



PROJECT COMPLETION REPORT

ITTO Project PD 450 Rev 1 (F): Capacity building for CDM Forestry in the Framework of SFM emphasizing Community Forests and Poverty Alleviation in Ghana



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Project Completion Report

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Capacity building for CDM Forestry in the Framework of SFM emphasizing Community Forests and Poverty Alleviation in Ghana

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Executive summary

The potential of forestry-related Clean Development Mechanism (CDM-Forestry) and payment for environmental services in forestry in general in Ghana is very significant as large areas of Ghana's forests have been degraded via over-aggressive, non-sustainable logging practices, slash-and-burn agricultural practices, and conversion of forests to alternative crops such as cocoa, and are so, therefore, eligible for CDM reforestation projects. Therefore the relevance to develop the capacity to conduct CDM-Forestry projects with a strong poverty- alleviation component is very high.

The project intends to develop the capacity for CDM-Forestry in Ghana via a community rehabilitation of Ghana's degraded forests targeted at poverty alleviation in conjunction with sustainable forest management (SFM). The expected outputs of the project are:

- Carbon stocks of the Oda-Kotoamso Community Agro-forestry Project(OCAP) will be determined using GPS supported comprehensive and complete measurement of all trees in the project;
- Mass spectrophotometric analysis will be done on wood samples from up to 5 trees each of the 19 tree species planted;
- A Large area of degraded forest will be reforested with the OCAP model using highly productive timber species;
- Comprehensive socio-economic studies will be conducted in the communities involved in the project;
- Capacity to conduct CDM forestry will be built with post graduate training of Ghanaian students; and
- Community-based CDM forestry methodology will be developed for the OCAP project

Deliverables:

- Allometric equation for estimating carbon of indigenous species in mixture stands was developed to facilitate carbon credit and marketing
- Capacity of Community farmers, Students and the project team were built in nursery management and CDM forestry methodologies
- Carbon content estimation of 19 tropical tree species have been determined
- CDM methodologies developed by the project were disseminated through workshop and international conferences to update stakeholders on the projects outcomes
- The project has increased strategies to restoring carbon stocks in degraded forest lands
- The project serves as a model to supplement the national forest plantation programme and climate change mitigation initiatives for global benefit

- Ten undergraduate students were accepted on internship and some aspect of research findings from the project was used for their undergraduate dissertation.
- Five master's students were engaged on the project for research work and theses.
- Research findings were published to enhance access and implementation of the strategies developed.

The project had beneficiaries including the Forestry commission, fringe communities of the Pamu-Berekum forest Reserve, students and researchers, national, regional and international agencies interested in carbon credit and marketing. The CDM project's execution has been effective and interesting, attracting other communities to participate in the project contributing to achieving the project objectives.

1. Project identification

1.1 Context

The Samartex Timber and Plywood Company Ltd. have developed a highly successful agroforestry forestry model system for involving village people. This model has been developed for some 450 hectares and has involved nearly 1000 farmers, villagers and young people in various aspects of clearing, planting and maintaining productive plantations in addition to short and midterm agricultural and horticultural production systems to provide income to the participants and to decrease slash and burn as well as shifting agriculture. This model system has involved unique profit-sharing and land ownership agreements between chiefs, elders and village people. In this project, we propose to add a CDM component based on accurate growth and yield measurements and carbon inventory to verify and validate carbon storage from the original 450 hectare project. Furthermore, we will replicate the community-based production forestry/agroforestry/ CDM model in another community in the Dry Forest Region of Ghana. We will have a strong CDM capacity building component to the project in training a PhD student in carbon forestry practices at Michigan Technological University and five Kwame Nkrumah University of Science & Technology students per year in various aspects of the carbon accountability. Samartex, FORIG and Michigan Tech have collaborated extensively over the past four years on the ITTO-sponsored mahogany project.

