rainfall in the latter part of time series. Here also t-test fails to detect any change. For Titilagarh station the most probable change year was 1961 detected by both CUSUM, CD test and student's-test having a decreasing trend in annual rainfall during 1961-2005. For annual among two stations, only Titilagarh station shows a most probable change year. It can be seen from the table that for mean maximum temperature both CUSUM and CD method shows 1971 as most probable change year and increasing trend in mean temperature after that, t-test failed to detect any change. For highest maximum temperature of Titilagarh station CUSUM test shows 1975 as most probable change year and CD test shows 1965 as change year with increase in highest maximum temperature after that year. For this station t-test detects increasing trend in highest maximum temperature after for the period 1965-1980.

The above analysis on rainfall and temperature gives a preliminary analysis of trend and pattern of rainfall and temperature in the two districts. While at the district level the rainfall in Nuapada district is showing a decreasing trend there is no significant trend in the Bolangir district. However, analysis at the station level shows that Titilagarh station shows a decreasing trend in rainfall. But even if, there is no trend in Bolangir district, the results from tests of step changes in mean shows that after 1960's there has been a declining trend of rainfall in both the districts. Our analysis of temperature data is constrained by the lack of availability of data because there is data for only two stations i.e. Bolangir and Titilagarh in Bolangir district. Among the two stations Titilagarh station show an increasing trend in annual temperature for the period 1950-80. Further, our analysis has a major limitation of lack of data at all the stations in two districts, thus we have analyzed the available data only. More disaggregated analysis would have thrown more light into trend of rainfall and temperature at local level.

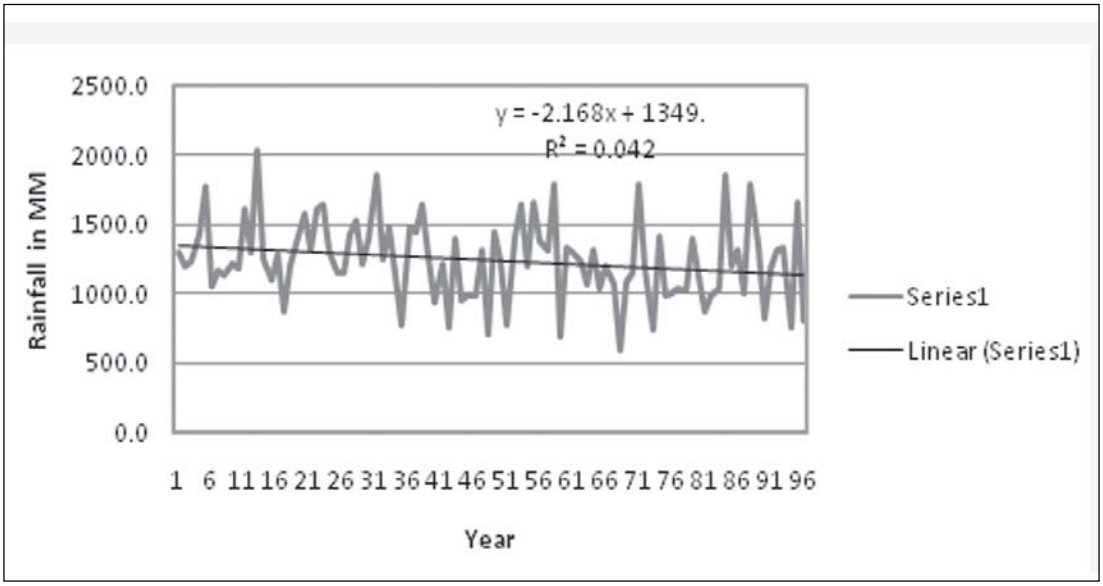
Graph-1

Annual Rainfall in Bolangir district from 1902-2005



Graph-2

Rainfall in Nuapada District



4. Farmers' perception of Climate variability and Change in estern Orissa

To assess farmers' perception on climate change we first looked at the climate data at the district level which has been described in detail in the previous section. However, due to lack of data at the village level in our study region we have used climate data at the district level to see what changes have taken place in the climate. Various studies have examined how analysis of meteorological data corresponds to the farmers' perception on climate variability and change (Vedwan and Rhoades, 2001; Hageback et al., 2005; Maddison, 2006; Gbetibouo, 2009). This is done by comparing local traditional weather cycle with climate change as perceived by the farmers of the region. Our analysis of perception of climate change includes analysis of farmers' perception on the temperature, rainfall in the last thirty years, changing weather cycle, perception about changes in number of hot days, frequency of droughts, changes in the timing of monsoon and post-monsoon rainfall etc.

4.1 Perception on temperature changes

About 88 percent of the farmers in Mahurundi village of Bolangir district feel that mean temperature has increased over the last thirty years and only 12.5 percent feel that it is constant. Similarly they also feel that number of hot days in increasing in the area. On the other hand in two Villages of Nuapada district the perception that temperature has increased is low among the farmers. About 70 percent of farmers in Kirkita village and 57 percent of farmers in Khamtarai village feel that temperature has increased in the last thirty years. Around 40 percent farmers in Kirkita and 27 percent in Khamtarai village feel that temperature in constant.

About 88 percent of the farmers in Mahurundi villages of Bolangir district feel that mean rainfall have decreased in their area over the last thirty years. Only 12.5 percent of the farmers feel that it is constant. When asked about whether they feel that climate is changing in their area almost 94 percent of farmers reported that climate is changing in their area since last thirty years. The following table describes the changes in temperature and rainfall in all the three villages. There are differences in perception about temperature change in both the district, in Bolangir district more percentage of farmers feel that temperature is increasing along with number of hot days. This corresponds to our analysis of temperature data at the district level in Bolangir where there was significant increasing trend of temperature in the Titilagarh station which is nearer to the village studied in Bolangir district. In Nuapada district however, the percentage of farmers perceiving increasing temperature is less than Bolangir district and at the same time the perception regarding number of hot days is also more in case of Bolangir farmers than the farmers in Nuapada district. We cannot compare farmers' perception data with district level data due to lack of data for this

district. However, it can be concluded that there is a general view among farmers that mean temperature is increasing in both the districts. Some farmers also view that deforestation in the local area is also an important contributing factor for increase in temperature over the years and also they feel that the summer season is now longer than earlier times adversely affecting their agriculture. Some farmers in Bolangir district reported of planting cotton two times in a season due to increase in temperature and destroying the seeds in their initial period, when they need rain and moisture.

Table-2

Perception of changes in temperature in the study region

Village	Increased temp	Decreased temp	Constant temp	Number of hot days Increasing	Number of hot days decreasing	Number of hot days constant
Mahurundi	87.5	0	12.5	87.5	0	12.5
Kirkita	69.2	5.1	25.6	64.1	7.7	28.2
Khamtarai	57.1	2.9	40.0	57.1	2.9	40.0
Total	70.1	3.7	26.2	68.2	4.7	27.1

Source: Field Survey, 2010

Table-3

Perception of changes in rainfall and Frequency of droughts in the study region

Village	Increased	Decreased	Constant	Don't know	Droughts Yes	Droughts No	Don't Know	Half Droughts
Mahurundi	0	88.5	10.5	0	56.3	15.6	15.6	12.5
Kirkita	0	94.9	5.1	0	71.8	12.8	7.7	7.7
Khamtarai	2.9	91.4	2.9	2.9	71.4	20.0	2.9	5.7
Total	0.9	91.6	6.5	0.8	67.3	15.9	8.4	8.4

Source: Field Survey, 2010

4.2 Perception on rainfall changes and frequency of droughts

In both the districts most of the farmers feel that rainfall has decreased over the last thirty years and frequency of droughts have increased in the area. In Mahurundi village around 89 percent of the farmers feel that rainfall has decreased in the area and around 56 percent farmers reported that the frequency of droughts have increased in the area. However, in other two villages of Nuapada district around 95 percent of the farmers surveyed in Kirkita and around 92 percent in Khamtarai village feel that rainfall is decreasing since last thirty years in the area. Around 72 percent of farmers in both the villages feel that the frequency

of droughts has increased in the area. This corresponds to our rainfall analysis in this district earlier where we found a significant decreasing trend in the rainfall in the area. Although, Bolangir district don't show any declining trend in the rainfall farmers feel that rainfall in decreasing in the area. However, the percentage of farmers having perception of declining rainfall and increasing frequency of drought is more in Nuapada district conforming to our earlier rainfall analysis. Another important observation from the farmers is that, some farmers have reported about half drought rather than full drought regularly in the area. According to the farmers half drought is a phenomenon where there is no rain just at the time of ripening of crops like rice so even if there is no drought according to amount of rainfall, the total production of crops will decline and will result in half droughts. According to the farmers this has become a regular phenomenon since last thirty years. Most of the farmers remember the severe drought year of 1965 in the area and according to them, after 1965 the trend of declining rainfall in prominent.

