Assessing Cameroon REDD+ Potential through a Participatory Method: Case Study of Akak Community Forest

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Abstract
Opportunities to mitigate climate change through the reduction of emissions from deforestation and degradation, forest conservation, enhancement of carbon stocks and sustainable forest management (REDD+) in developing countries, have risen to the top of international climate policy agenda, attracting increasing attention and investment from environmental organizations, development assistance agencies and the business community. Cameroon as other COMIFAC country members is actively participating in REDD+ negotiations under the UN Framework Convention on Climate Change (UNFCCC) and is currently implementing not less than seven pilot projects which are planned around nearly all of the large forested National Parks in Cameroon, which represents over 7% of the forested land in the country. In this article, we evaluated REDD+ mechanism potential to effectively avoid carbon emissions and identify potential co-benefits for Akak community forest located near the Campo-Ma'an National Park in the South region. To do so, we used a Participatory Land Cover Change Mapping (PLCM) methodology with selected members in the community. This approach draws on local knowledge of the community forest, current patterns of forest resource use and information regarding how the community's choice are expected to affect forest cover to develop a credible baseline scenario. REDD+ policy scenarios developed in this paper indicates a potential of 83, 588.9 tC and 98, 690.9 tC of avoided carbon emissions for the most conservative scenario after 5 years and 10 years respectively of intervention.

1. Introduction

Addressing the importance of tropical forests and the value of developing countries participation in global climate change mitigation efforts, a Reducing of carbon Emissions from Deforestation and forest Degradation mechanism has been agreed under the UN Framework Convention on Climate Change in 2010. Covering more than 198 million hectares in six countries, the Congo Basin hosts the second-largest block of tropical forest after the Amazon including Cameroon's forests that "constitute the second most contiguous forest after the Amazonian forest in the world"(Topa et al., 2010). Representing 11% of the Congo Basin, Cameroon's forests cover 19,6 million hectares. This includes humid dense evergreen forests, humid dense semi-deciduous forests, gallery forests, swamp forests and mangroves. Since 2005, Cameroon along with other Congo Basin countries has been actively involved in the inception of REDD process in the UNFCCC climate debate: participations in COP meetings, submissions to SBSTA via the Commission of Central Africa Forests (COMIFAC) (Haeusler et al., 2010). Selected in the World Bank's Forest and Carbon Partnership Facility (FCPF), Cameroon submitted its concept note for national REDD readiness planning (known as a Readiness-Plan Idea Note – R-PIN) in June 2008. Its Readiness Plan Proposal (R-PP) has been recently accepted in FCPF's Participants Committee session last October in Brazzaville and planning to develop its REDD+ National Strategy. There are two ministries in Cameroon which are directly responsible for REDD policy-making and related issues. The Ministry of the Environment and Nature Protection (MINEP) is overseeing climate change issues, while the

Ministry of Forests and Wildlife (MINFOF) is responsible for protected areas and forests (Freudenthal et al., 2011). Nine pilot subnational projects are implemented around nearly all of the large forested national parks in the country. Located near one of these national parks (Campo-Ma'an Park) is the Akak community forest which covers 5,000 hectares of high biodiversity and which will be greatly modified in the future. Hence, in this paper, we evaluated REDD+ potential of this community forest and identified some possible co-benefits for its population by comparing a baseline scenario with two REDD+ policy scenarios through a participatory approach called Participatory Land Cover Change Mapping (PLCM).

2. Methods

2.1 The Community Forest

Created in 1999, the Akak community forest is situated in southern Cameroon, Campo District. It covers an area of 5,000 hectares divided in two fractions of which 55% is relative primary forest. In the past years, this community forest was subjected to sporadic logging operated by the company "Forestière de Campo". The community forest is experiencing heavy out-migration due to the closing of the company cited above, resulting in a population of only 250 inhabitants (Metse, 2009) Economic activities practiced here are logging, collecting of non-wood forest products, fishing, hunting and very limited agriculture activities7 (Figure 1).

2.2 Preparation

For the land-cover change scenario exercises, we firstly prepared all the necessary material for producing maps. This includes flip charts, base maps, transparent overlays, etc. Then, we selected community members to be involved in the mapping exercise. When determining these members, we ensured that they were knowledgeable about current patterns of forest resource use, how they are likely to affect forest cover and the community's future plans. Only 20 people including males and females whose views are important and credible in the community and representing all different age groups and community groups were picked up. Before starting the exercise, we presented the aim and the approach to the group. The first discussions were about the identification of current pattern of forest resource use and it was only after we produced forest resource use maps that the concept of identifying threats to forest cover and predicting future changes in land cover was introduced.

