Achieving sustainable development through leveraging international environmental legislations for reducing emissions from deforestation and forest degradation (REDD) in India

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Abstract:

In most of the developing countries in the South, poverty and environmental problems are intricately linked. In India, the poverty-stricken areas coincide with the natural forest areas, in which more than 400 million people derive livelihood benefits from forests. Rural communities derive a number of benefits (including forest products and services) from forests. The tangible benefits from the forests include several non-wood forest products (including gums, resins, fruits, medicinal plants, etc). The intangible benefits (ecosystem services) from forests include: reducing climate change due to carbon sequestration by forest trees, soil and water conservation, biodiversity conservation etc. But due to lack of awareness of sustainability practices, anthropogenic activities of communities often causes forest degradation and deforestation, which in turn causes irregularities in monsoon patterns, leading to bad crops, decreased agricultural production and food scarcity. Before the 1990s, the over-dependence of rural and indigenous communities exclusively on forest resources for their livelihoods, hampered the sustainability of forests, and as a result, has been causing increasing impacts on forests in terms of deforestation and forest degradation.

For remediating these problems, the sustainable forestry principles were adopted by global community immediately after the UNCED (1992). As a result of this landmark environmental legislation, several international initiatives for managing the global forests in a sustainable manner were launched by a number of countries. In India, immediately after adoption of the Joint Forest Management Resolution (in 1990), communities have been following an adaptive co-management model, in which they have been jointly managing the forests in partnership with forest departments. After the adoption of this resolution, a number of projects aimed at sustainable forest management and for reducing emissions from deforestation and forest degradation were launched in India. These were mainly aimed at improving the forest management scenario and ensuring food security, and were funded by international donor agencies.

The present research explores the opportunities of leveraging international environmental legislations for reducing emissions from deforestation and forest degradation (REDD) in India. Using focused interviews (administered to researchers and departmental officials), and field research questionnaires, the paper tries to map the impacts of international legislations for achieving sustainable forest management and ensuring food security in the central Indian state of Madhya Pradesh. These analytical learnings may prove of import to concerned stakeholders and decision-makers in the North and South, who may upscale and utilize the learnings for suitable adaptation in other parts of the world.

Key words: food security, international legislations, sustainable development, forest management and REDD

1.1 Introduction

Most developing countries (including India) face the problem of balancing developmental imperatives alongside optimisation of existing natural so that the levels of acute poverty could be reduced and environmental problems could be resolved amicably. The veracity of anthropogenic climate change has been proved time and again, and is now a 'real and present danger' for whole of humanity. There have been several initiatives for combating climate change, using mitigation and adaptation methodologies, and the most successful among them has been the UNFCCC and the adoption of the Kyoto Protocol by 184 countries (by October 2009). According to the UNFCCC the central objective of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for taking concrete steps which would result in reducing their greenhouse gas (GHG) emissions. These amount to an average of 5 % against 1990 levels over the five-year (current) period of 2008 to 2012. All these countries have agreed to reduce their CO2 emission levels on a mutually agreed (and sometimes contested) levels, and have also started actions to adapt their economies towards making it more carbon friendly. But eventually, the Kyoto Protocol is going to expire in 2012 and the followup agreement (i.e. beyond Kyoto Protocol year 2012) is being finalised and will be the central topic of discussion and debate during the Conference of Parties meeting in Copenhagen in December 2009.

The major hurdle which is being faced by developing countries is the issue of lack of appropriate technological and financial resources for adapting to carbon neutral economies. Although the developing countries lack the necessary financial and technological capital, they do possess huge reserviors of natural resources. These could be leveraged for combating climate change. As we know, that the latest arrangement on REDD (i.e. Reducing Emission from Deforestation and Forest Degradation), claims to resolve the imminent dilemma of achieving equity between developing and developed nations towards their efforts of climate change mitigation.

1.2 Background

The REDD program of the UN was primarily formed to assist forested and nature-rich developing countries and the international community to gain experience with REDD and thereby contribute to the UNFCCC post-2012 process, and to assess how the

REDD payments can create the becessary incentives for ensuring the actual, lasting, achievable, reliable and measurable emission reductions, while benefiting the poor people and maintaining other ecosystem services forests provide.