1.2 Origin and Problem

Under the Clean Development Mechanisms (CDM) of the Kyoto Protocol, greenhouse-gas emission offsets are measured in metric tons of CO₂ equivalents and are called "Certified Emission reductions" (CERs). While CDM projects have made substantial progress in developing Asian and South American countries, only a handful have been initiated in Africa (Desanker, 2005). The recent ITTO-sponsored CDM Workshop in Accra, Ghana, December 2006 was an attempt to increase the awareness of the opportunities in CDM forestry in Africa. This was followed up with an African Regional workshop to build capacity in project design document (PDD) of ITTO producer countries for Afforestation and Reforestation Projects Development under the CDM in Abidjan, Cote d'Ivoire (June 2008). A major

outcome of these workshops was a clear message that improved capacity building is needed in CDM forestry in Africa (Anon, 2006).

The project aimed to add a CDM component to an existing and highly successful community agro-forestry/production forestry model system that the Samartex Timber and Plywood Company Ltd., a Ghanaian-based forest products company, has developed in western Ghana. This model system, the Oda-Kotoamso Community Agro-forestry Project (OCAP), has developed some 450 ha and has involved nearly 500 farmers, villagers, and young people in various aspects of clearing, planting, and maintaining productive forest tree plantations, in addition to short and midterm agricultural and horticultural crops. The project is truly unique in Ghana as it involves technical outreach, profit-sharing and land ownership agreements between chiefs, elders, village people, and Samartex that provide a mechanism for long-term sustainable community forest management.

The project intend to replicate the OCAP with another 100 ha site in the dry forest region of Ghana community using the knowledge generated from OCAP to build a successful community-based, agro-forestry project with strong forest products and CDM components. Successful replication of the OCAP model system in a truly sustainable manner with shared land ownership would prove this concept can be developed elsewhere in Ghana and western Africa as a means to seriously address poverty alleviation, and restoration of degraded forest in line with major goals for ITTO (ITTO, 2002).

2.0 Project objectives and implementation strategy

2.1 Project Rationale, Development and Specific Objective

The upper Guinean forest of Ghana have been degraded over a century from 8.3 million hectares to 1.6 million hectares as result of non-sustainable logging practices, slash and burn agricultural practices and persistent bush fires. Though the destruction of Ghana's forest was more intense outside forest reserves, about one third of the 214 forest reserves have been severely degraded. Pamu-Berekum Forest Reserve (FR) used to be among the most floristic reserves in Ghana however its classified among the 40 FR which are much degraded (Hawthorne and Abu-Juam 1995) with *chromolaena odorata* and *Panicum maximum* (elephant grass) as the dominant vegetation cover. There were virtually no seed trees left to produce seeds for natural regeneration to restore the original tree vegetation cover (Forest Service Management Plan 2001). It seemed the only way to restore tree vegetation cover on the Pamu-Berekum Forest reserve was diligent reforestation of the area through tree planting. However, initial effort to encourage individual and private tree plantations failed because of investment barriers and the belief that reforestation program of Pamu-Berekum would be viable if only public incentives/finances are provided. This belief was confirmed by the relative success of the limited Highly Indebted Poor Country (HIPC) assisted plantation program with support from Ghana Government development Partners.

We therefore propose a small scale CDM A/R project for the reforestation of Pamu-Berekum FR with the forest fringe communities to provide a financial system that can help to overcome the barriers to plantation development in the degraded forest whilst contributing to poverty reduction in the forest fringe communities.

The development objectives of the project was to develop "the capacity for CDM forestry in Ghana via a community rehabilitation of Ghana's degraded forests targeted at poverty alleviation in conjunction

with sustainable forest management (SFM)”. This project involved the private sector and native communities in SFM implemented in collaboration with the Oda-Kotoamso Community Agro-forestry Project of Samartex Timber and Plywood Company Ltd.

- (i) The specific objective of the project was to improve capacity for CDM forestry in Ghana via a community forest targeted at poverty alleviation in conjunction with SFM.