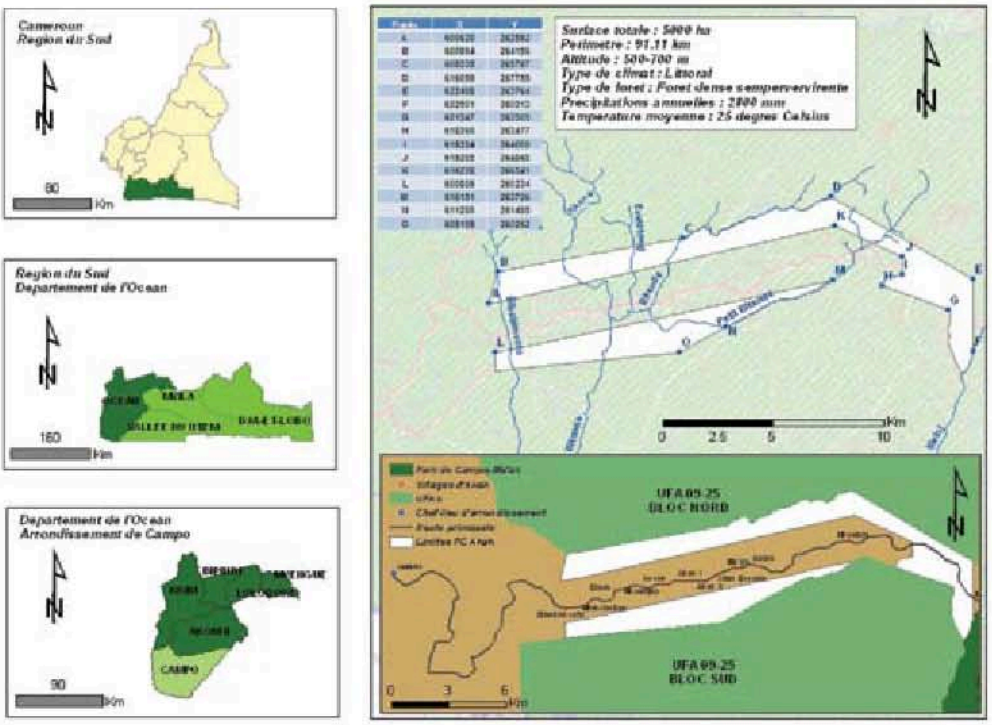

Figure 1: Location of the Akak community forest and GPS points used to delimit the boundary (UTM 32N)

2.3 Identification of Threats to Forest Cover

The selected members within the community established a list of actual and future planned forest resource use activities. To facilitate full participation and comprehension by local stakeholders, we represented each forest resource use activity cited by an icon, since the level of literacy was not the same among the 20 representatives from the community. After the activities had been listed and all the members agreed that the list was completed, they were asked to localize where these activities currently occur. Information collected here was later transferred and processed into a GIS in order to produce a map of forest resource use. A discussion was then initiated about the potential impacts of these activities on the forest cover. Stakeholders were then requested to draw on their experience of carrying out these activities and the changes on the forest cover they have observed in the past. In order to facilitate their task, we drew and explained them a graph (Figure2) presenting different levels of deforestation and forest degradation. The scale of this graph was also previously explained and the percentage of forest loss under each scenario defined. Final graph scale of a forest resource use activity was only accepted upon when there was a common consensus. Later, we classified forest resource use activities according to the intensity of their impacts on forest cover and the map showing the location of forest use activities was used to rank activities in terms of the extent to which they were practiced. We also considered potential external threats to forest cover and they were ranked separately.

2.4 Participatory land-Cover Change Mapping

In areas where the use of remote sensing, and modeling of future land-cover change scenarios is not feasible, and where local stakeholders interact closely with the forest, local knowledge of current and future threats to forest cover can contribute to clear and credible estimates of future land-cover scenarios. Participatory land-cover change mapping (PLCM) was carried out with the stakeholder group involved in the identification of threats to forest cover in Akak (Berry et al., 2010). Therefore, based on the experience and the ability of Akak community to make future previsions of forest resource use activities, we defined periods for land-cover change scenarios. A time period of 10 years and an intermediate period of 5 years were thus adopted. Then, participants guided by a facilitator, were requested to produce land-cover change maps depicting where the community is expecting to have undisturbed forest, disturbed forest, degraded forest, and deforested land for the periods adopted. Throughout this process, stakeholders were also requested to explain their categorization. The outcomes of this exercise are community's expected land-cover maps after 5 years and 10 years respectively. Digital versions were later produced using ArcGIS.