Conclusion

Analysis of farmers' perception regarding changing climate was carried out. The results indicate that farmers are aware that climate is changing in the area and observed trends in rainfall and temperature also support it.

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Conserving Local Biodiversity through Community Conservation Initiatives in Orissa, India

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The state of Orissa is one of the most resource-rich states in Eastern India, with diverse ecosystems that boast a wide variety of flora and fauna. In a way, Orissa symbolizes the contradictions in modern India between very high ecological and social diversity and extreme poverty and destructive processes of industrialization. Efforts by Government agencies to conserve wildlife in strictly protected national parks and sanctuaries often create conflicts with local communities who reside in and around these areas, because the physical presence of human is considered to be harmful. This exclusionary approach to protected areas inhibits the fair and equitable sharing of benefits of conservation with local communities and imposes the disproportionately costs of conservation upon them. Lack of recognition of or respect for their fundamental rights contributes to hostility towards Government conservation initiatives, which reduces the overall efficacy of conservation efforts and, ironically, further exacerbates degradation and local poverty.

Despite these complex challenges, local communities are driving their own initiatives to conserve wildlife and biodiversity in general and to generate sustained livelihoods (see

- CCIs play a crucial role in the conservation of vital ecosystems, critical wildlife habitats, and threatened species. Many CCIs function as wildlife corridors and establish linkages between official State protected areas.
- Some CCIs are responsible for the maintenance of essential ecological services, such as soil conservation, water security, and conservation of traditional crop varieties.
- They integrate links between traditional agricultural systems and forest ecosystems, thereby conserving at the landscape level.
- Some CCIs are crucial aspects of local economies; thousands of people depend upon them for survival and social and cultural values and uses.
- CCIs can be seen as community-based models of development built on local ecological knowledge systems that integrate traditional knowledge with current advancements in conservation science.

Box 1)[1] . Across community-owned lands, government-owned lands, and lands whose ownership is disputed, these initiatives are helping conserve a variety of ecosystems and habitats of wild flora and fauna through a wide range of institutional mechanisms, rules, and regulations. Even though these Community Conservation Initiatives (CCIs) are much older than the Government-managed protected areas, they remain unrecognized in federal and state law. While they have been functioning effectively without legal recognition, there are arguably some instances in which recognition of CCIs would further enable them to support biodiversity conservation and sustainable livelihoods.

The social and Ecological resilience of the mouth of the Devi River

The mouth of the Devi River, located about 60 kilometers from Bhubaneswar, the capital city of Orissa, has great ecological, historical, and economic significance. The Devi River mouth is one of the three mass nesting sites of the Olive Ridley turtle in Orissa[2] . It also provides habitat for the Indo-pacific humpback dolphin (Orcaella brevirostris), the finless porpoise (Neophocaena phocaenoides), and the smooth-coated otter (Lutra perspicillata)[3], as well as many species of residential and migratory birds. The surrounding forest area is also home to many wild animals such as chital, hyena, and jackal. This rich diversity in flora and fauna adds immeasurable value to local communities' livelihoods and well-being.

Around 15 000 traditional fisher-folk from 36 fishing villages are directly dependent on the river mouth for their daily livelihoods[4]. The traditional fisher folks live in small 'tandas' or hamlets adjoining the main revenue village. They collect fishes and crabs from the river mouth and do the fishing within 5-10 kms from the shore. On an average a traditional fisher folk can earn around Rs 10,000 - 12,000/month from the fishing activities. The traditional fishermen use fibre boats or motorized boats (kattamarams) and they usually do the fishing within 5-10 kms from the shore. They use monofilament nylon or plastic and make large meshed nets which do not strangle the turtles.

Apart from the fisher folks living in the tandas the villages located along the Devi River Mouth are also dependent fishing activities for their livelihood. Agriculture and Fishing are the prime source of livelihood of these villages. Those who do not practice fishing or

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[1] Pathak N, Bhatt S, Tasneem B, Kothari A and Feyerabend, G.B, Community Conserved Areas; A Bold Frontier for Conservation, briefing note 5, November '04, Pg.1, 2004

[2] Three mass nesting (arribada) sites in Orissa are the Gahirmatha sanctuary, Rushikulya, and Devi River mouth.

[3] The smooth-coated otter is listed in Schedule II, Part II, of the Indian Wildlife (Protection) Act, 1972, Appendix II of CITES, and VU A2cd in the IUCN Red List.

[4] Survey conducted by 'Sea Turtle Action Programme(STAP)', a local group working in and around Devi river mouth, in the year 2005

agriculture, work as wage labourers for their living and for this they even have to migrate to places outside the state. Since NREGA (National Rural Employment Generation Act, 2005) is not being properly implemented in their area[5] so they have to go to far away areas for labour work.

Survey conducted in this area shows that the average landholdings of each household is about 1 acres and the floods in 2003 and 2009 in Kadua and Devi river has seriously affected several hundreds of acres of crop in Gundalba[6] as well as neighbouring villages. Fisher folk and other farmers have not received any compensation for their losses and many of their lands still lie inundated with water.

Further it is to be noted that during the turtle breeding season, ban on fishing is imposed by the Orissa State Government for a period of six months from 1st November to 31st May. Out of 240 fishing days in a year, 180 fishing days (1st Nov to 31st May) has been restricted for turtle conservation, which has been affecting the livelihoods of traditional fisher folks, who are directly dependent on the river mouth for their livelihood. The total amount of loss incurred by the marginalized communities in each year is around 40.37 crores. The ban is imposed during the turtle breeding season and during the ban period the fisher community are provided with no alternate source of livelihood.

Apart from being a mass nesting site for olive ridley turtles, the area has a good mangrove forest cover. The many species of mangrove vegetation[7] play a vital role in the coastal ecosystem because of their role in the mitigation of coastal erosion, as nurseries for variety of fish and prawns, and as natural barriers to tidal and storm surges associated with tropical cyclones, which cause considerable damage to the ecosystem and communities' livelihoods. Good mangrove cover thus increases the resilience of the surrounding and constituent social and ecological systems.

However, the situation was much different a mere ten years ago. In 1985, mangrove cover in the Devi estuary was 2.58 square kilometers (km2) (K.Kathiresan, 2005). In 1997, the mangrove forest cover was reduced to 1.999 km2 (Kar and Chaddha, 1997) by one cyclone; the super cyclone of 1999 hardly left any trace of mangroves in the area. The super

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5 Earlier NREGS programmes were only implemented in certain districts (mostly tribally) of the state and has been extended to the entire state two years back; the activities are yet to start in these areas

6 Gundalba is one of the villages located along the Devi river mouth and it is from this village the initiative of community conservation of casuarinas forest started in the area

7 Examples include Avicennia officinalis, Avicennia alba, Aegiceras corniculatum, Ceriops decandra, Acanthus illicifolius, Bruguiera gymnorrhiza, and Excoecaria agallocha.

cyclone of 1999 almost destroyed the coastal casuarina and mangrove coverage, leading to high soil salinity (up to 15 parts per million) and reduced agricultural productivity. Villagers who were previously not very conscious of the need to protect the surrounding forests were driven to do so in order to prevent high salinity, minimize the intensity of future natural disasters, and ensure the ability to meet their daily livelihood requirements. The female residents of seven villages[8] in particular have emerged resolutely from the destruction and have successfully managed to protect and conserve around 15 km2 of casuarina forest and 5 km2 of mangrove forest in and around the mouth of the Devi River.

The Development of women's committees comittees for ecosystem conservation

In the face of these multiple challenges, women's groups from these seven villages have driven successful initiatives to conserve the forest and coastal biodiversity. This social revolution started in the year 2000 with many of the women coming forward and resolving to conserve their adjoining forest areas and other natural resources. Today, the positive impacts of the CCIs on the protection and conservation of the rich biodiversity of the area are quite evident. For example, the women of each village have formed Community Forest Protection Groups or Committees and have adopted the practice of thengapalli or regular patrolling to protect the nearby Astarang Forest. They have successfully protected and regenerated around 15 km2 of casuarina forest. The regenerated casuarina forests have also helped provide a barrier against the saline wind and sand particles that enter the village from the beach.