2.2. Project implementation strategies

This project built on the successful OCAP Community Agroforestry Project in western Ghana and conducted the inventory research that was necessary to determine the carbon mitigation strategy by replicating the OCAP model in which 450 ha plots was reforested in an agroforestry system with the Oda-Kotoamso community. The scientific and technical lessons learned from the OCAP was employed in the implementation of the CDM project which involved a number of fringe communities near the Pamu-Berekum Forest reserve with the aim of establishing a sustainable forest management system for reforestation of these degraded lands. A 100 ha site of the degraded forests in the dry forest of Ghana was demarcated as the project area for planting.

Carbon content estimation of all 19 major tree species in the OCAP project (including indigenous species *Ceiba pentandra*, *Entandrophragma angolense*, *Khaya anthotheca*, *K. grandifoliola*, *K. ivorensis*, *Terminalia ivorensis*, *T. superba*, *Triplochiton scleroxylon*, *Aningeria altissima*, *Milicia excelsa*, *Heritiera utili* and exotic (*Cedrela odorata*) was done by analysing ground samples from cross-sectional cookies using a Carlo Erba NA 1500 NC elemental analyzer.

The data was used in conjunction with intensive inventory analyses to determine accurate estimates of total carbon stocks in the OCAP project. Activities carried out included the use of GPS for inventory of all the trees on the demarcated 450ha planted stand of the OCAP and clearing around individual trees to allow easy assessment of the tree height and diameter of each tree.

The canopy cover within the stands of the 450 ha plantation was determined using hemispherical photos taken with digital camera that was fitted with fisheye lens. The photos were analyzed with the WinSCANOPY software version 2005A (Regent Instruments Inc. Quebec, Canada) to determine carbon sequestration and the canopy cover in the plantation. Baseline participatory public appraisals was conducted in the Abirikasu, Buobunu, KomfuokroM and Koradaso communities close to the degraded forest to determine which farmers could be effectively involved in the plantation project. Assessments of suitable crops that will be compatible with the trees were discussed. Before planting, nurseries of highly productive timber species were established in the communities, farmers were educated on best nursery management techniques that could be applied on other cash crops to generate alternative income. Nursery equipment such as wellington boots, cutlasses, watering cans, knapsack sprayers were given to farmers to improve their activities. Clearing of sites was undertaken and planting was done. The project team liaised with the Forest Service Division at Dormaa of the forestry commission to apply the planting designs that incorporated much of the farmers’ food crops they needed for subsistence. This was to motivate the farmers to effectively participate in the CDM project. Regular weeding was maintained in the established stands to improve the crop and tree growth. Annual evaluation of growth and productivity of the trees were done as well as analysis of carbon sequestration of the stand. Farmers, students and range officers were given training in simple estimation of carbon from the trees on the field. Fire and green belts were constructed at the edges of the planted sites to prevent wildfires and the farmers formed volunteer

groups that were responsible for protecting the trees from bushfires. Fire control equipment was provided to facilitate smooth execution of the fire control measures.

Comprehensive socioeconomic studies were undertaken in the project communities including OCAP and Pamu-Berekum to analyze the situation of participating farmers and communities. The project team conducted inventory of major natural resources used by the participating communities which could impact on the project. Further socio-economic analyses of the project impacts on the indigenous peoples, local employment, food production, fuel wood and other forest products was determined. Some aspect the socio-economic survey was utilized for a master's thesis by a student at the University of Amsterdam. Effective community participation strategies which enhanced maximum resource management were documented.

A Ghanaian student was trained at the masters level in carbon accounting and management in forestry at Michigan Technological University, U.S.A and eventually he obtained his PhD in lakehead University, Canada. The project assisted six masters' graduate students at Kwame Nkrumah University of Science and Technology, Kumasi, Ghana to conduct their research using the project facilities. Ten undergraduate students were accepted on internship for training in the CDM forestry.