Thus the REDD program assists in resolving some of the challenges of governance of international relations and achieving sustainable development leveraging the available natural resources. It also provides for several financial mechanisms for poverty reduction and resolution of environmental problems through implementing global governance interventions for forests. It claims to be an efficient mechanism for ensuring equitable and secure access to natural resources without jeopardizing their sustainable management by the poor communities in developing countries.

At COP 13, held in Bali, Indonesia in December 2007, in adopting the decision known as the Bali Action Plan (see section 3.5), the concerned parties agreed to consider the policies and incentives for appreciating REDD and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (para 1(b)(iii), UN Doc FCCC/CP/2007/L.7/Rev.1).

1.3 Outline of paper in light of REDD

Currently, the REDD has chosen total nine countries, viz: 3 countries in Africa (Democratic Republic of the Congo, Tanzania, Zambia), 3 countries in Asia & Pacific(viz. Indonesia, Papua New Guinea, Vietnam), and 3 countries in Latin America & Caribbean (Bolivia, Panama, Paraguay) as pilot countries for its implementaion and testing of REDD program.

The present paper tries to explore the possibilities of implementing the REDD program in India in the post-2012 regime of the Kyoto protocol. In India majority of forest resources function as life-support systems for nearly 400 million (Jadhav, 2003) poor people and also act as safety nets. These people use their forest resources for meeting their daily needs of food, fuel and fodder, and a host of other ecosystem services. But inspite of heavy dependence of people on forests the forest resources in many of these forest patches, are used in a sustainable manner due to certain indigenous forestry practices that have been in practice in villages in Central India sincetime immemorial. These indigenous forest management practices as followed by

the forest fringe communities reduce the extraction and dependency load on forests and thus help better management of forest carbon. These practices could be possibly tested as one of the candidate methodologies / mechanisms under the UN-REDD program and leveraged for benefiting the indigenous communities, so that they could be suitably compensated for their efforts of saving and conserving the forests, and thus assisting in the fight against climate change.

Taking a case study of forest resource utilisation pattern of the villagers of a forest fringe village in central India, the paper tries to analyse the current scenario of their dependency needs and highlights some lessons that may prove to be of import to the scientific community.

2. Positioning Indian forests as a viable candidate for REDD

Indian tropical forests (and most other forests in the tropical belt) have a stark uniqueness as regards their resilience to natural changes and also due to their unique location on the planet. They receive the maximum insolation and exhibit complex and intricately interdependent survival systems. Due to the biodiversity, they are also valuable sources of genebanks. The tropical forests in central India are characterised by mixed dry deciduous forests that harbour miscellaneous species that bear peculiar seasonality in terms of regeneration potential. They are mainly dependent on the monsoons for flowering and fruiting. Even though there is a conspicuous absence of huge trees like the *Sequoias* and the red pines (like in the US), these forests have a variety of species that yield seasonally viable non-wood forest produce (NWFPs) like: fruits, flowers, fibres, fodder, barks, seeds, gums and resins, dyes, etc. These NWFPs are a valuable source of sustenance for a majority of people living in and around the public forests in Central India (esp. Madhya Pradesh). More than 400 million people (mostly tribal, rural and indigenous communities) are thought to be benefitted suitably from these forest resources (Jadhav, 2003).

But due to heavy population pressures on the existing forests, and their unsustainable harvesting practices, the tropical forest resource base in central India was continually showing a depleting trend. The phenomenon of unsustainable harvest of NWFPs used to set in a chain of events of leading eventually to progressive forest degradation and a steady loss of carbon from the forests. But there are certain indigenous forestry

practices that have been in practice in forest villages in central India. These indigenous forest (carbon) management practices as followed by the forest fringe communities reduce the dependency load on the forests and thus help better management of forest carbon. The management and governance of the forests based on the practices are helping to reduce poverty and mitigate intricate environmental problems like climate change. The global program of REDD could help these communities to suitably inculcate the indigenous practices into mainstream carbon management strategies & methodologies, and achieve the goal of food security for the poor, in tandem with achieving environmentally sustainable development.

3. Necessity for managing carbon

The amount of carbon in the form of carbon-di-oxide has been increasing all over the world at an alarming rate. CO2 is emitted from anthropogenic activities like manufacturing units, automobile exhaust, rapid rates of deforestation and many other natural sources as well. The increase in the percentage of CO2 and other green-house gases in the atmosphere are responsible for the abrupt changes in atmospheric weather patterns, irregular bouts of droughts, floods, unpredictable storms and hurricanes and many more incidences of catastrophic proportions.