The women of the village of Gundalba have pioneered the CCIs in the area by forming the Pir Jahania Jungle Surakhya (Pir Jahania Forest Protection Women's Committee) Women's Committee in 2000. The village has 60 households and one woman from each household is part of the Pir Jahania Women's Committee. With this strong foundation of 60 members, the Committee adopted the practice of rotational patrolling of two to four women at a time to protect the forest within their traditionally identified boundary. The extent of the forest boundary has been demarcated mutually between the villages and the boundaries are identified by physical landmarks. of the forest. At their monthly meetings, the Committee formulated and passed resolutions for a set of regulations for the management of the forest. With the meetings presided over by the President or Secretary of the Women's Committee and attended by the local forest officers as special invitees, the resolutions were passed only when the decision was accepted by two-thirds of the Committee members. Once a resolution is passed, it is then shared with the rest of the villagers in a palli sabha (village

[8] The villages includeDaluakani, Anakana, Gundalba, Aisinia, Siddikeswar, Sohana and Sribantapur.

meeting). For example, the Women's Committee has fixed one day each month during which all 60 households in the village are allowed to collect fuel wood from the forest. Similarly, a different day (usually after three or four days after the villagers of Gundalba have collected) has been fixed when the neighbouring villages dependent on the same patch of forest resources can collect fuel wood from the forest. There is no conflict between these villages over the shared resources, as the boundaries and forest protection rules and regulations have been defined by mutual agreement of all seven neighbouring villages, many of which also have women's committees. Those from outside Gundalba have been given this privilege on the premise that they refrain from cutting or chopping any trees, which they used to do prior to the women-initiated forest protection system. During the remaining days in the month, the Women's Committee patrols the forest and nobody is allowed to collect additional firewood. The regulations established by the Committee are strictly adhered to and respected by the villagers. The Committee has also fixed different levels of fines, as a sort of localized compliance mechanism. For example, if a member of the Committee does not fulfill her patrolling duty, then she must be a fine of 50 Rupees. If anyone is found to be chopping trees or collecting firewood on any day other than the fixed one, the guilty party faces a fine of 200 Rupees. For minor offence, the defaulters are left with strict warning of not repeating the act.

The strong commitment of the community members has yielded rapid and positive ecological results. Since the widespread destruction in 1999 spurred their initiatives, newly regenerated mangrove vegetation and the forest cover (especially of mangroves) has gone up 63% from 2.58 km2 in 1985 to 4.21 km2 in 2004, even after the super cyclone decimated nearly all mangrove cover12. This is due to natural regeneration within newly formed mudflats and the concerted efforts of the local communities to restore the forest. The mangrove vegetation has attracted a lot of residential and migratory birds, which are also a tourist attraction. Furthermore, the mangrove forest serves as a coastal buffer against natural disasters. Buoyed by these results, the Women's Committee plans to expand the mangrove cover in their area even further.

In addition to the effects of this well-organized social institution on the regeneration of the forest, the initiatives of the Women's Committee have also influenced the local youth and children of their village and adjoining villages. The local youth have formed groups to help protect the Olive Ridley turtles (a Scheduled I species under the 1972 Wildlife Protection Act13) during their breeding season14. The Women's Committee has constructed an interpretation and learning centre and aims to earn some income through regulated tourism during the breeding season. The youth are also engaged in maintaining an eco-friendly ambience for the tourists15 and suitable habitat for the local wildlife by collecting garbage

and segregating the degradable and non-degradable waste. The degradable waste is converted into organic manure and used in the agricultural fields, but due lack of technical knowledge and support, the non-degradable waste is left as such. The villagers not only protect the turtles during the breeding season, but also have special fishing norms during the mating and nesting times to avoid contributing to sea turtles' already high mortality rates.

The youth groups and Women's Committee, in addition to elders and others from the community, have recently started thinking beyond environmental protection and have plans for the sustainable development of their village and conservation of the whole coastal ecosystem. They have come together to develop a People's Biodiversity Register16 of their area and have started devising their own community management plans. All of the abovementioned activities demonstrates the social resilience of the villagers around the mouth of the Devi River and the mobilizing effect that CCIs can have within and among villages towards collective aims of biodiversity conservation.

Lack of legal security threatens to undermine community conservation initiatives

Government initiatives[9] for the regeneration and restoration of mangroves along the entire coastline of India tend to involve huge financial investments and are arguably not sufficiently adapted to unique local contexts. In addition, the existing conservation efforts of communities such as the ones described above are unrecognized and may be undermined by large-scale Government initiatives.

The coastal communities around the mouth of the Devi River rightly claim that they had carried out the conservation activities on their own accord after surviving the 1999 cyclone disaster that left not a single tree in their area. After years of concerted efforts, the mangroves and casuarina have regenerated, but the communities now feel betrayed when the Forest Department claims it as Government property and restricts the mobility and access of the communities to the resources. Since the land is legally classified as forestland, it is under the control of the Forest Department but the people were protecting the stretches of casurina forest. After the super cyclone of 1999, the Forest Department had done the casuarina plantation in 15 sq km stretch. At that time, realizing the need of

[9] In May 2010, World Bank aided 'Integrated Coastal Zone Management Project' for Orissa has been approved for its implementation for two coastal stretches i.e. from Gopalpur to Chilika and from Paradeep to Dhamra. The Budget outlay of the project is Rs 227.63 crores (Rupees two hundred twenty-seven crores sixty-three lakhs only). The basic objective of the project is to promote sustainable management of coastal area on a long-term basis to balance environmental, economic, social, and cultural as well as address the livelihood issues of local communities.

casuarinas forest in their area, the people had suo motu given apart some portions of their private land for the plantation purpose. Then the villagers, particularly the women groups of seven villages along the Devi River Mouth formed forest protection committees and started protecting the forest patch with all zeal and vigil. After 10 yrs. of protection, their initiatives had led to growth of well stock casuarinas forest, which the Forest Department claims as their forest and does not recognise the initiative of the communities.

In July 2010 the Forest Department has started the coupe felling operation and has leased out to Orissa Forest Development Corporation for felling of casuarinas trees. The women groups who have been protecting the forest vehemently opposed this action of the Forest Department and they snatched away the axe and embraced the trees, not allowing the Forest Department to chop away the trees which they considered priceless for their livelihood as well as a strong protection barrier against natural hazards. The Forest Department tried to bribe them by saying that the villagers would get 50% of the share, as they were registered as Van Surakhya Samities(VSS) in the year 2007, under the Joint Forest Management policy (JFM)[10] of the Government. During the interaction with the villagers, they said that they had no knowledge when they were registered as VSS and till date they have received no records in support of that. In spite of fierce opposition from the villagers, the coupe felling operation is going on at the moment while I write this article and the people are not even given 50% of their share, which is their legal right if the Forest Department claims it to be registered as VSS under the JFM guidelines. The coupe felling operation is being undertaken at a time (July-August) when the coast is most vulnerable to cyclones and other natural disasters and only 8-10 lines of casuarinas plantation is left which the communities feel will no way prtect their villages from the saline ingress or cyclonic storms. The Department has of course undertaken plantation on around 20 acres of land on the coast of Daluakani village. These plantations have been undertaken within 50 mts of the coast. It is to be noted that this area is the mass nesting site of olive ridley turtles and the turtles come around 200 mts within the coast for laying their eggs. These plantations done within 50 mts distance would undoubtedly cause obstruction for the ridleys which is Schedule I species and invites the highest legal protection. Further the villagers also doubt the survival of these plantations as they apprehend if there are strong winds or cyclonic storms, these plantations would be uprooted as they have no protective barrier in the front.

[10] Joint Forest Management Policy was passed in 1990, which offers for participatory management of the Forest by the Communities and the Forest Department. But in practice it has been found that JFM has turned out to be a failure as it has very limited space for the local people to exercise their rights and virtually they have no role to play in the decision making process.

Frustated with the move of the Forest Department, these communities now demand legal recognition of their self-driven conservation initiatives. The communities have now started applying for community rights under the recently enacted 'The Scheduled Tribes and Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006'(commonly known as Forest Rights Act) over the forestland and the forest resources over which they were depending since generations. They are also demanding for the recognition of their 'rights to protect, conserve and manage their own community forest resources which they have been traditionally protecting and conserving for sustainable use' as mentioned in Sec 3 (1) 9i) of the Forest Rights Act. They firmly believe that such recognition would enable them to better manage and conserve the coastal resources and ecosystem[11].

In addition, there is no law or policy in India that recognizes the customary rights of traditional fisher-folk and other coastal communities that depend upon the coastal land and water for their livelihoods and well-being. The communities demand that the Coastal Regulation Zone Notification, 1991[12] should be amended accordingly. Till date there are no guidelines indicated in the CRZ notification for the preparation of Coastal Zone Management Plans. The communities demand that Coastal zone management plans should be prepared by the government in consultation and repeated discussions with the local communities depending upon the coastal waters. The management plans thus prepared by the Government should be passed by the village councils or Gram Sabhas so that the plans of the communities are duly reflected in the national or state level management plans. Importantly, they also call for the enactment of a separate Act in line with the recently enacted Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006[13], which arguably set a legal precedent for the recognition of the customary rights of

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[11] The Preamble of the Forest Rights Act, 2006 clearly says that 'whereas the recognized rights of the Scheduled Tribes and other traditional forest dwellers include the responsibility and authority for sustainable use, conservation of biodiversity and maintenance of ecological balance and thereby strengthening the conservation regime of the forests while ensuring livelihood and food security of the forest dwelling Schedule Tribes and other traditional forest dwellers.'