2.5 Calculation of Predicted Changes in Land Cover

To calculate the changes expected by the community in land cover, we first overlayed on the land cover map previously produced, maps depicting each of the land cover change scenarios. After that, areas of each land cover type affected by the land cover changes types (Figure 2) were calculated in ArcGIS. Finally, in order to get the change in carbon stocks associated with the land cover change type, we just altered the carbon stocks of each land cover type by an amount proportional to the expected loss or increase in carbon stocks.

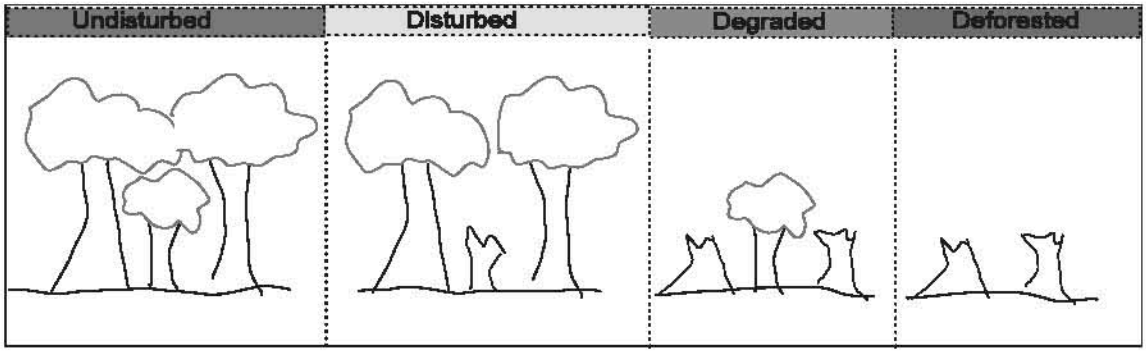

Figure 2: Graph depicting levels of deforestation and forest degradation used to identify impacts of forest resource use activities on forest cover. (Source: Berry N. et al. 2010)

3. Results

3.1 Akak Land Cover

The Akak community forest is divided into five land cover types. A relative primary forest called "Fut Afan" in Mvae language occupies more than 50% of the total land. Between the Fut Afan and the agroforestry zone is an area of secondary forest which extends to an area of 300 meters in width on the two fractions of the community forest. To the east, there are some clumps of bamboos and two permanently flooded forest areas. And, finally to the centre within the secondary forest, we have a new plantation created by an agro-industrial company.

3.2 Deforestation and Forest Degradation Drivers in Akak Community Forest

The Akak community firstly listed three main activities they are undertaken within their community forest (Figure 3) that are deforesting and degrading the forest cover. The perceived impacts of these activities on the forest cover are explained in the Table 1 below. The community also listed potential external threats to its forest like population growth due to development projects and timber companies. (Table 2)

3.3 Baseline and REDD+ Policy Scenarios

Among the most crucial issues of a new global 'reducing emissions from deforestation and forest degradation, forest conservation, carbon enhancement and sustainable forest management' (REDD+) regime is how to set appropriate baselines or reference levels from which to measure carbon benefits Unfortunately, up to date, there has not been a general agreed-upon 'formula' for how to set baseline scenarios (Angelsen, 2009 and Berry et al., 2010). A REDD "baseline" defines an expected, or business-as-usual, emission of carbon dioxide from deforestation and forest degradation in the absence of additional efforts to curb such emissions (Griscom et al., 2008).