Participating communities were educated on their responsibilities to qualify for carbon credit and trade in order to reduce the risk from any extreme expectations. Benefit sharing agreements using the Modified Taungya system under the Forest and Wildlife policy of the Forestry commission of Ghana was applied to ensure equity. The farmers involved in the CDM forestry at Pamu- Berekum and the Forestry commission of Ghana have 40% each of the benefits that would accrue from the plantations and the land owners as well as the traditional authority obtains the remaining 20% benefits. The responsibility of ensuring sustainability of the stand by maintaining the trees and protecting it from fire incidence is a collective role of the project beneficiaries as well as the project executing agency. Major findings and results from the project implementation which supported participatory community plantation development in Ghana was disseminated to the key stakeholders. Awareness workshops were organized to sensitize stakeholders at the Forestry commission on the feasibility and effectiveness of CDM forestry in Ghana. CDM forestry methodology for the OCAP plantations was documented and a proposal was submitted to the CDM Executive Board.

2.3 Assumptions and risk

The major risk for the project identified was; that working with communities and groups of farmers is generally a more rigorous challenge than dealing with a single large land owner. However, the extensive experience garnered by the senior Samartex personnel (including co-principal investigator Mr. Ghartey) in dealing with the complex rural community dynamics in western Ghana especially with the OCAP minimized the risk of failure in replicating this experience in another community i.e. Pamu-Berekum.

The success of developing models for carbon estimation in the Pamu-Berekum reforestation site was based on the assumption that the main carbon accounting procedures needed in this project had similarities with projects and experiences from carbon sequestration projects in the USA executed by co-principal investigator **Prof. Andrew Burton**. Thus, the complex carbon accounting determination was capably overseen in this project and training of Ghanaian students in carbon accounting at Michigan Technological University, U. S. A. enhancing capacity in potential carbon trading in forestry. Active community involvement in the project was assured as FORIG has collaborated successfully with farmers from diverse cultural and socioeconomic backgrounds on various local and donor funded projects in

Ghana. Thus the development of the CDM methodology and strategy will enhance sustainability of CDM forestry in Ghana for global climate changes mitigation and restoration of degraded landscapes.

3.0 Project performance

a). Specific objective

The specific objective of the project was to improve capacity for CDM forestry in Ghana via a community forest targeted at poverty alleviation in conjunction with SFM.

Activity	Realized Project Elements	Differences Between Planned and Realized Project Elements
<u>OUTPUT 1</u> Carbon stock of 450 ha OCAP project determined	Achieved objective	None
<i>Activity 1.1:</i> Demarcate and compartmentalize Mass spectrophotometric analysis will be done on wood samples from up to 5 trees each of the 19 tree species planted;	Map of the OCAP was obtained from Sarmartex. The project team liaises with some field staff from samartex to demarcate the area into compartments to facilitate the tree inventory of trees for carbon stocks assessment.	
<i>Activity 1.2:</i> Tree inventory	Complete enumeration of tree species was undertaken on the demarcated compartments 450ha OCAP plots	
<i>Activity 1.3:</i> Determine canopy cover of stands	The canopy cover within the stands of the 450 ha plantation was determined using hemispherical photos taken with digital camera that was fitted with fisheye lens.	
<i>Activity 1.4:</i> Data analysis	Data analysis was undertaken successfully	
<u>Output 2</u> Carbon content of 19 species	Achieved Objective	None
<i>Activity 2.1.</i> Felling and collection of wood samples	5 trees were selected from each of the 19 tree species planted for collection of wood samples	
<i>Activity 2.2.</i> Crushing and milling of Wood	The sampled wood were crushed and milled	
<i>Activity 2.3</i> Analysis of carbon content of wood	Soil sampling was done to determine the soil carbon. Diameter and total height of the	