[12] Keeping in view the importance of the coastal environment and the need to protect the coastal ecosystems from the pressures of developmental activities, the Ministry of Environment and Forests had issued the Coastal Regulation Zone (CRZ) Notification, 1991 under the Environment (Protection) Act, 1986. This notification, which is still in force, seeks to protect and regulate the use of the land within 500mts of the coast and 100mts along the tidal influenced water bodies. All developmental activities proposed to be located in this zone are regulated under the Notification. It classifies the coastal stretch of the country into CRZ-I (ecologically sensitive areas), CRZ-II (built up municipal areas), CRZ-III (rural areas) and CRZ-IV (Islands of Lakshadweep and Andaman & Nicobar).

[13] The Scheduled Tribes and Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006, was notified in 2006. The Act of the Parliament received the assent of the President on the 29th December 2006 and this Act recognizes and vest the forest rights and occupation in forest land in forest dwelling Scheduled Tribes and other traditional forest dwellers who have been residing in such forests for generations but whose rights could not be recorded; to provide for a framework for recording the forest rights so vested and the nature of evidence required for such recognition and vesting in respect of forestland.

tribal and other traditional forest dwellers over their forest resources[14]. There are other existing provisions in Indian law and policy that indicate a trend towards recognition of CCIs[15, 16], but they arguably have limited scope in and of themselves. A separate Act that explicitly recognizes the CCIs of traditional fisher-folk and coastal communities would grant them the right to continue their livelihoods that contribute to the conservation and sustainable use of biodiversity. This would also assist India in fulfilling its obligations under the United Nations Convention on Biological Diversity[17], particularly Articles 8(j) and 10(c), which call on Parties to protect and support indigenous peoples' and local communities' traditional knowledge and customary ways of life that contribute to the conservation and sustainable use of biodiversity[18]. To implement such an Act, Gram Sabhas (village council) should be given the authority to develop, implement, and monitor and evaluate their own coastal management plans and the local authorities (Panchayats) should be given the power to take punitive action against activities deemed illegal by Federal and State law and by the local management plan.

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[14] The Scheduled Tribes and Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006 is considered to be one of the most revolutionary acts in the legislative history of India. This Act is intended to redress historical injustice faced by forest dwellers. In addition to the right of community over land and forest produces, in Section 3(1)(k), it also imparts upon communities the right to access biodiversity and the right over related traditional knowledge and intellectual property rights. For the first time in the legal history of India, the traditional rights of forest dwellers to conserve and nurture their forest resources are recognized.

[15] Under Section 36 of the Wildlife (Protection) Amendment Act 2002, Conservation Reserves, which are Government-owned, biodiversity rich areas (particularly areas important as corridors), are recognized as protected areas. In this section, there is also a provision to recognize Community Reserves as protected areas, which includes private and community-owned areas (though most of the common land is taken over by Government) that are imbued with conservation values and/or areas in which the community has voluntarily conserved wildlife. Since most of the CCIs are located on Government-owned lands, these provision are not enough to provide them legal recognition. Furthermore, it is difficult to accommodate diverse, situation-specific institutional arrangements in a uniform configuration such as Community Reserves. The Ministry of Environment and Forest has yet to draft guidelines for implementation of Community Reserves, which would indicate the potential usefulness of the stated provisions.

[16] Driven by thousands of self-initiated forest-protecting groups in Orissa, the State government passed a resolution regarding the involvement of communities in forest protection in 1988, and national guidelines were followed under the National Forest Policy 1988 through JFM resolutions that came into practice in 1990. The National Forest Policy is the first national scheme wherein villagers are involved in protection of Reserved and Protected forest. Now thousands of Vana Samrakshan Samitis operating in Orissa enjoy recognition of their usufruct rights and share in the benefits of conservation, including through funds to support their efforts.

[17] The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. The objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding

The need for appropriate recognition and support

The conservation and sustainable use of biodiversity requires the full and effective participation of local communities whose livelihoods depend directly on these resources in decision-making and governance processes. The above example of the initiatives of the Women's Committee near the Devi River mouth illustrates the need for appropriate legal recognition and support of CCIs. In order to do so, the following points needs to be addressed:

- CCIs must be legally recognized through elaboration and further amendments of existing laws, including recognition and support of local governing institutions and rights of the local communities over the resources upon which their livelihoods depend;
- Local communities should devise clear guidelines for external agencies who want to support and engage with them to ensure that any interactions are according to locally defined values and priorities;
- Technical and financial support must be provided to local communities contributing to the conservation and sustainable use of biodiversity, including through promotion of sustainable livelihood options (such as value addition and marketing of non-timber forest products and community based ecotourism), scientific monitoring and research, and capacity building to help local communities understand and engage with relevant laws and policies; and
- A holistic approach to development is required in order to take into consideration communities' rights over resources that they have been conserving for generations. Transparent and participatory planning processes would also enable communities to prevent and mitigate activities that are detrimental to their livelihoods and surrounding biodiversity.

Community conservation initiatives at the mouth of the Devi River and elsewhere in Orissa illustrate clearly that traditional systems of resource management have conservation values and principles ingrained within them that officially recognized or managed areas often lack. Rather than imposing alternate models on the local communities and undermining their conservation efforts, it is critical to better understand the values of these initiatives and provide locally appropriate legal recognition and support at the national and international levels rather than.

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Climate Change : Loss of Biodiversity and Rural Livelihoods...! What are we doing?

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CLIMATE is probably the most important determinant of vegetation patterns globally and has significant influence on the distribution, structure and ecology of forests (Kirschbaum, et al., 1996). Several climate-vegetation studies have shown that certain climatic regimes are associated with particular plant communities or functional types (Holdridge, 1947; Thornthwaite, 1948; Walter, 1985; Whittaker, 1975). It is therefore logical to assume that changes in climate would alter the configuration of forest ecosystems (Climate Change 1995; Solomon, A., 1986). The Third Assessment Report of IPCC (Climate Change, 2001a) concluded that recent modeling studies indicate that forest ecosystems could be seriously impacted by future climate change. Even with global warming of 1-2°C, much less than the most recent projections of warming during this century (Climate Change, 2001b), most ecosystems and landscapes will be impacted through changes in species composition, productivity and biodiversity (Leemans, R. et al., 2004). These have implications for the livelihoods of people who depend on forest resources for their livelihoods (Gitay, H., et al., 2002; Ravindranath N., et al., 2006).

In this connection a small analysis report is prepared by collecting literature on forests, biodiversity and climate change and analyzing the secondary information. The report mainly considers the research reports published by the renowned scientists, Ravindranath N., et al., (2006) Kanowski J., (2009) and Vandana Shiva (1993) and reputed enthusiasts, Lang C. (2010) in the realm of environment, climate change, forests and biodiversity. This analysis report is purely based on secondary information and research works of the scientists. Let us now examine the projections and predictions of the research study conducted by Ravindranath N., et al., (2006) on the "Impact of climate change on forests in India". The results of afore mentioned study were based on the Global assessments which have shown that future climate change is likely to significantly impact forest ecosystems.

The study made an assessment of the impact of projected climate change on forest ecosystems in India by the year 2085. This assessment was based on climate projections of

Regional Climate Model of the Hadley Centre (HadRM3) using the A2 (740 ppm CO2) and B2 (575 ppm CO2) scenarios of Special Report on Emissions Scenarios and the BIOME4 vegetation response model. The main conclusion is that under the climate projection for the year 2085, 77% and 68% of the forested grids in India are likely to experience shift in forest types under A2 and B2 scenario, respectively. Indications are a shift towards wetter forest types in the northeastern region and drier forest types in the northwestern region in the absence of human influence. Increasing atmospheric CO2 concentration and climate warming could also result in a doubling of net primary productivity under the A2 scenario and nearly 70% increase under the B2 scenario. The study suggests that the trends of impacts could be considered as robust but the magnitudes should be viewed with caution, due to the uncertainty in climate projections. Given the projected trends of likely impacts of climate change on forest ecosystems, it is important to incorporate climate change consideration in forest sector long-term planning process, (see Ravindranath N., et al., (2006).