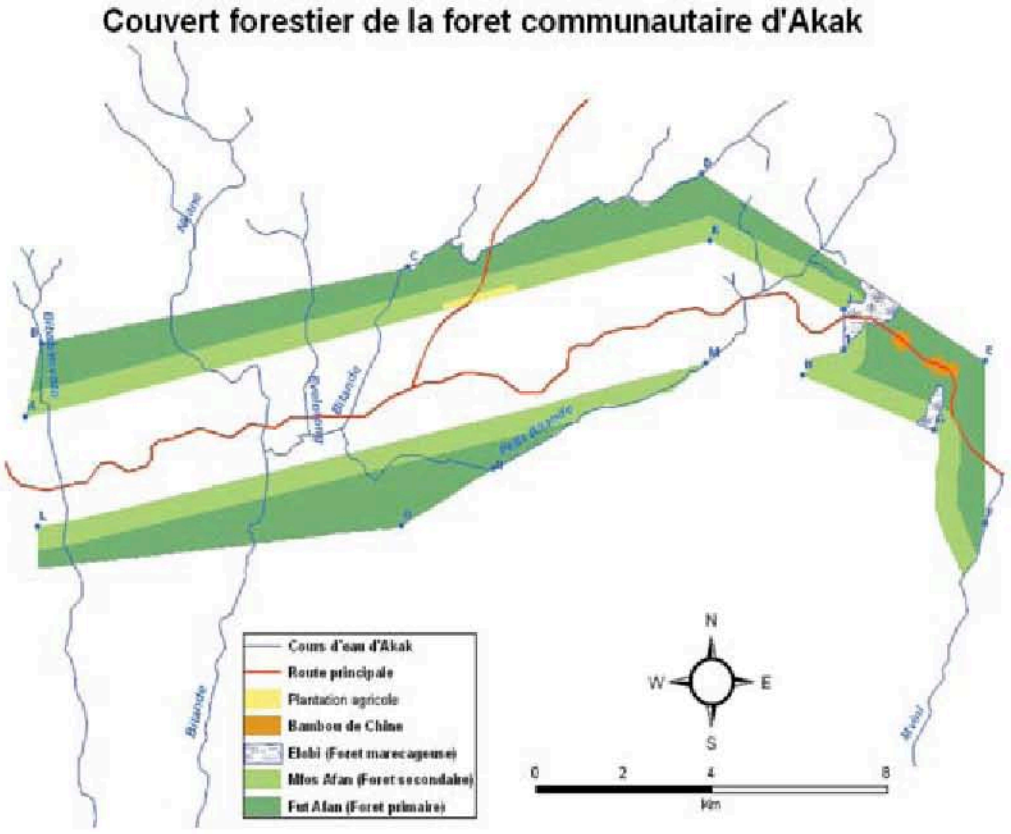

Figure3: Current land cover within Akak Community Forest described through participatory mapping with local stakeholders

Table 1: Description of land cover identified at Akak Community Forest through the PCLM approach

Land cover	Description	Area (ha)
Relatively primary forest (Fut Afan)	This forest has been partially exploited by illegal logging of timber companies. It has a closed canopy and the leaves of the tree species are generally dark green in color along the year. The understory is poor but there is high presence of lianas.	2772,9
Secondary forest (Mfos Afan)	Forest has been selectively logged and used for agriculture. The canopy is quite opened. The understorey is greatly herbaceous.	2057,3
Bamboo	Forest essentially graminaceaous without understory located near the Campo-Ma'an Park.	39,7
Permanently flooded forest (Elobi)	Area permanently flooded made up of commercial trees and some raphia.	104,9
Agro-industrial plantation	New opened field for food crops as cassava, banana, plantain, etc.	25,1
Total		5000,0

Table 2: Internal deforestation and degradation drivers and their expected impacts on the forest cover identified by the Akak community. These activities were ranked by intensity (order of magnitude) and area (extent of impact). In both cases a rank of 1 indicates the greatest impact perceived

Resource use activity	Expected impacts on forest cover	Intensity rank	Area rank
Logging	Selective removal of valuable timber tree species for local and commercial uses. This could result in a 20%-40% reduction in forest cover.	2	2
Industrial mixed agriculture	High forest clearing by an agro industry to establish mixed crops as cassava, bananas, etc. This could result in a 70%-100% reduction in forest cover.	1	3
Fishing, hunting and collecting NFTPs	75% of NFTPs are collected in the agroforestry zone. Subsistence hunting and fishing would not have an impact on the forest cover.	3	1
Population growth	Great development projects arriving in this zone as the Kribi Deep Sea Port and the Mbalam Railway will certainly boost immigration resulting in a high demand for forest products. This could result in a 70%-100% reduction in forest cover.	1	1
Timber companies	The opening of new forest trails leading to FMU 09-025 and illegal logging carried out by timber companies will also have an impact on the forest cover and this could result in a 40%-60% reduction in forest cover.	2	2

