Carbon for Forest-Dependant Communities: Developing a Case for Nellore Forest Division

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Introduction

In the context of climate change, forests are unique in that they are both a source and a sink of carbon dioxide, the most abundant greenhouse gas. In the quest for reducing the carbon dioxide concentration in the atmosphere to combat climate change, reducing deforestation and degradation, and increasing carbon sequestration through afforestation and reforestation are considered very pertinent. In addition to providing timber, fibre and bioenergy, forestry activities also provide the added co-benefits of environmental services such as soil and water conservation and biodiversity conservation. A majority of forest-dependant communities derive sustenance and livelihood benefits from the forests.

It is important to diversify the livelihood base of forest dependent communities and at the same time strengthening the incentives provided to them in *lieu of* their efforts in protecting and managing forests. Revenue from the sale of carbon credits, in both mandatory and voluntary markets, is an important, additional step in this direction. The following sections describes, the efforts by Andhra Pradesh Forest Department in co-managing the forests in collaboration with forest dependent communities through Andhra Pradesh Community Forestry (APCFM) Project, and builds a case for linking forest dependant communities to the existing carbon markets. An existing plantation project in Nellore district has been assessed for its carbon sequestration (GHG removal) potential and possible sale of carbon credits in voluntary market. This is followed by a description of a potential institutional mechanism for trading and channeling the benefits to the communities.

APCFM Project

The Andhra Pradhesh Forest Department launched the Andhra Pradesh Community Forest Management Project (APCFM) with the objective "*to reduce rural poverty through improved forest management with community participation*". This was to be achieved by evolving the existing system of participatory forest management whereby poor, forest-dependent communities generate incomes from the development and maintenance of forest productivity in areas placed under their stewardship.

The core principle in achieving this objective is the empowerment and improving capacity of impoverished forest fringe communities to fully undertake enhanced management and protection of adjacent forests. The adoption of CFM under the project represents an advance over the concept of JFM followed in the APFP. Communities will be empowered to become more autonomous and self-reliant regarding the management of forest resources assigned to them. Under JFM, the APFD took lead on both forest planning and forest-related decision making. Under CFM, the Forest Department acts more as a facilitator, regulator, and provider of technical support, while the community takes the lead in forest planning and decision making, subject to conservation and sustainable management regulations, National Forest Policy and guidelines imposed by APFD.

All benefits flow to communities and usufruct shift to community control. The state's policy is to provide 100% benefit accruing from harvest of NTFPs and growth of various wood products to the communities. The communities have the harvesting and selling rights of the above commodities

under the overall regulation of the existing forest laws. While the communities have the option to utilize the above produce to meet their domestic needs and market the surplus, they are required to set apart a portion of the sale proceeds and recycle it for forest development.

In addition, the communities are also entitled to a 50% share in the amount of penalty levied and realized from those involved in commission of forest offences, as a measure of incentive to encourage their participation in forest protection.

The project focuses geographically on districts with significant forest areas and high concentrations of poor forest fringe households. The project targets vulnerable groups (women, scheduled tribes and castes, migrant herders and landless) who would benefit from the enhanced forest asset base being developed and managed by communities under the project.

The project objective will be achieved through the implementation of three inter-linked components of (i) Creating enabling environment for CFM, (ii) Forest management and (iii) Community development. The APFP and GoAP's own initiatives and investments in JFM, have initiated the establishment of a solid village institutional base for protection and management of forest areas in the form of Vana Samrakshana Samithies (VSS).

Eucalyptus clonal plantations under APCFM project

The forest cover of Andhra Pradesh is around 4 million ha (which is around 16% of its geographical area) (State of Forest Report 2005. 2008). A sizable extent of forests in Andhra Pradesh are degraded without any valuable or desired species that can be supported and encouraged. In some cases such forests have degraded to the extent of attaining the status of scrub vegetation. The causes of such acute degradation are many. Biotic factors in the form of grazing pressure, removal of firewood for domestic use and annual fires and resultant non-establishment of regeneration are some of the causes that have led to this massive denudation. These forests are also associated with rain shadow regions and consequently have predominantly xerophytic vegetation. The forests in Nellore and parts of Chittoor districts covered under the project are of this type.