	trees were measured. The carbon content of the selected tree species was determined using suitable allometric equations	
Output 3 Reforestation of degraded land	Achieved objective	None
Activity 3.1 Select degraded forest by CDM definition		
Activity 3.2: Participatory public appraisal	Focus group discussions and workshops on CDM were organized in the fringe communities of Pamu-Berekum to identify potential farmers that would participate in the project	
Activity 3.3: Seeds collection and processing	Seeds of valuable indigenous species including African mahogany, <i>Ceiba pentandra</i> , <i>Entandrophragma</i> species and the exotic <i>Tectona grandis</i> were collected from superior seed trees and processed.	
Activity 3.4: Nurseries establishment	Community nurseries were established to produce seedlings for planting. Nursery equipments such as wellington booths, knapsack sprayer, watering cans and cutlasses were supplied to farmers to facilitate their nursery activities.	
Activity 3.5: Clearing of sites for planting	Manual weeding was done to clear off weeds as part of site preparations for planting.	
Activity 3.6: Pegging and planting	Pegs were cut from bamboo strips for pegging of the cleared lands and planting was done. Mixtures of fast growing indigenous and exotic species were combined with food crops in agroforestry system. Pure plantations of the indigenous species were also established for demonstration.	
Activity 3.7: Assessment of trees and crop production	The influence of the tree-crop interface on productivity of the established stands were evaluated	

Activity 3.8: Analysis of carbon sequestration in stands	The sequestered carbon in the 450 ha OCAP and 100ha Pamu-Berekum reforestation stands was analyzed using allometric equation of the measured diameter and height of the trees. This provided information on the carbon production potential of the stands.	
Output 4 Socioeconomic studies in participating communities	Achieved objective	None
Activity 4.1: Baseline survey for situation analysis	Socio-economic surveys were conducted in the forest fringe communities to assess their knowledge on climate change issues and their willingness to plant trees on their farms as CDM approach.	
Activity 4.2: Socio-economic and environmental survey	Socio-economic surveys involving focus group discussions and seminars with the community farmers was undertaken to collate data on their social backgrounds, livelihood activities and the willingness to participate in the CDM plantation programme.	
Activity 4.3: Inventory of nat. res. use in communities forest of similar sizes	The use of natural resources including the forest, non-timber forest products and ecological services was inventoried to assess the potential impacts on the project	
Activity 4.4: Evaluate participatory strategies	The expectation of the farmers on the tree planting project was assessed, through baseline studies the household income of every farmer and their expectations in terms of benefit from the project was solicited and strategies to ensure optimum benefits was put in place.	
Activity 4.5: Identify mechanisms for CDM forestry	Land tenure issues or access to land was a critical factor, engagement with communities,	

	<p>financing conditions, etc.) Principles for CDM projects in Ghana should be considered The right of smallholder farmers was protected hence equitable benefit sharing schemes using the modified taungya system was adopted for lands leased in the OCAP. The Pamu-Berekum reforestation site was a gazetted reserve as such there were no conflict of ownership between the participating partners.</p>	
Activity 4.6: Define responsibilities and roles	Aside the community nurseries, some seedlings were supplied to the farmers for planting. Farmers level of participation in the CDM project was encouraging and the collaboration was strengthened through field visits and regular interactions.	
Output 5 Building capacity for CDM forestry in Ghana	Achieved objective	
Activity 5.1: PhD training in MTU	Ghanaian Ph.D. student was trained in carbon estimation and management at the Michigan Technological University to assist the project team with his expertise and skills developed.	
Activity 5.2: Master research in KNUST	Five (5) masters' level students were accepted on the project and they utilize some aspect of the project results for their dissertations.	
Activity 5.3: Undergraduate internships	Twelve(12) forestry technicians had the opportunity to study on the project	
Activity 5.4: Awareness workshop	Series of workshops and seminars were organized in the communities to sensitize the farmers/tree growers on CDM forestry issues.	
Output 6: Community-based CDM methodology developed	Achieved Objective	
Activity 6.1 Workshops in participating communities on responsibilities for CDM forestry	Several workshops were organized at the project executing agency, Sarmatex and participating communities to outline the roles and	

	responsibilities of the partners involved in the project.	
Activity 6.2 Promote community CDM forestry in Ghana	Small scale CDM forestry was actively promoted in Ghana using the model restoration of the degraded dry forest zone of Ghana.	
Activity 6.3 Prepare CDM methodology for the OCAP Plantation	Refined CDM methodologies successfully applied in the OCAP was documented for national use.	