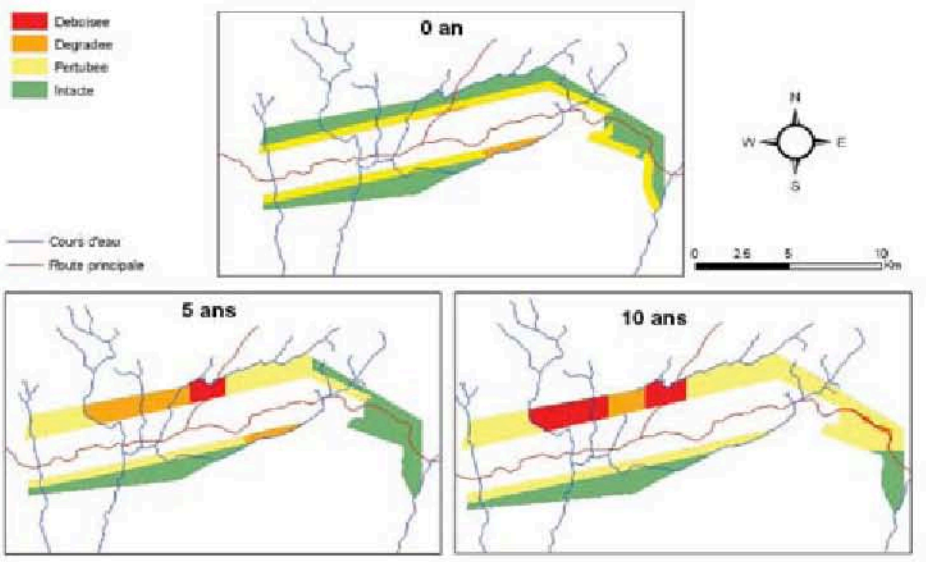

Figure 4: Land change baseline scenarios described by the community of Akak

Table 3: Land cover change scenarios described by Akak community and factors used for c alculation of change in carbon stocks (Adapted from Berry. N et al, 2010)

Initial land cover	Land cover change scenarios+	Explanation of patterns observed under the baseline scenario	Occurrence in baseline scenario (ha and %of initial area)			Change in carbon stocks□
			Year 0	5years	10 years	
Relatively primary forest (Fut Afan)	Undisturbed: remains intact	Area of intact forest declines over time as agricultural areas are expanded and timber is harvested	2779.9 (100%)	1647.9 (59%)	1106.5 (40%)	No change
	Disturbed	Area of intact forest is logged and industrial agriculture is expanded	0.0 (0%)	679.4 (25%)	1179.4 (42%)	17% reduction
	Degraded		0.0 (0%)	345.7 (12%)	84.3 (3%)	33% reduction
	Deforested	Areas of intact forest are cleared to establish industrial fields	0.0 (0%)	140.5 (4%)	401.9 (14%)	75% reduction
Secondary forest (Mfen Afan)	Undisturbed: increases canopy cover to resemble intact forest	Forest near the Park; is left to regenerate	0.0 (0%)	365.3 (17%)	365.3 (17%)	79% increase
	Disturbed: remains disturbed	Forest logging is intensified	1924.6 (94%)	1219.1 (59%)	1351.8 (66%)	No change
	Degraded		132.7 (6%)	402.7 (20%)	93.6 (5%)	43% reduction
	Deforested	Areas of disturbed forest are cleared for plantations	0.0 (0%)	79.0 (4%)	255.4 (12%)	83% reduction
Bamboo*	Undisturbed: remains intact	Logging could make this forest to disappear	39.7 (100%)	39.7 (100%)	0.0 (0%)	NA
	Disturbed	This forest will be greatly degraded by logging and could even disappear	0.0 (0%)	0.0 (0%)	0.0 (0%)	NA
	Degraded		0.0 (0%)	0.0 (0%)	27.2 (69%)	NA
	Deforested		0.0 (0%)	0.0 (0%)	12.5 (31%)	NA
Permanently flooded forest (Ekobi)	Undisturbed: remains intact	Logging will modify this forest	184.9 (100%)	0.0 (0%)	5.08 (6%)	No change
	Disturbed	Opening of new trails for logging by the community and timber companies operating in FMU 09-025	0.0 (0%)	184.9 (100%)	90.9 (87%)	12% reduction
	Degraded		0.0 (0%)	0.0 (0%)	0.0 (0%)	38% reduction
	Deforested		0.0 (0%)	0.0 (0%)	7.9 (7%)	81 % reduction
Agro-industrial plantation	Undisturbed: Fields are abandoned and canopy regenerates to resemble intact forest	Not expected to occur	0.0 (0%)	0.0 (0%)	0.0 (0%)	NA
	Disturbed/Degraded: Fields are abandoned and canopy regenerates to resemble disturbed and degraded forest	Agricultural areas are abandoned for fallow	0.0 (0%)	0.0 (0%)	0.0 (0%)	448% increase
			25.1% (100%)	0.0 (0%)	0.0 (0%)	189% increase
	Deforested	Intensification for food production	0.0 (0%)	25.1% (100%)	25.1% (100%)	No change