This makes it necessary to reduce the amount of green house gases (of which carbon dioxide constitutes a major component) by way of carbon sequestration. Carbon sequestration can be broadly thought of as the capture and storage of carbon (or its compounds). It aims to keep carbon emissions from reaching the atmosphere by capturing and diverting them to storage, or to remove carbon from the atmosphere by various techniques. It can be achieved by three broadly definable methods viz:

- Terrestrial methods
- Geological methods
- Advanced chemical and biological methods

4. Status of forests in India and its REDD potential

Capture of carbon through forest ecosystem is one of the terrestrial methods of carbon management. The case of carbon sequestration and management in India is of strategic significance due to the critical role of forests in the lives of the people and

the rural economies. Land is a limiting factor in an agrarian country like India. About 72.2% of the population in India is dependent on agriculture and forests and live in rural areas that are in or around forests (Census, 2001). India has signed international treaties and conventions that singularly indicate to speed up actions to either reduce the green house gas emissions or take up immediate measures to reduce those in atmosphere. The process of replacement of obsolete technology being extremely complex and capital intensive, it would be economically infeasible for India to invest in these technologies on a national scale. Thus a viable alternative is urgently needed that would strike a balance between optimising costs, increasing efficiency and create effectiveness. Hence it is necessary to look towards terrestrial methods for carbon sequestration in India and these include raising and protecting forests and their management through people's participation. These activities involve lesser costs, are labour intensive, and are suitable for India's socio-economic situation.

In order to meet these protocols, India has taken concrete steps through activities related to conservation and protection of existing forests. The protected area network in India comprises of about 88 national parks, 490 wildlife sanctuaries and is spread over 15.3 million hectares. Twelve biosphere reserves have been set up to protect representative ecosystems. Management plans are being implemented for 20 wetlands with coral reefs and mangroves being given a priority. The National Afforestation and Eco-development Board is responsible for regenerating degraded forestland, land adjoining forests and ecologically fragile areas. All these initiatives are ample proof that India's contribution towards mitigating the GHGs (green house gases) especially CO2 are on par with any other nation. This makes it a suitable candidate for implementing REDD assisted projects in post 2012 climate regime.

4.1 Potential of community managed forests for carbon management

Before going to the conceptual analysis, it would be worthwhile to assess the forest situation in India and role of forests in carbon management. The State of Forest Report published by Forest Survey of India (FSI, 1997) estimated the recorded forest area of the country to be 76.52 million ha, whereas the actual forest cover is estimated to be 63.33 million ha, which constitutes 19.27% of the country's geographical area. The growing stock of forests is estimated to be about 4740 million cubic metres with an average volume of 74.42 cubic metres per hectare. The total annual increment of

the growing stock is estimated to be 87.62 million cubic metres (FSI 1997). The dense forests (crown density above 40%) constitutes only about 11.17% (showing an increasing trend) and forests with more than 70% crown density exist only over 6% of the country's land mass. Forest cover is a direct indicator of the existence of a viable carbon sink mechanism in the country.

4.2 Forest cover in indigenous areas

It is interesting to note that the total forest cover in the tribal districts (areas dominated by indigenous people) as per the 1997 assessment of Forest Survey of India is 41.72 million ha, which constitutes about 65.86% of the total forest cover of the country. This constitutes a major chunk of the nation's forested land. This fact is ample proof that in places where indigenous people are jointly managing the forests the forest cover is of a superior quality. This in turn provides lessons for studying the basis of better forestry practices in these areas leading to sustainable forest management and resulting in better carbon management.

It is known that hardwood species contain around 48% of carbon in the form of cellulose and wood and other carbonaceous compounds, and it is estimated that 2.2 tonnes of dry wood is needed to sequester one tonne of carbon (Chaturvedi, 1994). When the wood is combusted, the contrary process begins in which the atmospheric oxygen (O2) is used and CO_2 is released into the atmosphere. Thus, the forests act as a source as well as sink for carbon, depending on the manner and purpose for which they are reared and taken care (Chaturvedi, 1994). But growth rate and carbon sequestration capacity of forest declines towards plant maturity stages. In mature forests, growth rate is largely offset by wood decay (Chaturvedi, 1994) and this affects the carbon sequestration potential. Mature and climax forests are neither good sources nor sinks of atmospheric carbon (Dabas and Bhatia, 1996). It is estimated that forests that experience a net loss of biomass volume through mortality due to disease or fire become net carbon emitters (Kyrklund, 1990).