Preliminary qualitative assessments of potential climate change impacts on forests in India (Ravindranath, N. et al., 1997; Ravindranath, N. et al., 1998) were based on earlier GCM (General Circulation Model) outputs of climate change (Lal, M., et al., 1995; Hulme, M., et al., 1995) that have undergone considerable refinement. Following this there were two regional studies, the first pertaining to potential climate change impacts on forests in the northern state of Himachal Pradesh (Deshingkar, P., 1997), and the second in the Western Ghats (Ravindranath, N. et al., 1997). These studies indicated moderate to large-scale shifts in vegetation types, with implications for forest dieback and biodiversity. With certain limitations though! Ravindranath N., et al., (2006)

Ravindranath N., et al., (2006) found that when the impact of projected climate on the forested grids based on the FSI forest types and area data is considered, the dominant miscellaneous forest type (where no species dominates) distributed across different parts of India, occurring in different rainfall and temperature zones and dispersed in fragments of varying sizes, is projected to undergo large-scale changes with 75% of the grids in A2 and 67% of the grids in B2 likely to be subjected to change of forest type. The economically important forest types, such as Tectona grandis, Shorea robusta, bamboo, upland hardwoods and pine, are projected to undergo change. When pine, teak, sal and bamboo are considered, over 75% of the grids are projected to undergo change in A2 and B2 scenarios. The forest types, which are likely to undergo minimal or no change under both A2 and B2 scenarios are Western Ghats evergreen, semi-evergreen and mangrove forest types.

This indicates that well over half of the area under forests in India is vulnerable to the projected climate change under both A2 as well as the moderate B2 GHG scenarios. Similar trends were observed using IS92a scenario based HadRM2 climate outputs and BIOME3 model, which reported over 70% of all the grids projected to undergo change in vegetation types and potential vegetation (Ravindranath, N., et al., 2003; Nakicenovic, N. et al., 2004).

A review of studies by IPCC, (Climate Change 2001) and Gitay et al., (2002) has shown that forest biodiversity or the species assemblage is projected to undergo changes due to the projected climate change. Biodiversity is likely to be impacted under the projected climate scenarios due to the changes or shifts in forest or vegetation types (in 57 to 60% of forested grids), forest dieback during the transient phase, and different species responding differently to climate changes (Climate Change 2001) even when there is no change in forest type. Climate change will be an additional pressure and will exacerbate the declines in biodiversity resulting from socio-economic pressures (Gitay et al., 2002; Ravindranath N., et al., 2006)

Reflection on the above study

Considering the projections and predictions of the study conducted by Ravindranath N., et al., (2006), the following points become apparent that

- Over half of the area under forests in India is vulnerable to the projected climate change, Biodiversity is likely to be impacted under the projected climate scenarios due to the changes or shifts in forest or vegetation types,
- Forest are likely to dieback during the transient phase gravely affecting the biodiversity and local livelihoods,
- The dominant miscellaneous forests is projected to undergo large-scale changes,
- The economically important forest types, such as Teak (Tectona grandis), Sal (Shorea robusta), bamboo, upland hardwoods and pine, are projected to undergo change,
- Minimal or no change has been observed in the Western Ghats evergreen, semi-evergreen and mangrove forest types.

The scientists though claim that the results are suggestive in nature and no attempt was made to assess or develop adaptation strategies due to the uncertainty involved in the climate impact assessment and the preliminary nature of the model outputs. Hence, abstractly though for now, Let us take the projections of the above research study into confidence and evaluate what the current local practices and national and international policies are up to in connection to forest and biodiversity conservation, enhancement of rural livelihoods and mitigation of climate change impacts.

National Forest Conservation and Rural Livelihood Enhancement Programmes of India - the paradox!

There is no gainsaying about the fact that India is a mega-biodiversity country where forests account for about 20% (64 million ha) of the geographical area (State of Forest Report 2001). With nearly 200,000 villages classified as forest villages, there is obviously large dependence of communities on forest resources (Ravindranath, N., et al., 2004). Thus it is important to assess the likely impacts of projected climate change on forests biodiversity and the livelihoods of forest dependent people, Ravindranath N., et al., (2006). To have a closer look at the projects and practices at the local and national level in connection to forest and biodiversity conservation and livelihood enhancement of the forest dependent communities, let us examine the evolution, implementation, and impacts of Social Forestry (SF) and Joint Forest Management (JFM) programmes which were hailed as the pro-poor and participatory forest management strategies for the conservation of forest and biodiversity and enhancement of forest based livelihoods.

A brief look at the history of forest management of India reveals that the report submitted by National Commission on Agriculture (NCA) during 1976 noted that forests occupied 23% of India's land, but their contribution to the National Product was less than one percent. It concluded that mixed plantations had no commercial value. During this phase there was a shift from conservation forestry to production forestry. The NCA suggested the setting up of a corporation to manage forests and to attract monetary assistance from various government and nongovernment sources. As a result, autonomous forest corporations were started and large-scale plantation activities began. The NCA report also suggested starting Social Forestry (SF) programme on non-forestry lands such as village commons, government wastelands and farmlands to reduce pressure on forests. The consequent degradation of vegetation on village lands led to increased pressure on the forests from the people affected by these activities. Though the programme was largely aimed at meeting the needs of the community, the involvement of the local community was marginal or absent (Murali et al., 2003).

One of the major criticisms of the social forestry programme was that it did not meet its objectives such as meeting diverse biomass needs and participation of local communities and lack of involvement of local community in choice of species. Therefore, only exotic species such as Eucalyptus and Acacia were planted in large stretches of lands. The programme was helpful to the farmers who were market oriented (such as Gujarat, Punjab and Haryana) but less helpful to meet the subsistence biomass needs such as firewood, fodder and NTFP of rural poor and tribal communities. Therefore, the natural forests continued to get degraded (Murali et al., 2003).

Noticing the lapses in the social forestry programme, the national forest policy of 1988 departs significantly from previous policies because it mandates that the local people must be actively involved in programmes of protection, conservation and management of forests. For the first time, local people living in and around the forests were given a chance to participate in the management of forests. They were considered partners, not only in protection and regeneration of forests but to share the usufructs and profits as well. The focus of forest management shifted from commercialization, to conservation of soil, the environment and the rights of the local populace (Murali et al., 2003).

Subsequently, on June 1, 1990, the Government of India passed guidelines launching the JFM programme. It recommended the participation of village communities in the regeneration of degraded forest and notified that villages that are effectively protecting the forest would have exclusive rights to that forest's produce. The 1990 circular of the Government of India, paved the way for most states (23) to adopt participatory forest management strategies by passing JFM orders (Murali et al., 2003).

But after almost two decades of experimenting with JFM in different states, the sustainability of the programme is still doubted and its implementation hinges on a number of preconditions. Various social, economic and cultural factors affect the progress of JFM. Some of the problems identified are as follows: the need to change the attitude and ethos of the forest bureaucracy, lack of understanding of the locals' socio-economic and cultural value system, not giving priority to gender issues, inter and intra village conflicts, lack of statutory authority to local institutions, inadequacy of meaningful involvement of the people, donor driven, rather than need driven programme, target oriented rather than people oriented and failure to address issues of sustainability (Reddy R. et al., 2004).

As per the State of Forest report, MoEF, GoI (1999), is concerned, an attempt to conserve the forests through the JFM has not produced the much-claimed positive impact in Andhra Pradesh as a whole. Although a large number of the forest protection committees were established through the JFM, it couldn't control the deforestation. In fact, the same report further quotes that, before the formation of VSS / FPC in the State, the forest area was 23.02 % and it has declined to 16.08 %. In other words wherever VSS / FPC are very active deforestation rate is higher (Ravinder, 2003; Reddy G. et al., undated).

A major lacuna in the provision of VSS / FPC is that the involvement of the FD supersedes that of the villagers. The participatory role of the village people in the planning process of JFM has ignored by the FD officials. The micro-plan is framed in the forest office; rarely does it reach the villagers. People are rarely aware of the budgetary allocations and the

budget plan for their village. Ideally the VSS / FPC should be in possession of a copy of the budget plan but that rarely happens. The second copy is with the Forest Ranger, which is never shown (Reddy G. et al., undated).

According to Gopal and Upadhyay (2001) the legal and policy frameworks need more clarity because the provisions of the Executive Order governing JFM often conflict with the Forest Conservation Act 1980, leading to set backs in the efforts of the poor to seek livelihoods from the forests they improve. Livelihoods of the poor in the rural areas largely depend upon food, fuel wood, fodder, small timber and non-plant extractions. Hence the policy makers are expected to consider paying attention to these five categories as a policy of management rather than seeing it as an obstacle (Gopal and Upadhyay 2001). It is even more when the tribes within the Scheduled areas are finding it difficult to compensate livelihood losses due to restriction on head loading and Podu (Reddy G. et al., undated).

Baviskar (1998) stresses on the importance of understanding the sensitivity of the 'tribal community' before making the policies pertaining to ecology and equity in tribal societies and into their internal dynamics because it is they who play an important role in the affairs of forest management and hence more powers and decision-making role to JFM committees should be given as a step toward greater decentralization and devolution, an issue frequently raised by both supporters and critics of JFM movement though in different contexts (Jodha, 2000). More explicit and equitable sharing mechanisms to ensure benefits of JFM to tribes, landless labourers (particularly women) who have been deprived of their traditional earning options following the introduction of JFM in many areas, promote workable means to empower women, e.g., by raising their number at all levels of forest service (Jodha, 2000). Furthermore, the organizational environment of forest agencies should be reoriented to allow women to participate equally with their male counterparts. Working groups, diagnostic studies, new monitoring systems, and feedback loops that enable emerging experiences to be channeled into policy-making will transform these institutions, making them accountable to their staff and the public that they serve (Poffenberger and Betsy Mc Gean, 1996; Reddy G. et al., undated).