- For each of the initial land cover type, four land cover scenarios are described corresponding to the classes of forest cover used during PCLM
- This forest cover was excluded from our baseline calculations because there were no data of Bamboo carbon stocks in Cameroon when reviewing literature (see Table 4).
- To get the change in carbon stocks between the different land cover types (relatively primary forest, permanently flooded forest, bamboo, agro-industrial plantation and secondary forest), we compared Neale. E et al studies in Nkolenyeng and Nomedjoh and ASB's report on land-use carbon dynamics.

We defined a baseline scenario through a participatory approach which is totally based on community's knowledge of their forest resource uses and their planned activities. The different land cover change scenarios described by Akak community are shown in figure 4. As observed in the different maps, the community of Akak is expecting that its forest cover will gradually degrade during the next ten years as a result of intensive logging due to the proximity of the market as the Kribi Deep Port will be constructed. They also expect that the forest will be greatly deforested in an approximate area of 1,000 ha in the north due to agricultural activities carried out by an agro-industrial company which will sign a15 years contract with the community. But also, according to the community, the forest cover will increase after five years in the East because this part of the forest, very close to the Campo-Ma'an Park has been abandoned many years ago to regenerate and the fact that they don't have enough financial means to log and export timber from this zone. Nevertheless, the local stakeholders estimate that the situation will be different after ten years as they will certainly be able to mobilize necessary funds for logging in that area. All the changes in land cover resulting from the land change scenarios described by the community of Akak, and factors for changes in carbon stocks that were applied to calculate change carbon stocks under the baseline scenario are summarized in the table below. Table 4 presents the initial carbon stocks for each land cover type. The change in carbon stocks (Table 3) have been applied to these initial values to estimate the change in carbon stocks for the scenarios described. The evolution of carbon stocks expected by the local stakeholders during the next ten years if there is no intervention (baseline scenario) in Akak community forest is shown below (Figure 5).

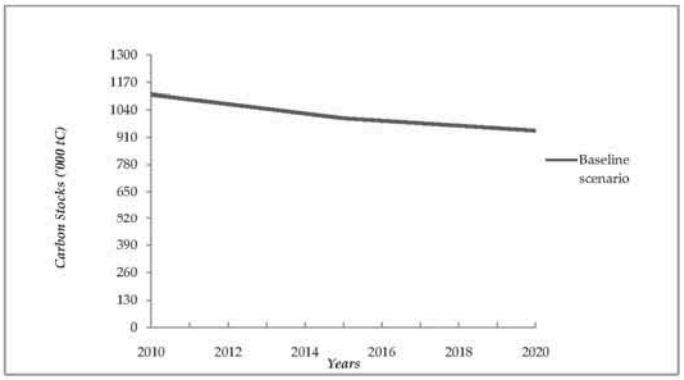

Figure 5a: Evolution expected of carbon stocks under the baseline scenario. For carbon calculations details see Table 3.

Table 4: Initial carbon stocks for initial land cover type in Akak community forest and their source

Land cover type	Initial area(ha)	tC/ha	Average carbon stock	Source
Relatively primary forest (Fut Afan)	2772.9	252.0	698,770.8	IITA study data on Cameroon[8] over 17 years (1984-2001)
Secondary forest (Mfos Afan)	2057.3	199.0	398,123.2	J. Kanmegne, 2004
Permanently flooded forest(Elobi)	39.7	136.0	14,266.4	State of forests of Congo, 2008
Bamboo	104.9	NA	NA	Data not available
Agro-industrial plantation	25.1	43.4	2,058.2	J. Kanmegne, 2004
		Total	1,113,218.6	