4.3 India's policy environment for forest management

The forests in India are managed by a hierarchical bureaucracy controlled by the state governments. The administration of these forests is carried out in a systematic and manner through a series of national forest policies and working plan documents. The

most recent National Forest Policy of India 1988 treats forests, broadly under three heads:

1. as an ecological entity,
2. as a source of goods and services for use by local populations, with particular emphasis on non-wood forest products,
3. as a source of wood and other products for industries and other non-local users.

The policy prescribes people's participation in the management of forest resources as a means of achieving the above-mentioned objectives thus providing a sustainable system of management on government and common land.

4.4 Role of joint forest management (JFM)

The framework of JFM is an eventual outcome of the realisation that active and willing participation of the indigenous rural communities is necessary for any forest management and regeneration programme to succeed. The early experiments with JFM approach were started in the states of West Bengal and Haryana in the 1970s by the local forestry officials who saw the futility of trying to keep people out of forests by using coercive measures such as fines and arrests, and envisaged a greater effectiveness if the communities were involved in management of forests. Drawing lessons from the success, the first ever resolution on Joint Forest Management (JFM) to institutionalise people's participation and encourage people's involvement in mainstream forest management was framed in the year 1990 through a government resolution and was made applicable to the country's forests. As a result 27 states in the country have endeavoured to achieve the JFM policy objectives by formulating location specific guidelines and plans, which have resulted in adoption of JFM by 27 Indian states covering an area of over 17 M ha and is being managed by more than 84,000 JFM committees (Ravindranath & Sudha, 2004). The maximum number of JFM committees and area under JFM programme is in Madhya Pradesh (the number of JFM committees being 12038 and the area being 5.8 million hectares). The village Mathar, the study site under consideration is located in the state of Madhya Pradesh. Here it becomes necessary to study the structure function and mandate of a JFMC.

4.4.1 Categorisation of JFMCs

The JFMCs have a stipulated mandate along with a set of rights and duties to perform. They are allotted a forest area by the forest department nearing their habitation (village) and depending on the status of the village the committees are categorised as follows:

- → Village Forest Committees (VFCs) i.e committees constituted in/nearing revenue villages canopy density of less that 40%
- → Forest Protection Committees (FPCs) i.e committees constituted in forest villages who have villages canopy density of 40 – 80 % and
- → Eco-Development Committees (EDCs) i.e committees constituted in protected areas (viz: national parks, sanctuaries, biosphere reserves etc.).

4.4.2 Constitution of JFMCs

The composition of these committees is based on the population and social structure of the village. It is ensured that representation from all the social and economic classes of the village is considered. As a whole all the families of the village comprise the pool of members with at least two representative adult members (viz: husband and wife) from each family. The executive committee and its office bearers are elected from this pool of members. The committee looks after the activities of the JFMC for a period of one year till the new one gets elected. The committee consists of a chairman, a treasurer and a secretary who is often a field forester from the forest department (usually a beat guard).

4.4.3 Forest resources dependency pattern

The JFMCs are directed to plan their activities and document the same in the form of a site specific micro plan. This microplan serves as a guiding document for the activities of the committee throughout the year of its functioning. They are also entrusted the task of having at least one meeting in a month and discuss their previous month's activities and chart a plan of action for the coming month/s.

In order to carry out the activities each JFMC receives a fixed sum of money from the state government as a JFMC corpus fund each year which is used for carrying out the day-to-day activities of protection of forests and meeting eventualities if any. These

activities include fire fighting, night watchmanship, weeding, guarding the ANR (Assisted Natural Regeneration) sites, occasional soil working etc. In return the members get privileges of the facility of *Nistar*. This is a facility, which allows the villagers to extract one headload of dead, dying or diseased trees or woody material from the allotted forest. The seasonal flowers, fruits, seeds, medicinal plants, grasses, honey etc. are allowed for self- consumption purposes. Controlled grazing of cattle in marked semi-degraded forests is also allowed with the issue of a permit pass from the concerned forest division.