4.0 Project outcome target Beneficiaries

4.1 Elaborate on the extent to which the project objectives were achieved

The project specific objectives were to improve capacity for CDM forestry in Ghana via a community forest targeted at poverty alleviation in conjunction with SFM. All stakeholders including the forestry commission, community members and the project field crew contributed their quota towards achieving the set objectives of the project. The successful experience from the OCAP was tapped to replicate the project in a degraded forest in the dry forest zone of the country. The project team conducted several community sensitization workshops to educate the communities on the actualities of CDM forestry in order not to raise their expectations of benefits arising from the project. The community farmers around the degraded Pamu-Berekum forest reserve including Dormaa- Koradaso, Buobunu, Abirikasu and Komfuokrom expressed their willingness to participate in the project after focus group discussions on tree planting and the potentials of CDM. Farmers were trained on some basic strategies of plantation establishment and management to build their capacity in the CDM forestry. Suitable plantation designs that ensured the integration of food crops with different indigenous and exotic tree species were adopted in restoring the degraded reserve. Agro-forestry system that ensured the basic subsistence from the crops and also promoted long term benefits of the planted stands was prioritized throughout the execution of the project. Series of socio-economic surveys and participatory rural appraisals were conducted in the OCAP and fringe communities of the degraded Pamu-Berekum forest reserve to evaluate the cost and benefits of Agro-forestry practices targeting carbon crediting as compared to sole agriculture practices. The capacity building component of the project was developed by acceptance of undergraduate and postgraduate students both locally and internationally for academic internships on the project. Knowledge in nursery management and carbon estimation were transferred to students and farmers as a form of capacity building. State-of-the-art- technologies in bee-keeping, gari processing and snail rearing was introduced to the projects' participating farmers as an alternative livelihood activity. The projects' overall goals were achieved with collective effort of all stakeholders of the project.

4.2 The situation existing after project completion as compared to the pre-project Situation

Tangible outputs:

The project implementation was very proactive and viable as many community farmers were actively engaged in the CDM forestry and were willing to adopt the agro-forestry designs introduced by the project team. The agro-forestry systems which incorporated much food crops to enhance the subsistence of farmers and seedlings of valuable indigenous species that are relatively fast growing were supplied to farmers for planting. Farmers were motivated by increased yield of their crops and the returns from the sale of the carbon sequestered by the trees in the near future. In the OCAP plantations the benefits the industry will derive from the stand was also clearly outlined to arouse their active participation in the project. The implementation of the project has been very encouraging with the deepening interest of all stakeholders including the participating communities and the industry which has resulted in planting over 100 hectares of the dry forest zones of Ghana.

The project results were published in reputable research journals (list below) and presentations were delivered at various conferences and seminars for global access to the valuable information.

4.3 PUBLICATIONS

- 1 Emmanuel Opuni-Frimpong, Nana Yaa Nyarko-Duah, Ebenezer, J.D. Belford, Andrew J. Storer (2014) Silvicultural systems for restoration of mahogany in degraded landscapes in Africa: Influence of mixed rainforest plantation on growth and pest damage, *Open Journal of Forestry* 4; 414-425.
- 2 Opuni-Frimpong, E., Kuudaar, S., Opoku, E.O., Nyarko- Duah, N.Y., and Opoku, S.M. (2014). Promoting indigenous species and biodiversity in plantations: *Khaya grandifoliola* (Welw) CDC a suitable candidate species for restoring degraded forestlands in mixed plantations. Book of abstract, First National Forestry Conference. Pp 39-37
- 3 Opuni Frimpong, E., Nyarko-Duah, N., Opoku, S., Storer, J.A. Burton, J.A. (2014). Restoration of degraded lands with mahogany in mixed-species plantations promotes biodiversity and conservation of valuable timber species. *The International Forestry Review Vol.16 (5)*, 142.
- 4 Opuni Frimpong, E., Opoku, S.M, Owusu, S.A., Storer, J.A. Burton, J.A. (2014) Growth and productivity of *Khaya grandifoliola* in the dry semi-deciduous forest of Ghana: a comparison in pure and diverse species stands. *The International Forestry Review Vol.16 (5)*, 144.
- 5 Opuni-Frimpong E, Opoku S. M, Storer A. J, Burton A. J and Yeboah D. (2013). Productivity, pest tolerance and carbon sequestration of *Khaya grandifoliola* in the dry semi-deciduous forest of Ghana: a comparison in pure stands and mixed stands. *New Forests* 44 (6) 863-879 (DOI 10.1007/s11056-013-9376-6).