The most commonly found problem between the Vana Samrakshan Samithis (VSS) / Forest Protection Committees (FPC) members and forest officials is with regard to species selection. In Andhra Pradesh if the members insisted on NTFP, horticulture, and coffee plantation in Vishakapatnam, the Cuddapaha VSS / FPC stressed on horticulture plantation, while Adilabad VSS / FPC inclined to show interest on both, but forest officials have shown little or no interest in the VSS member's choice, (Reddy G. et al., undated) Ironically, the main species used for Afforestation in River Valley catchments are again Eucalyptus and Silver

oak, on the higher reaches of hills in Visakhapatnam and East Godavari districts. Moreover, Andhra Pradesh Forest Development Corporation has encouraged planting of coffee and pepper under silver oaks in over 5000 ha tribal lands in Visakhapatnam and East Godavari district (Kshitija 2006). But the objectives of the 1988 forest policy or the JFM guidelines speaks the other way i.e. conservation of soil, the environment and the rights of the local populace but not the promotion of commercially important species which have serious implications on the stability of forest ecosystem, livelihood security and cultural identity of the local communities!

Just one glance at the projections of the study by Ravindranath N., et al., (2006), which predicts that the dominant miscellaneous forests is predicted to undergo large-scale changes, and the economically important forest types, such as Teak (Tectona grandis), Sal (Shorea robusta), bamboo, upland hardwoods and pine, are assumed to undergo change, warns us about the looming threat to the biodiversity and the livelihoods directly associated with it as a result of climate change. In this given scenario these seemingly insignificant and trifle activities (at least from the foresters point of view) of aggressively promoting commercially important monocultures with disregard to the species choices of the local communities may have serious implications for the forests and the society at large in the changing scenario of climate change.

International solutions to global warming and climate change- a big?

Kyoto Protocol is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC or FCCC), aimed at fighting global warming. The UNFCCC is an international environmental treaty with the goal of achieving "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The Protocol was initially adopted on 11 December 1997 in Kyoto, Japan and entered into force on 16 February 2005. As of July 2010, 191 states have signed and ratified the protocol.

However, the World Rain Forest Movement's bulletin, (1998), denounces the Kyoto Protocol by saying that the Kyoto Protocol, agreed in December 1997, has been a market-oriented approach, since it tends to establish a trading system to buy and sell carbon emissions. Tree plantations have gained a major role in relation to this issue because of their supposed condition of carbon sinks. The Protocol established that afforestation is one of the activities that Annex I countries can undertake to achieve their "quantified emission limitation and reduction commitments" for greenhouse effect gases (Art. 2). It also stated that "removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation, since 1990, measured as

verifiable changes in carbon stocks" are to be considered by Annex-I countries to meet such commitments (Art 3.3.). According to the Framework Convention on Climate Change (UNFCCC) this group includes industrialized countries and ex-planified economy countries, in process of transition to a market economy.

The so-called Clean Development Mechanism (CDM), defined by the Kyoto Protocol in Article 12 as a form of cooperation between both groups, provides a way by which Northern countries will be able to comply with their commitments, simply through the establishment of extensive tree monocrops in the South. When a public or private entity of an Annex-I country invests in a plantation project in the South, it is the investing country that will receive emission reduction certification for the project. As a matter of fact this provision that goes together with the net approach means that industrialized countries are freed of their responsibility to cut their carbon emissions in a significant way, while the South will offer their territory to projects aimed at capturing them, which will bring negative environmental consequences with them, as tree monocrops do. On the other hand it is not fair that those countries historically responsible for global warming would now receive assistance from poor countries. This is "foreign aid" upside down, isn't it? (WRM's bulletin, 1998).

Let's take the case of the tree plantation project promoted by the Dutch FACE Foundation (Forests Absorbing Carbon Dioxide Emissions). This organization aims to plant 150.000 hectares of trees to absorb CO2 equivalent to that emitted by a modern 600 MW coal fired power plant. Half of this area has been set up in the Ecuadorian Andes. Far from promoting the use of native species, the project is based on eucalyptus and pines. Even though these exotic species grow slowly in that environment, FACE justifies their use by saying that most of the native species in Ecuador have disappeared because of deforestation and that local people's knowledge about them has been lost with the forests themselves. This is however untrue and the only reasonable argument to justify the use of exotics is that they are easier and cheaper to plant (WRM's bulletin, 1998).

Large-scale monoculture plantations are known to be detrimental to the environment, both in natural forests and in grassland ecosystems: decrease in water yield at the basin level, acidification and loss of permeability of soils, nutrient depletion, alteration in the abundance and richness of flora and fauna. Nevertheless, there is an aspect of plantations that is perhaps not so well known: their social and cultural effects. Indigenous peoples and local communities that live in the forests are suffering encroachment of their lands by plantation companies and are forced to leave them, losing their lands and livelihoods, what means undermining the material and spiritual basis of their respective cultures. In

many cases, plantations require the previous destruction of the natural forests. The case of the Tupinikim and Guarani indigenous peoples in Espirito Santo, Brasil, is paradigmatic. After a long and unequal struggle to recover their ancestral lands, taken away by Aracruz Cellulose to establish eucalyptus plantations for pulp production, they were recently forced to sign an agreement that reduces significantly the area of their lands, to the benefit of the company (WRM's bulletin, 1998).

In the Portuguesa state of Venezuela, Smurfitt Cartons is dispossessing local peasants of their lands and destroying and replacing riverine forests with eucalyputs, pines and gmelina monocrops. Oil palm plantation companies in Sumatra, Indonesia, are expropriating local peoples' lands, which has resulted in civil unrest, since they are willing to defend their lands and livelihoods. Similar situations involving either eucalyptus and/or oil palm are also frequent in Sarawak, Malaysia, where indigenous peoples are being dispossessed of their traditional lands to make way to plantations and are fighting back to defend the forests. In Chile, large-scale pine plantations have expelled peasants from their lands and substituted the forests that provided to people's livelihoods. The list of local communities affected by tree plantations is indeed very long and the above are just a few examples to prove the social and environmental destruction that this "solution" can imply if implemented at an even larger scale (WRM's bulletin, 1998).

Other global processes --as the Convention on Biological Diversity and the Intergovernmental Forum on Forests-- are now warning about the potential impacts of tree plantations on forest biological diversity and on other attributes of natural ecosystems. Even the Kyoto Protocol itself mentions that Annex I countries "shall strive to implement (their) commitments ... in such a way as to minimize adverse social, environmental and economic impacts on developing country Parties" (Art. 3.14). However, actions are going in the opposite direction to words. National inventories of greenhouse-effect gases that every state has to prepare for monitoring its situation in relation to the commitments of UNFCCC consider the increase of tree plantation areas --called "planted forests"-- as positive for the global environment and include carbon capture by plantations in their respective budgets. Such methodology was adopted without taking into account the mentioned neither the negative impacts nor the regional or local features that can affect the calculation. The net effect of a plantation on carbon intake--once all the variables are taken into account-- is still at the hypothesis stage (WRM's bulletin, 1998).

In sum, the promotion of tree monoculture plantations under the CDM by the ongoing global process on climate change has a weak scientific basis. From a political, social and environmental perspective, far from being a solution to the problem, they contribute to

consolidate a scheme that is threatening people and the environment worldwide. A change in this approach is urgently needed. Article 9 of the Kyoto Protocol itself considers the possibility of implementing such changes "in the light of the best available scientific information and assessments on climate change and its impacts, as well as relevant technical, social and economic information". But, of course, this is not a matter of wording but of political will. Shall the COP4 in Buenos Aires be another lost opportunity? - Source: WRM's bulletin Nº 16, October 1998.

Are tree monocultures a solution to global warming?

According to the report published by the Africa Geographic, (2010), Australian scientists researching environmental restoration projects have found that the reforestation of damaged rainforests is more efficient at capturing carbon than controversial softwood monoculture plantations. The research, published in Ecological Management & Restoration, challenges traditional views on the efficiency of industrial monoculture plantations.