5. Materials and methods

5.1 Sampling and selection of study site

The study is based on a resource economics and utilisation pattern survey of the village named Mathar situated in Delabadi range in the state of Madhya Pradesh. The village is located in Ratapani Wildlife sanctuary. The village was selected for the present study due to strategic reasons like representativeness of the forest area, degree of people's participation in forest protection and management, use pattern of the forest resources by the villagers and ease of accessibility by road. The village has an Eco-Development Committee, and is situated in Delabadi Forest Range in Obedullahganj Forest Division.

The study tries to prove the paradigm that forest management practised through people's participation in a developing country like India, can contribute to sustainable forest management and hence efficient carbon sequestration. It drives home the idea where local forestry practices prove to be a potent tool to capture carbon due the existence of a favourable policy environment, local forestry initiatives and motivation of people towards sustainable forest management.

5.2 Tools used

In order to gather the requisite information, household survey method was adopted. In this survey the sampling intensity was 10%. The information was collected through an open-ended village level questionnaire conducted in the area in January 2002. The tools of participatory rural appraisal (PRA), focused group discussions (FGD) and time line method were used to collect information. Since a sanctuary comes under the category of a protected area, no extraction of commercial/bulk timber is allowed and strict measures and laws exist in India in this regard. Hence one can expect to witness

the net change in biomass in the forests over a period of time. This net increase (or decrease) in biomass is directly proportional to the carbon capture capacity of the forests and can be monitored from time to time. Additionally the people in the village follow indigenous forest management practices, which result in the conservation of the forest trees and contribute substantially to the total carbon sequestered through the forest trees. Convenience sampling was resorted wherever no other alternative was available.

5.3 Location of the site

As discussed earlier the village Mathar is located in the Delabadi forest range, which is a part of Ratapani wildlife sanctuary in Madhya Pradesh State. Ratapani wild life sanctuary is situated partly in the districts of Raisen and Sehore and comes under the jurisdiction of Obedullahganj Forest Division located in the heart of the state of Madhya Pradesh. The area being a sanctuary is managed under a management plan that is currently under revision. Ratapani is located on 77 deg 31' 32" and 78 deg 4' 3" east longitude and 23 deg 6' 17" and 22 deg 49' 47" north latitude.

5.4 Climatic conditions

The climate in the region is hot, damp and dry. The mean daily temperature is 25.2^{o}C (with mean daily max of 31.6^{o} C and mean daily min 18.7^{o} C). The highest temperature ever recorded in the forest division was 45.6^{o} C and the lowest was 1.7^{o} C. The rainfall in the area has a range from 1066.5 to 1273.3 mm and the annual mean rainfall is 1171.7 mm. Most of the rains are received in the monsoons (70%) and there are occasional rains in winter months (3.6%)

5.5 Resource use pattern

The total forest area allotted to the Eco development Committee (EDC) of Mathar for protection is 4684.541 ha over which the villagers have usufruct rights. The forests in this area are of tropical dry deciduous teak type. The major crop is teak (Tectona grandis) though associates of teak and bamboos are occasionally found in patches.

5.5.1 Woody resources

The village is situated in the immediate vicinity of the forest area and the resource use pattern bears intimate relationship with the forest ecosystem. The average number of

individuals per family in the village is 7-8. Most of the people are tribals and depend on agriculture for sustenance. (the table related to demographic information is attached separately)

Most the houses in the village (85 %) are made of woody material like bamboos, with grass thatched roofs and have medium sized timber poles (15 cm girth). The average yearly requirement of timber for house construction and repair purposes per household is about 30 kg dry weight of timber. The people use firewood for cooking fuel. It is either extracted from forests or from individual agricultural fields. The average annual requirement of fuelwood per family (of eight people) is 12 cartloads (roughly equivalent to 18 tons).

Besides the forests, trees are also grown around households and agricultural fields who provide small timber, fruit and fodder. These include many timber/fodder tree species some of which are: Azadirachta indica, Leucenia leucocephala, Zizyphus jujuba, Cassia fistula, Acacia arabica, and fruiting trees like Mangifera indica, Syzygium cumini, Psidium guava, Jackfruit etc. Apart from these certain bushy vegetation and shrubs like Prosopis juliflora, Lantana kamara and agricultural waste are also used as fuel for cooking purposes.