In order to get an insight of REDD+ potential to effectively avoid carbon emissions in Akak community forest, we simulate and propose two REDD+ policy scenarios. The first policy (REDD+ Scenario 1) is to reduce 50% of thesurface9 that would be affected to agriculture as the community has not yet signed the contract to rent 1,000 ha to the agro-industrial company for the coming fifteen years. The second one (REDD+ Scenario 2) is to add to the first policy, agroforestry techniques in the 500 ha rented by the community to the company. The scope of both policies is avoided deforestation and degradation and sustainable forest management. Then, we compared changes in carbon stocks of these REDD+ policies with changes occurred in the baseline scenario for the next ten years. As it is to be observed in the figure above, whichever the policy scenario adopted for the Akak community forest, REDD+ is a very effective way to tackle carbon emissions in this forest. The most conservative scenario (REDD+ Scenario 2) indicates a potential of 83, 588.9 tC and 98, 690.9 tC of avoided carbon emissions respectively after 5years and 10 years of intervention (Figure 6).

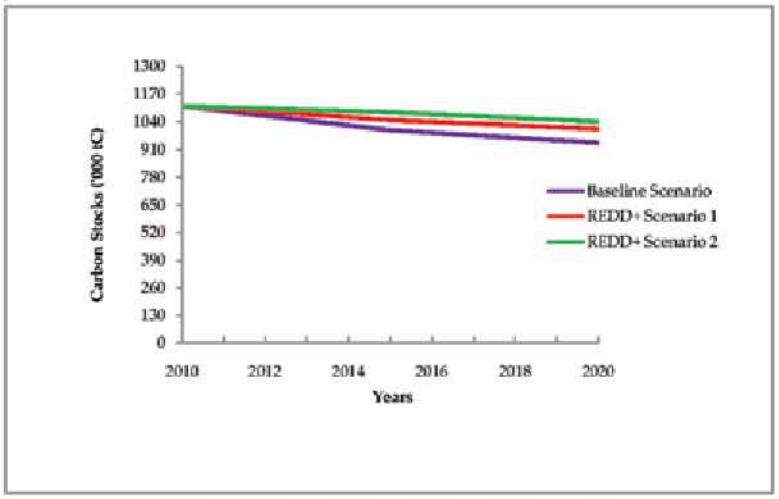

Figure 5b: Comparison of change in carbon stocks under baseline scenario and REDD+ scenario policy proposed

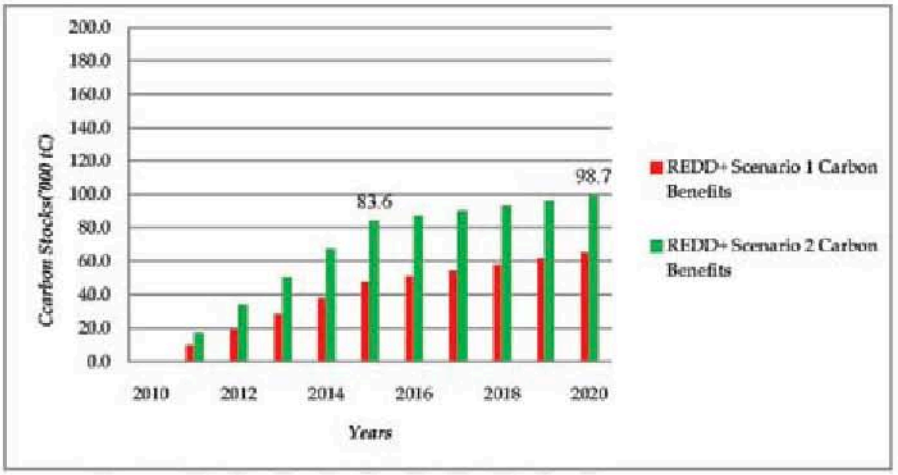

Figure 6: Compared REDD+ policy scenarios avoided carbon emissions benefits

3.4 Potential REDD+ CoBenefits for the Akak Community Forest

Beyond avoided carbon emissions, REDD+ policies scenarios developed in this study, could also bring out some environmental and socio-economic benefits for Akak population. This includes Ntem's watershed protection, biodiversity conservation, improving livelihoods and poverty alleviation. As the Akak community forest is located in the Ntem watershed, REDD+ policy scenarios interventions through agroforestry techniques could increase evapotranspiration and reduce stream flow because of the reduced leaf area index. Besides, this could also increase root depth and reduce soil compaction (Stickler et al., 2009). Biodiversity conservation could be the most important potential co-benefit of both REDD+ policy scenarios. Indeed, this forest is highly rich in biodiversity and can be saved by deflecting deforestation. Suchan intervention may reduce forest fragmentation, restore degraded lands, provide more habitats for animals and increase understory vegetation inside the Akak community forest. Socio-economic benefits like better livelihoods and then the reduction of poverty may also appear as alternative economic activities are developed by the community itself. These activities include beekeeping, ecotourism and fish breeding. Developing these activities could generate a lot of employment opportunities for the local community and therefore increase their revenue.