Under the APCFM project, Eucalyptus clonal plantations have been raised in various districts of the state. In Nellore district, about 477 individual plantations covering various years of plantations under 137 VSS have been raised since 2003. The year wise plantation details are given in table 1

Table 1. Area wise Eucalyptus clonal plantations in Nellore District

Year of planting	Age of Plantation	Area (ha)
2003	5	394.97
2004	4	1197.25
2005	3	943.5
2006	2	984.5
2007	1	716.5
Total		4236.72

Source. APFD

These plantations are managed on a seven year rotation and coppice crops are raised after first and second rotation. After the third rotation (harvest), the area would be replanted with Eucalyptus or some other forest species; the area would continuously under forestry use. This provides an excellent opportunity to participate in the global carbon market to realize carbon credits for the forest-dependant communities.

Carbon markets and carbon credits

The carbon market can be compliance based such as the one created under Kyoto protocol or some voluntary market wherein companies/countries take up proactive steps out of their responsibility towards environment. The Kyoto protocol provides three mechanisms namely: Clean Development Mechanism (CDM), Joint Implementation (JI) and Emission Trading (ET) using which developed countries can meet their target. Of these, the CDM is the only one in which developing countries can participate.

The CDM has the dual objective of helping developing countries in achieving sustainable development and assisting developed countries in achieving compliance with their quantified emission limitation and reduction commitments. CDM activities have to be *'supplemental'* to domestic actions of developed countries.

Forestry and community-based projects have not been able to make a mark in the current CDM portfolio across the country. This phenomenon is mainly due to small scale and large number of independent developers involved that, makes monitoring and benefit sharing difficult. The transaction cost increases due to multiple location of monitoring. However with advent of voluntary carbon markets in India (such as the Chicago Climate Exchange) the possibility of taking up such kind of project will increase. Under the voluntary carbon markets the project developer need not face the stringent terms and condition of CDM. The norms are much softer but the price offered is also lower than the CDM market.

The Chicago Climate Exchange (CCX) is North America's only and the world's first legally binding, yet voluntary, multi sectoral, rule based and integrated greenhouse gas reduction and trading system. CCX members include corporations such as Ford, Dupont; utilities such as American Electric Power; universities such as University of Tuft and University of Minnesota; non-governmental organizations such as World Resources Institute and the Rocky Mountain Institute; cities like Chicago, Illinois and Oakland, California. CCX members make voluntary commitment to reduce GHG emissions by 1% per year from 2003-2006, for a total of 4%, below a baseline average of 1998-2001 and to further reduce up to 6% below baseline by 2010. A member who joins later than 2003 is also expected to reduce a total of 6% by 2010 with respect to its baseline emission levels. A member whose emissions exceed its commitment can reduce emissions directly, purchase emission allowances from other CCX members who are below their commitment targets, or purchase offsets from third parties. (Chicago Climate Exchange, 2008)

Forestry sector is one of the eight key areas under CCX .Eligible forestry offset projects include:

- Afforestation
- Managed forestry
- Carbon stored in long lived wood products

- Reduced emission from deforestation and degradation
- Urban tree planting

Under the Afforestation category, plantations raised on or after 1st Jan 1990 on unforested or degraded forestlands are eligible for carbon credits. Such projects can earn carbon offset benefits at a rate based on the annual increase in carbon stocks of above-ground during 2003-2010 over the baseline of the carbon pools as on 31 Dec 2002 or 31 Dec of the year preceding registration with CCX (Chicago Climate Exchange, 2008). Under this category no harvest is allowed during the contract period with CCX. In general, the innovation, flexibility and lower transaction costs associated with CCX carbon offset projects can benefit buyers as well as suppliers. Under the Managed forests category harvest is allowed and needs to be deducted from the carbon stock. For Managed projects, no land eligibility criteria have been mentioned. However, for the project mentioned, below the land eligibility has been assessed based on the criteria mentioned for Afforestation project.