5.5.2 Non-wood resources

The villagers extract seasonal fruits, leaves and flowers from the allotted forest area. These include fruits of Aonla (Emblica officinalis) Chironji (Buchnania lanjan), flowers and seeds of Mahua (Madhuca indica), leaves of Tendu (Diospyros melanoxylon), medicinal plants like safed musali (Chlorophytum tuberosum) and a variety of grasses. Most of the NWFPs are used for self-consumption while some are sold in the nearby markets at Raisen and Obedullahganj. Tendu leaf (which is used for making a local cigar) is a nationalised product, and is not allowed for individual extraction but is accomplished through seasonal contractual labour employed by the forest department. This also supplements the income of the people. They are collected and auctioned by the government each year, and are the highest revenue earners for the forest department (in the year 1999 in Madhya Pradesh state the collection was 4 bn rupees). There are around 2230 cattle-heads in the village. (these include buffaloes, cows, calves, and bullocks). About 80% of the villagers take their cattle to the jungle

for grazing, the remaining 20 % either satisfy their needs through agricultural waste or by stall feeding. The average consumption of fresh grass per cattle per day comes to around 10-12 per kg, depending on its age as well as the type.

6. Indigenous forestry practices for assisting REDD

6.1 Sacred groves as carbon reservoirs

The majority of villagers belong to of tribal class and follow diverse traditional beliefs. They believe that the forests are an endowment of nature and they venerate it like god. According to them these forests are the embodiments of gods Shankar, Hanuman, etc. In memory of these gods the villagers have demarcated certain 'sacred groves' inside the forests. (It is estimated that in India, there are only about 1000 square kilometres of undisturbed sacred groves, scattered in patches all over the country). Only the groves in the remote and inaccessible areas remain untouched. While religious taboo protected the groves near towns earlier, today they are protected with the means of barbed wire fencing or hedges.

These sacred groves are believed to provide a range of material and non-material benefits to the village people. These beliefs include prosperity to the family who plants one tree a year, healthy life to the one who plants a pipal (Ficus bengalensis) tree, a happy married life to the one who plants a tamarind tree. Similarly there are many other beliefs for the other forest tree species like Terminalia bellerica, Terminalia chebula, Terminalia arjuna, Pterocarpus marsupium etc. As a result of these beliefs the trees are not harvested and are allowed to grow. The villagers even plant these trees around their households. The people in the village do not harm these trees and believe that whoever harms the trees he/she would be accursed.

6.2 Role of indigenous practices in forest carbon management

People practice the conservation of the trees out of a belief of veneration for the forests. These beliefs are in consonance with the JFM policy. A striking aspect to note is that the trees conserved by these villagers are mostly deciduous species. One of the most simple ways by which earth's deciduous forests help to slow global warming is to leaf out progressively earlier each spring and remain photosynthetically active increasingly later every fall. This gradual lengthening of the growing season allows trees to remove more carbon dioxide from the atmosphere every year; and this

phenomenon, in turn, reduces the annual rate of rise of the air's CO2, completing a negative feedback loop that slows the warming that originally set the whole process in motion. Thus the local forestry practices have a bearing on CO2 sequestration.

7. Utility of forest management practices for initiating REDD activities

The study site is composed of a variety of deciduous species. Among these mixed dry deciduous teak usually forming the major proportion of the crop on shallow porous or stiff-clayey soils. Characteristic species are Anogeissus latifolia, Diospyros tomentosa and other common dry deciduous trees. The main species are given below (as observed in the field):

Stratification of top and middle storey trees:

Tectona grandis, Anogeissus latifolia, Diospyros tomentosa, Pterocarpus marsupium, Terminalia tomentosa, Dalbergia paniculata, Boswellia serrata, Lagerstroemia parviflora, Albizzia adoratissima, Madhuca latifolia, Salmalia malabaricum, Terminalia belerica, Cassia fistula, Butea monosperma, Bridelia retusa, Wrightia tinctoria, Bauhinia racemosa, Emblica officinalis, Buchnania lanzan, Acacia catechu, Acacia leucophloea, Ougeinia dalbergeoides, Sterculia urens, Ficus retusa, Gardenia latifolia, Cordia myxa, Cochlospermum religiosum, etc.

In a parallel case of deciduous trees several aspects of the phenomenon of greater carbon sequestration (as compared to evergreen ones) were investigated in detail by White *et al*. (1999). In a study they utilized 88 years of data, spanning the period 1900 to 1987, that were obtained from twelve different locations within the eastern United States deciduous forests. In addition, they demonstrated that this relationship was linear over the entire mean annual air temperature range investigated, which stretched from 7 to 19°C and included growing seasons ranging in length from 150 to 210 days.