4. Discussion

The consensus made with selected members in Akak community, showed that the forest cover will be greatly modified for the coming 10 years as a result of current and planned land use activities. Stakeholders expected that future infrastructure projects (Kribi Deep Sea Port, Mbalam Railway, etc.) will have the most impacts on their community forest cover. They indicated that these projects will boost demography in the zone, which in turn will increase the demand for forest products. The group of stakeholders also expected that the agro-industrial company will firstly intensify its activities around the trail leading to the north part of the FMU 09-025. After that, it will progress in the west direction of this trail to satisfy increasing food demand as a result of population growth. We particularly noticed that the community itself doesn't plan any agricultural activities within the community forest just because they are afraid of elephants, monkeys, etc. which constantly destroy food crops and harvests. Therefore, they will limit their agricultural activities around their settlements. Apart from activities resulting in deforestation and forest degradation, the community is expecting to the regeneration of the forest cover in the eastern part of the community forest. They indicated that this area close to Campo-Ma'an National Park, where there have not been any human activities, has been left abandoned since many years for regeneration. Another small area in the south-east, where there was illegal logging operated by timber companies in the past years, has also been left for the similar purpose. Our analysis indicates that the Akak community forest will lose around 112,000 tC and 172,000 tC after 5 and 10years respectively if there is no intervention. This amount of carbon represents an annual 65, 7 ha of forest cover loss with an annual deforestation rate of 1.4%. This deforestation rate is higher than the national deforestation rate which is 1.0% for the period 2000-2005 according to the FAO's Forest Resource Assessment (FRA) in 2006. The two REDD+ policy scenarios simulated in this paper indicate a high potential of reducing carbon emissions in the Akak community forest. The most conservative scenario (Scenario 2) presents a reducing potential of 83,588.9tC and 98,690.9 tC respectively after 5 and 10 years of policy interventions. Furthermore, these policy scenarios can provide other benefits beyond the reduction of carbon emissions. These benefits are the conservation of animal and forest biodiversity, the protection of Ntem's watershed, and the improvement of livelihoods. But, all this potential and benefits cannot be achieved, unless any upstream activities are being implemented. These activities include:

- Capacity-building of the agro-industrial enterprise in using modern and sustainable agriculture practices.
- Developing a payment for environmental services mechanism to increase this community forest's rent and reward forest conservation and management practices. This mechanism should strengthen community rights and governance through implementation of forest tenure reforms and integrated into inclusive and broad-based development strategies.
- Developing sustainable economic activities like ecotourism, beekeeping, etc.
- Reinforcing sustainable forest management by adopting reduced impacts logging practices.

We recognize that the PLCM approach represents an approximate future scenario and that the land cover change scenarios presented in this paper represent estimates of what is expected to occur within the Akak community forest. But the estimations obtained through this approach, are helpful instruments to predict changes in land cover and carbon stocks (Berry et al., 2010). The first limit of our study concern the stratification of the forest made by the community because we didn't have enough time and financial means to make a remote sensing analysis to validate this stratification. The second one is that we didn't consider leakages when building our REDD+ policy scenarios also for time and financial means.

5. Conclusion

REDD+ negotiations under the UNFCCC, are going rapidly and this mechanism will certainly be part of the post-Kyoto climate agenda. As Cameroon is participating in this program, we evaluated in this paper, a community forest REDD+ potential through a participatory approach. The baseline scenario simulated shows effectively that the forest cover will be significantly reduced if nothing is being done. Hence, we proposed that two policy scenarios can be undertaken to avoid forest cover loss and carbon emissions. Both policy scenarios indicate a high potential of forest carbon emissions reduction. But, they can also improve Akak community's livelihoods and reduce poverty. In order to capture all this sustainable potential, a number of measures and policies should be undertaken and implemented. The PLCM used for evaluating the REDD+ mechanism potential in Akak community, provide an effective way for these illiterate forest-dependent people to define their forest uses, internal and external threats to forest cover and conceptualize how these threats are expected to change the land cover. This creates a sense of ownership within the community and the responsibility to articulate and implement activities to reduce their impacts on forest cover.

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