Case study: Potential CCX project in Nellore district.[1]

Land eligibility
The land eligibility has been established based on satellite imagery for years 1988 and 1996.

Baseline carbon stock
As the project area had only scanty shrubby growth prior to plantations, for all practical purposes, the above ground carbon stock is assumed to be nil. Further, as the plantation activity started only in November/December, 2003, the baseline carbon stock as on December 31, 2002 is assumed to be minimal and therefore not considered for calculations.

Sampling strategy for estimating carbon sequestration under the project
For estimating the standing biomass, and subsequently the carbon store, stratified random sampling based on year of planting and soil type was employed. For soil information, soil type map developed by NBSS&LUP (National Bureau of Soil Survey & Land Use Planning) was used. Based on discussion with officials of NBSS&LUP, the traditional soil classes were merged into 8 classes. The soils in the plantation area were found to fall under four classes: red clayey soil, red loamy soil, black soil, and rocky and gravelly land/soils (table 2)

Table 2. Area under various strata

Age of Plantation	Black	Red Clayey	Red Loamy	Rocky And Gravelly	Total
1	123.5	442	122	29	716.5
2	171.5	556.5	200.5	56	984.5
3	208	550	116	69.5	943.5
4	258.25	682	150	107	1197.25
5	96.75	224.72	48.5	25	394.97
Total	858	2455.22	637	286.5	4236.72

[1] The project has not yet been submitted to CCX. The preliminary estimates given in this paper is subject to revision.

Quadrants of size 25 x 20m (500 sq.m) were randomly laid out. The minimum sample size was determined as per the criterion approved by CDM Executive Board (UNFCCC 2007). Following 10% level of precision and the 95% confidence level for standing biomass (t/ha), the minimum number of plots, and the number of plots actually laid down are given in table 3. However, a total of 112 plots where laid down to achieve a sampling intensity of 0.15%. A minimum a 3 plots were laid for each strata.

Table 3. Number of plots sampled

Stratum	Area (ha)	No. of required samples	Plots sampled
Black (2)	171.5	1	5
Red Clayey (2)	556.5	3	17
Red Loamy (2)	200.5	0.3	6
Rock Land (2)	56	1	3
Black (3)	208	1	6
Red Clayey (3)	550	3	17
Red Loamy (3)	116	1	3
Rock Land (3)	69.5	0.2	3
Black (4)	258.25	4	8
Red Clayey (4)	682	7	20
Red Loamy (4)	150	3	5
Rock Land (4)	107	1	3
Black (5)	96.75	1	3
Red Clayey (5)	224.72	4	7
Red Loamy (5)	48.5	1	3
Rock Land (5)	25	0.0	3
Total Area	**3520.22**	**33**	**112**

Note. The values shown in parenthesis in column one represent the age of plantation

In the laid down sample plots, GBH of all the trees were measured and the height of 25% of trees were recorded, starting from the first line.

Data Analysis

In order to estimate the crop height, Lorey's mean height equations were used and the mean height of a quadrat was used to calculate the standing biomass of a quadrats. The standing biomass was calculated using biomass equation developed for Eucalyptus hybrid by Ravindranath *et al* (1991):

$B = 9.109 + (162.6706 \times D^2H)$

Where

B = biomass in kgs

D = diameter in m

H = height in m

Carbon pools

As per the CCX guidelines for managed forestry projects, amongst the various carbon pools, only above ground biomass (AGB) and below ground biomass (BGB) are considered. For converting biomass into carbon, the default value of 0.5 as per IPCC Good Practice Guidance has been used. For estimating the GHG removals and the number of Verified Emission Reductions (VERs), TARAM (Version 1.2)[2] tool was used. The tool accounts for loss of carbon due to harvest, while estimating the net GHG removals

Estimates of Net GHG removals

The growth performance under various strata is summarized in table 4. As expected the growth performance (MAI and annual carbon increment) was found to be poor in rocky and gravelly soil compared to other classes.