By means of scientific techniques the average rate of carbon sequestration can be calculated for a particular tree or species, over the course of its life. This is known as the mean annual carbon increment (MAIc). Carbon storage in a particular year may fall above or below this average, depending on the stage of the life cycle and other factors, which influence growth such as rainfall or temperature. The exact rate of carbon sequestration for a particular species of tree therefore depends on both the site

and the fluctuation in weather. The MAIc therefore accounts for variation in site and species, and uses an average of the climatic conditions.

8. Results and findings

8.1 Regeneration: Inspite of the pressures on the nation's forests, the forests in the tribal areas of India show a sustainable and growing trend. During the regeneration survey in the study site the natural regeneration of forestry species was found out to be good (1413 seedlings per hectare) which is far above the average natural regeneration status of the forests in Madhya Pradesh.

8.2 Biomass: The amount of grass harvested by each family per day was found out to be equal to 25 kg. The average canopy density in the allotted forests is nearly 65%. Thus the people of the village due to their indigenous belief systems are able to manage forest carbon by virtue of their traditional beliefs and local traditions.

8.3 Household trees (domestic sequestration): People plant trees around their households as well. These trees (i.e trees outside forests, TOFs) yield valuable small timber, fuelwood and fruits. Around 10% of the total wood demand is met from these trees. These also contribute considerably towards carbon sequestration.

8.4 Sacred groves: People in the site venerate a variety of trees. From the field observations it was noticed that the total quantity and quality of these venerated trees has been showing an increasing trend. These trees are not harvested and are given social and religious protection. This in turn supplements the total amount of carbon captured in the area. The beliefs and traditions linked with these trees are also responsible for mitigating conflicts in the village and contribute to the social well being of the villagers.

8.5 Suitability for REDD activities: All these criteria make the sacred groves a befitting case for introducing projects and activities of global environmental governance through the REDD framework. Under this program the perspectives of local and Indigenous Peoples are also taken care of. This is because the UN Declaration on the Rights of Indigenous Peoples forms the basis for the UN's work on these REDD issues. Earlier, initial consultations with Indigenous Peoples on plans for

implementing the UN-REDD Programme were held throughout 2008 during various international meetings and conferences. The REDD Programme will also continue to engage with civil society and indigenous people through a series of global and regional and national consultation workshops.

8.6 Policy integration of indigenous people and their practices: Integrating the efforts of indigenous practices (like sacred groves, venerated lands and similar cultural landscapes) for carbon management can be greatly benefitted from the REDD framework. Indian forests are extremely rich in biodiversity and provide important ecosystem services such as food, fibre and water regulation. In addition to its role in reducing greenhouse gas emissions, REDD provides the opportunity to safeguard these other forest values and services. The UN's REDD Programme recognises the importance of gaining multiple benefits from REDD, and has developed an approach to support countries in their efforts to integrate multi-functionality of forests into their REDD planning. Since UN-REDD is presently building on existing experience, and working with relevant partners and stakeholders, they are also planning to step up the work to promote understanding of the potential for achieving multiple benefits, and to provide tools and guidance to assist decision-making that will deliver these benefits through the implementation of REDD activities.

9. Conclusions

Terrestrial carbon sequestration by forests in a developing country is possible only through people's participation. The impact and the quantification of these processes scientific disciplines may later confirm the veracity of the outcomes and quantify the same. Indigenous people (grassroots level stakeholders) are a part and parcel of the forest environment. In any initiative towards forest management and conservation in a developing country, people's views and participation go a long way in achieving the desired goals. Forests are a major reservoir of goods and services. These include various environmental services as well. The people living in and around the forests may not be conversant with the latest technologies and jargons of the scientific community but are extremely sensitive to the sustainability of forests and their local beliefs and traditions have blended in such a way that they are able to conserve them. These concerns for the forests have become a part and parcel of their traditional belief

systems and are expressed by means of veneration of the forests and its constituents and in doing so they also help in raising and preserving more and more carbon sinks.

It is for the international scientific community (assisted by pilot projects funded by donors and UN) to conduct detailed and extensive studies on mapping the existing forest management practices of these people, understand their perspective of the forests and related traditions and quantify the associated impacts. Project based interventions would produce better and reliable information , and time-tested methodologies would improve the estimations.

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