'Carbon markets have become a potential source of funding for restoration projects as countries and corporations seek the cheapest way to reduce carbon emissions.' 'However, there is a concern that this funding will encourage single species monoculture plantations instead of diverse reforestation projects, due to the widely held belief that monocultures capture more carbon.' (Kanowski J., 2009)

Softwood monoculture plantations are grown for industrial purposes and are used as a cheap and abundant source of resources such as timber and rubber. However the plantations are highly controversial, with some ecologists describing the lack of diversity as a 'green desert'. (Kanowski J., 2009)

The study lead by Kanowski J., (2009) sought to test the belief that monoculture plantations would capture more carbon by studying three types of projects in north-eastern Australia: monoculture plantations of native conifers, mixed species plantations and rainforest restoration projects, comprised of a diverse range of rainforest trees. 'They have found that restoration planting stored significantly more carbon in above-ground biomass than the monoculture plantations of native conifers and tended to store more than mixed species timber plantations,'. 'Compared to the monoculture plantations reforestation projects were more densely stocked, there were more large trees and the trees which were used had a higher wood density then the conifers at the plantation.'

Kanowski J., (2009) argues that these findings challenge the existing view of monoculture plantations. For example the Australian Government's National Carbon Accounting Tool

Box predicts that monoculture plantations would sequester 40% more carbon then restoration plantings in northern Australia, yet this study demonstrated that carbon stocks were higher in restoration plantings than in mixed-species plantations and monoculture plantations.

The research also suggests that restoration plantings store more carbon over time. However, as restoration projects are more expensive then monoculture plantations it is unlikely that carbon markets will favour restoration. (Kanowski J., 2009)

'In order to be an attractive prospect for the markets new reforestation techniques and designs are going to be required.' 'New designs will have to ensure that restoration can provide a habitat for rainforest life and store carbon at a cost comparable to industrial monoculture.' (Kanowski J., 2009)

Is carbon trade under REDD the new monoculture?

Besides progressive large scale afforestation programmes such as the National Afforestation Programme (NAP), India is also taking great strides towards establishing partnership to implement "Reduce Emissions from Deforestation and Degradation in Developing Countries (REDD)" project. Preliminary assessment studies were also conducted in this connection (see, TERI for COP 15, 2009). The preliminary study conducted by The Energy and Resources Institute (TERI) 2009, expressed that India is now ready to implement REDD with its existing proactive and progressive environmental laws and conservation policies. The report also delineates a clear cut institutional mechanisms to implement REDD in India. But what is missing in the proposed institutional frame work is the representation of the grass-roots, who are the crucial stakeholders in the project according to REDD guidelines.

A look at the institutional structure proposed by TERI in the preliminary assessment studies conducted for implementation of REDD in India is as follows: The Ministry of Environment and Forests (MoEF) is the central institution which is responsible for framing policies and laws for the forestry and environment sectors in the country. It is proposed that a REDD Cell be established at MoEF for coordinating with the various other ministries and help with the policy design and international reporting. This cell could be supported by network of Indian Council for Forestry Research and Education (ICFRE) institutions for research, Forest Survey of India (FSI), and National Remote Sensing Agency (NRSA) for forest assessments, and specialized institutions like Wildlife Institute of India (WII) and Indian Institute of Forest Management (IIFM) in areas of their expertise. Forest management at the state level is coordinated by respective State Forest Departments (SFD) under the

guidance of national policy and legal framework. SFDs could coordinate implementation of REDD projects and facilitate distribution of revenues in their respective states. In addition to FPCs created under the JFM programme, there are many other grassroots-level institutions like Panchayats, Van Panchayats, cooperatives, indigenous institutions (especially in the north east) which are involved in management of forest resources. Though FPCs, with the help of Panchayats, appear best suited to implement REDD Plus in large part of the country, traditional institutions will be much more effective in some regions like the north eastern states. A comprehensive state-wise assessments need to be undertaken to analyze the efficacy of various grassroots level institutions to implement REDD Plus (see also TERI, 2009).

From the above prescribed institutional structure for the implementation of REDD in India it becomes evident that the power to take necessary decisions related to the implementation of REDD is vested only with SFDs and other government organizations. The role of grass root institutions is again confined only to the implementation (perhaps as labour) and they have no role to play in the decision making on the issues which will have major impacts on their lives and the resources which they are critically dependent on for subsistence and survival. The preliminary report on REDD implementation considers policies, budget and top level bureaucracy but completely ignores the crucial factors such as biodiversity, rural interests, livelihoods and cultural affiliations. What is more alarming is the mention of the promotion of energy plantations such as Jatropha (Jatropha curcas) on wasteland as biofuel and the estimated returns to the rural populations from it. It was said in the report that an assessment study on the efficiency of the grassroots institutions is yet to be carried out. This throws at us an important question, does the implementation of REDD in India going to be another fiasco! Another Social Forestry and Joint Forest Management Programme in the offing! Or perhaps the worst?

In contrast there is an emergence of stiff resistance to REDD in the countries where it is being implemented already. According to the WRM Bulletin (2010), in May 2010, the Indonesian and Norwegian governments signed a Letter of Intent for a US$1 billion avoided deforestation deal. As part of this deal, the Indonesian government announced a two year moratorium on new concessions in forests or peat swamps. There are mixed messages from the Indonesian government about what the moratorium actually means. Some government officials say it will apply to at least some of the 26.7 million hectares on which the palm oil industry plans to expand its plantations. Agus Purnomo, head of Indonesia's National Climate Change Council, told Reuters that at least some of Norway's money would go on compensating oil palm companies whose concessions will be revoked. "When you revoke licences, when you cancel things, it involves money," he said. Other officials

state that the moratorium will not apply to existing concessions. If the latter is true, the moratorium will have little or no impact on deforestation in Indonesia, even for the miserly two years that it is in place (Lang C. 2010).

The international negotiations on reduced emissions from deforestation and forest degradation (REDD) might even end up encouraging more clearing of forests, draining swamps and conversion to monocultures in Indonesia. In August 2010, Reuters reported Wandojo Siswanto, a special adviser to the forestry minister, as saying that "If there is agreement on REDD, we could put palm oil plantations to be eligible for that." He added, "I think it would be good if we just say that palm oil plantations could also mitigate climate change through carbon sequestration through the nature of the trees." He said that existing and proposed plantations developed on degraded land could be eligible for carbon credits (Lang C. 2010).

The problem, as World Rainforest Movement and others have pointed out over and over again, stems from the United Nation's failure to recognize that plantations are not forests. Currently, in the bizarre world of the UN climate change negotiations, the UN's definition of forests fails to differentiate between native forest and industrial monoculture plantations (Lang C. 2010).

But even if REDD functions as it is supposed to, avoiding deforestation rather than encouraging the expansion of monocultures, there are still risks. With REDD schemes locking up the carbon in forests, a new form of "scientific" forestry is emerging where experts tell local communities how to manage the forests as carbon stores. Local communities' knowledge of the forest and their management of the forest have to be adapted to the new carbon economy. Forests could become carbon monocultures - existing to produce one product: carbon credits to bail out the north's failure to reduce its greenhouse gas emissions. Like other monocultures the productivity (of carbon credits) may increase, but productivity from the perspective of local communities could decrease (Shiva V. 1993, Lang C. 2010).

Of course, indigenous peoples and local communities are not taking this lying down. Many are demanding that their rights be fully incorporated into any international agreement on REDD. Their message is "No Rights, No REDD." (Lang C. 2010).

In April 2009, more than 400 indigenous peoples met in Anchorage Alaska for the Indigenous Peoples' Global Summit on Climate Change. They produced the Anchorage Declaration, specifically rejecting carbon trading and forest offsets as false solutions to climate change. On REDD, the declaration states that "All initiatives under Reducing Emissions

from Deforestation and Degradation (REDD) must secure the recognition and implementation of the human rights of Indigenous Peoples, including security of land tenure, ownership, recognition of land title according to traditional ways, uses and customary laws and the multiple benefits of forests for climate, ecosystems, and Peoples before taking any action." (Lang C. 2010).

Others are opposing REDD completely. Via Campesina, an international movement of peasants and small-scale farmers with about 300 million members, states that "The REDD+ initiative should be rejected." Indigenous peoples meeting at the World People's Conference on Climate Change and the Rights of Mother Earth in Bolivia in April 2010 stated, "We condemn the mechanisms of the neoliberal market, such as the REDD mechanism and its versions REDD+ and REDD++, which are violating the sovereignty of our Peoples and their rights to free, prior and informed consent and self determination." (Lang C. 2010).

In August 2010, the Social Forum of the Americas rejected REDD: "We denounce Northern geopolitical countries governments rather than confront serious climate change impacts they are seeking to evade responsibility and to develop new carbon market mechanisms to make more profit, such as 'Reducing Emissions from Deforestation and Degradation' (REDD), which promotes forests commercialization and privatization and loss of sovereignty over territories. We reject such arrangements (Lang C. 2010).