Table 4. **Annual biomass and carbon increment under various project strata**

S. No.	Stratum	Biomass			Annual increment in terms of carbon (tC/ha/yr)	Annual increment in terms of CO_2 (tCO2/ha/yr)
		Average t/ha	MAI (t/ha/yr	Average MAI for soil type		
1	Black (2)	12.7	6.34	5.82	2.91	10.67
2	Black (3)	18.6	6.21			
3	Black (4)	24.5	6.13			
4	Black (5)	23.0	4.60			
5	Red Clayey (2)	12.9	6.45	5.80	2.90	10.62
6	Red Clayey (3)	14.7	4.89			
7	Red Clayey (4)	23.7	5.92			
8	Red Clayey (5)	29.6	5.92			
9	Red Loamy (2)	14.8	7.39	6.70	3.35	12.28
10	Red Loamy (3)	16.6	5.55			
11	Red Loamy (4)	24.3	6.07			
12	Red Loamy (5)	39.0	7.80			
13	Rock Land (2)	14.3	7.17	4.77	2.39	8.75
14	Rock Land (3)	11.9	3.95			
15	Rock Land (4)	19.2	4.79			
16	Rock Land (5)	15.9	3.17			

The result of this analysis, especially the average MAI for soil type, along with the area planted each year were the main inputs into the TARAM model. The net anthropogenic GHG removal by the project (after deducting harvest amount) for a 20 year period has been worked out using the tool and is given in table 5.

[2] TARAM -Tool for Afforestation and Reforestation Approved Methodologies Developed by BioCF and CATIE (see http://wbcarbonfinance.org/Router.cfm?Page=BioCF&FID=9708&ItemID=9708&ft=DocLib&CatalogID=40526- for latest version of the model)

Table 5. Net GHG removal by the project

Project year	Net GHG removals by project (tCO_2eq)
1	6,813
2	27,982
3	61,906
4	109,958
5	169,488
6	229,020
7	240,853
8	199,883
9	170,134
10	130,771
11	109,956
12	169,488
13	229,020
14	240,853
15	199,883
16	170,134
17	130,771
18	109,956
19	169,488
20	229,020

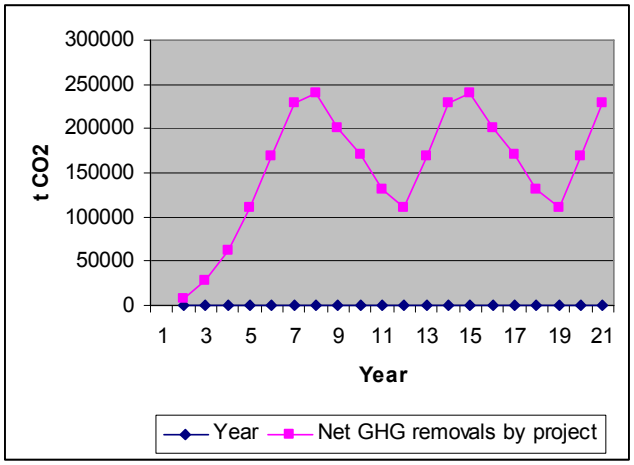

Figure 1. Net GHG removal by the project

A perusal of table 5 reveals that, the total GHG removals from 2003-2010 (year 1 to year 7) is 240,853 t CO_2 eq. The annual GHG removal, thus works out to 33408 t CO_2 eq. On the other hand, considering a contract period of 20 years with CCX, the net GHG removal at the end of 20 years is 229,020, which work out to 11451 t CO_2 eq per year. Depending upon the final approval of the two proposed pathways, the net annual GHG removals could be either 33408 t CO_2 eq or 11451 t CO_2 eq.

Expected revenue from sale of VERs

Revenue steams from the two probable scenarios are worked out (table 6).The calculations are based on a nominal value of USD 3.5 for a VER (tone of CO_2 eq). The total revenue for the 7 year period under Scenario 1(considering crediting period of 2003-07) comes to Rs 421 lakh, while total revenue for seven years under Scenario 2 (considering contract period of 20 years) works out to Rs 140 lakh.

Table 6. Projected revenue from sale of VERs

Scenario 1: Considering crediting period of 2003-07	
Annual GHG removals(t CO_2 eq)	34407
GHG removals from 2003-10 (t CO_2 eq)	240,853
Annual revenue (in Rs lakhs)	60
Total revenue for the period 2003-10 (in Rs lakhs)	421
Scenario 2: Considering contract period of 20 years	
Annual GHG removals(t CO_2 eq)	11451
GHG removals from 2003-10 (t CO_2 eq)	80,157
Annual revenue (in Rs lakhs)	20
Total revenue for the period 2003-10 (in Rs lakhs)	140

Note. USD 1= Rs 50

Transaction costs

Like any carbon project, trading under CCX platform also involves some transaction costs. The transaction costs in case of CCX projects include cost of registering as an aggregator (or payment to an existing aggregator), cost of trading in CCX platform and cost of validation. However, the cost of registering as an aggregator is a one-time investment and with this transaction can be made for other projects in other parts of Andhra Pradesh, thereby spreading this cost.

Institutional Mechanism

For trading on the CCX platform, one has to go through an Aggregator (an entity that serves as the administrative representative of multiple offset-generating projects and undertakes carbon trade on behalf of project proponents). In the present circumstances, APFD could either go through the registered Aggregators in India or register itself (or one of its associate organizations) as an Aggregator. The Centre for Forest and Natural Resources Management' (CEFNARM) under the Andhra Pradesh Forest Academy (APFA) is ideally poised to become a socially responsible link between the communities and the CCX, and act as an Aggregator.

At the field level, a two-tier structure is suggested for management of these plantations. The first tier consists of Vana Samrakshana Samithies (VSS) participating in the programme. The second tier consists of a federation of all the participating VSS at the divisional level, known as the Divisional Committee (DC). President of each participating VSS represents the respective VSS at the DC. The DC in turn would elect a Chairman for operational purpose (this has no legal validity at the moment). The DC will act as an interface between CEFNARM and participating VSS. They would be responsible for organizing participative monitoring of the carbon stock along with the local forest officers. The trading would be facilitated by CEFNARM.

The CEFNARM, as the Aggregator, will be responsible for undertaking all transactions on behalf of VSS at the CCX platform. For this purpose, the CEFNARM will have an MoU with the DC, clearly defining the terms of the business relationship between CEFNARM and DC/VSS. The business relationship would include CEFNARM retaining a certain amount (percentage) out the revenue from the sale of each VER for meeting their operational costs and for conducting monitoring and third party verification, capacity building of DC/VSS.

CEFNARM will be responsible for interaction with all third party organizations like project developers, project verifiers, institutes who can undertake capacity building activities, etc.

Conclusion

Carbon sequestration (GHG removal) is an environmental service performed by forests like other services such as biodiversity conservation and soil and water conservation. Forest-dependant communities play a very important role in protecting the forests, thus facilitating the flow of these services from the forests, and should be compensated for their efforts. Carbon revenue offers an opportunity for diversifying their livelihood base, and at the same time works as a compensation mechanism for the bigger global environmental service they are providing. However, in addition to developing technical-know how in developing project briefs and project development documents, what is required is a clear cut mechanism for distribution of benefits to the communities, on the lines of CFM mandate. If successful, the learning from this pioneering effort would go a long way in scaling up the activities at the state level or even at the national level.