Forest Policies, Plantations and Responses of the Local Communities in India

The Forest Policy of 1952 was initiated to allow exclusive state control over forest management. The policy aimed to increase government control over forest resources and develop forests to meet the timber needs of industry and defense. It declared that village communities should not be permitted to exercise their traditional rights over the forests at the expense of national interest. The Wildlife Protection Act 1972 was initiated to establish sanctuaries and national parks for protection of wildlife. By 1996, 80 national parks and 441 sanctuaries were constituted, accounting for 4.3 % of the geographical area and 20% of the forest area in the country. This act prohibited communities to enter forests. Even today, local communities including tribal people are being relocated from having their settlements in the forests. (Murali et al., 2003).

During the 1980s, while the administration was preoccupied with large-scale plantation oriented social forestry projects; self-initiated community forest protection groups began emerging. These initiatives got little or no support from the state Forest Departments, with the exception of West Bengal, where a few progressive foresters actively supported and

facilitated the initiation of Forest Protection Committees (FPCs). The spread of these initiatives is apparent in states such as Bihar, West Bengal, Orissa, Karnataka and Haryana. Over 13,000 systems were available in the country in different states (Murali et al. 2000).

Though these systems are in existence over a century and throughout India but are poorly understood and documented, but they appear to be gaining momentum and receiving support at the village, state and national levels. However, the central and state governments began to perceive its significance and acknowledged the need to recognize and legitimize community efforts (Murali et al. 2000).

If the emergence of Community-Based Forest Management in India can be perceived as a response to the rapid degradation of forests and the consequent threats to livelihoods, subsistence and environmental services and ground level democratic response to a highly centralized, ineffective and inefficient forest governance system. However, as Shiva V., (1993) points out, "People everywhere have also resisted the expansion of eucalyptus plantations because of its destruction of water, soil and food systems." She gives the example of a World Bank-funded social forestry programme in Karnataka state, in India. In August 1983, the Raitha Sangha, the farmers' movement, marched to the forestry nursery and pulled out millions of eucalyptus seedlings. They planted tamarind and mango seeds in their place (Lang C. 2010).

This resistance to the spread of monocultures turned scientific forestry on its head, which had reduced all species to one (eucalyptus). Villagers reasserted their needs, over the need to provide raw material for the pulp industry. They also reasserted their knowledge over that of the World Bank's and the government's forestry experts (Lang C. 2010).

Similar protests against eucalyptus also started in the 1980s in Thailand. In a series of demonstrations, villagers have dug up eucalyptus saplings, burned down nurseries, marched, written letters, taken part in demonstrations, ordained forest trees to prevent them being cut down to make way for plantations, cut down eucalyptus trees and re-established community forests (Lang C. 2010).

Such resistance has often been met with brutality. The farmers in Karnataka were arrested. In Thailand, more than a dozen environmental activists have been killed in the last decade. Sometimes the violence starts even before villagers protest. In the late 1980s, a company called Arara Abadi, part of the Indonesian pulp giant Asia Pulp and Paper (APP), started to acquire land near the village of Mandiangin in Sumatra. The company simply seized land from the indigenous Sakai and Malay people without compensation. Armed police and

military officials took part in meetings between the company and villagers. A 2003 report by Human Rights Watch documents the intimidation and violence against people living in the area of APP's plantations. One villager told Human Rights Watch, "We often heard about people being arrested or just disappearing. So when they came here wearing their guns, we just kept our mouths shut." The company imposed a monoculture of opinion as well as monocultures of fast-growing trees (Lang C. 2010).

There have been several reports that APP is planning to expand its operations to Cambodia and Vietnam. In 2004, APP raised its none-too-attractive head in Cambodia, in the form of a company called Green Elite. The company planned an 18,300 hectare acacia plantation inside the Botum Sokor National Park. Green Elite was kicked out of the country, but not before it had logged several hundred hectares of melaleuca forest and started to build a wood chip mill (Lang C. 2010).

In 2007, Green Elite received permission to establish 70,000 hectares of fast-growing tree plantations in Nghe An province in Vietnam, for permission to set up plantations. The planting is being carried out by a subsidiary of Green Elite called InnovGreen Nghe An. The plantations are going ahead, and InnovGreen plans to establish a total of 349,000 hectares of industrial tree plantations in six provinces in Vietnam (Lang C. 2010).

A company called Golden One Company, which is reported to have links with APP, aims to establish industrial tree plantations in Laos. The company has mapped out an area of approximately 12,000 hectares, although the exact status of the plantation concession is unknown (Lang C. 2010).

Conclusion

The impacts of climate change are perceptible and clear! The submergence of Satavaya village in Kendrapara District of Orissa (Barik S., 2010) and the submergence of two islands of Sunderbans which have vanished from the map leaving 6,000 people as environmental refugees because their lands are now underwater (Harrabin R., 2007) are perceptible indicators of the impacts of changing climate scenario.

Furthermore, climate change could cause irreversible damage to unique forest ecosystems and biodiversity, rendering several species extinct, locally and globally (Climate Change 2001). Forest ecosystems require the longest response time to adapt, say through migration and regrowth (Leemans, R., et al., 2004). Further, a long gestation period is involved in developing and implementing adaptation strategies in the forest sector (Ravindranath, N. et al., 2002). Thus there is a need to develop and implement adaptation strategies.

Adaptation is adjustment in natural or human systems in response to actual or expected climatic stimuli and their impacts on natural and socio-economic systems (Ravindranath N., et al., 2006). Thus, it is imperative to act upon to address the impending impacts of climate change on forests, biodiversity and forest dependent livelihoods.

First of all the forest officials should shake-off their heads from the obsession of applying the principles of timber oriented management practices to the forests. They should now start to rationalize the promotion of commercially important exotic and monoculture plantations in the forests unless there are no other alternatives available. This is necessary because several climate-vegetation studies have shown that certain climatic regimes are associated with particular plant communities or functional types. Moreover, the study of Ravindranath N. et al., (2006) predicted that there will be minimal or no change in the Western Ghats evergreen, semi-evergreen and mangrove forest types. The dominant miscellaneous forests is projected to undergo large-scale changes and The economically important forest types, such as Teak, Sal, bamboo, upland hardwoods and pine, are projected to undergo change. Furthermore, research studies conducted by Kanowski J., (2009) claims that restoration plantings store more carbon over time than monoculture plantations.

Forest planning and development programmes may have to be altered to address the likely impacts of climate change and appropriately adopt various policy and management practices to minimize the adverse impacts and vulnerability. Adaptation strategies are also needed to ensure a proper balance between demand and supply of forest products (Ravindranath N. et al., 2006). In this scenario efforts should be made to stabilize the vulnerable miscellaneous forests through restoration plantations and assisted natural regeneration. The area under the evergreen, semi-evergreen and mangrove forests should be increased and proper measures and activities should be initiated in this direction. It requires not only funds and raw materials but also the change in the attitude and capacity building of all the stakeholders associated with it.

There is no gainsaying that the forest department (FD) is all powerful but the fact is that FD is not as powerful as the economic and the development sector. Hence, succumbs to the demands of the development sector which seldom considers the well being of the natural resources and rural livelihoods. Moreover, FD is beset with the limitation of funds, manpower, lack of knowledge on the complex ecosystem dynamics of forest ecology, and reservations against recognizing and accepting local communities as equal partners in conservation, thereby, either ignoring their customary rights or being insensitive to their subsistence needs has made the FD all the more emaciated. Hence, it is now necessary to

reorient the strategies of forest and biodiversity conservation. For instance, a person who lives all his life in the forest is more linked to the forest and its surroundings both emotionally and culturally than a forester who is deputed to work in that particular area for a couple of years. Thus, the values, choices and interests should be taken into account while designing and developing forest and biodiversity conservation projects.

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Till the community members were the only managers of forest, our forest resources were quite safe. They remained bio-diverse rich and lent balance to the ecology. As forest resources were needed to be used and abused for so called 'development' of 'civilised' people, gradually those forest managing communities were forced alienated from the forest land, forest resource or forest management. Other non-direct stakeholders, including government, yielded more power in management and harvest of the forest resources. It had catastrophic repercussions on the forest resources as they started degrading fast and furious. Though the communities themselves resented, their resentment was often mute and thus remained unheard or ignored.

Soon, climate change started engulfing the whole world. All became affected and vulnerable. All saw a threat. In such circumstances attention has again come towards the forest resources as it plays a big role in enhancing and mitigating climate change and its impacts. Interest groups have started evincing more keenness in protecting forest as a tool to mitigate climate change. It brings in a scope to seize initiatives. We have solid experiences that sustainable forest management is possible only when the direct stakeholders - forest dwelling and forest dependent communities – are the managers of it.

This book contains papers that capture the impact of climate change on forest and bio-diversity; and the experiences of community forest management. This volume will be a valuable reading for all those associated with forest and bio-diversity management, particularly those working on community and forests. It will be of interest to policy makers, administrators, NGOs and other organisations.

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