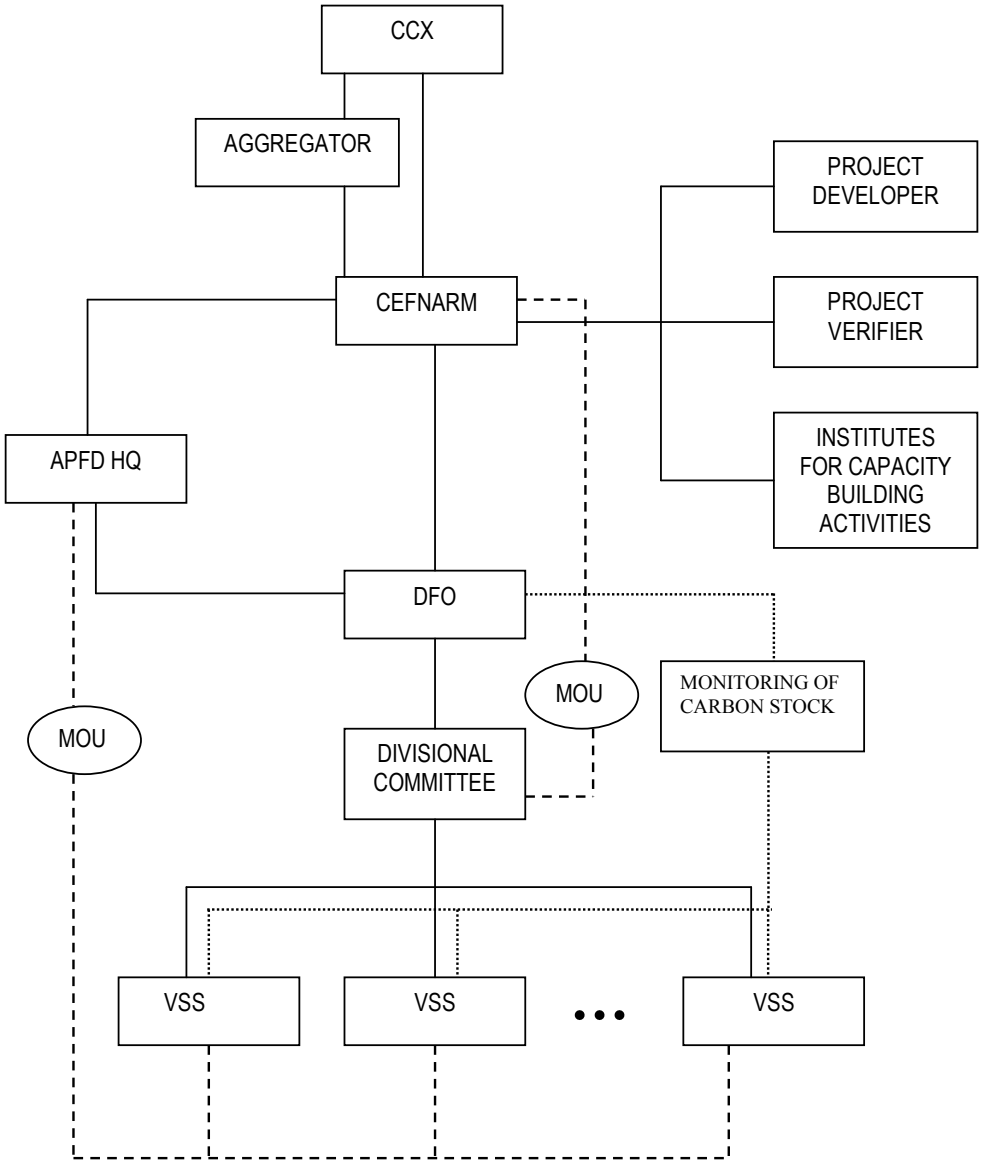

Figure 2. Institutional Structure

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