- 6 Opuni-Frimpong E, Opoku S. M, Storer A. J (2012) Growth and Productivity of *Khaya grandifoliola* in the Dry Semideciduous forest of Ghana: A comparison in pure stands and in mixed stands. IUFRO – FORNESSA Regional congress. Nairobi – Kenya, 25th – 29th June, 2012. Book of Abstracts. Pp 197.

4.4 Support to Sectoral Policies and Programs

The project outputs are contributing to the realization of the following sectoral policies and programs on forest plantations.

- It will promote small and medium forest plantation as channel of job creation for the rural communities and forest dependent people
- Application of practical technologies in restoration and rehabilitation of degraded landscapes
- It will enhance food production and security through the adoption of agro-forestry systems
- It will support investments in plantations establishment including the indigenous species to enhance the attainment of the national forest plantation goals in Ghana
- It will increase biodiversity conservation of degraded forest lands to increase their connectivity to other forests.

It will improve soil conservation, water erosion control in forest lands and ecological integrity

- It will encourage collaborative resource management among community farmers, governments and other relevant stakeholders
- The project results will increase government commitment to degraded landscape restoration through massive forest plantation development schemes
- Growing of trees under the CDM will help sequester CO₂ in the atmosphere for mitigation of global warming
- Communities and farmers in the plantation site will benefit from carbon credit to improve their livelihoods.

2.3 The Physical Environment

Throughout the execution of the project, land preparation activities were done adequately to prevent destruction of the soil microclimate and other neighboring farming areas. In the community agro-forestry system, farmers were guided in the clearance to prevent excessive burning and herbicide applications were avoided in order not to destroy microorganisms in the soil. Within the project demarcated areas, the project field team focused on using various mixed plantation designs that will enhance the trees growth while increasing crop production for farmers' subsistence and sustainable livelihood. The interest of many farmers within the fringe communities was renewed after comparing the fields of the project farmers to theirs and they

assured us of their willingness to also participate in the project to increase the forest cover of the degraded dry forest reserve.

(iii) Participation of the target beneficiaries in the implementation of the Project and their utilization of the project results.

The project stakeholders included the climate change unit of the Ghana Forestry Commission, Samartex Company Limited, OCAP farmers group and farmers within the fringe communities of Pamu- Berekum and Kranka. These stakeholders were actively involved in the project steering committee meetings held at the project executing agency. Usually, a representative of the Ghana Forestry Commission from the climate change and the plantation unit chairs the meeting and the participating farmers groups were present often, and they were given the chance to air their views on the strategies necessary to be adapted to ensure successful implementation of the project. The state of the project implementation and achievements chalked were delivered through technical presentations at the steering committee meetings and at workshops held at the communities. Participatory rural appraisals and seminars were organized in the communities to educate farmers and the Forest Service Division, FC on the methodologies of the Clean Development mechanism including the requirements to qualify for carbon credit. The project results were also published in recognized journals and Community based CDM methodologies in Ghana have been documented.

(i) Project sustainability after Project Completion as a result of conditions prevailing at completion.

Effective monitoring and evaluation strategies have been put in place to ensure sustainability of the CDM project after completion. In the OCAP plantations, Samartex had establish a strong agreement with the participating farmers and the land owners as such farmers considers the trees to be their own property and will therefore take proper care of the stand for such benefits. The local authorities also protect the trees by the rules and regulation of their chieftaincy. Farmers at the Pamu-Berekum site also knows the profit that could accrue from the trees they have planted and are obliged to take good care of the trees to prevent it from destruction and possible loses, and the Forestry Commission also protects the trees as a national property. FORIG had signed an MOU with Samartex to regularly monitor and collate data on the OCAP plantation until harvest. The project team would undertake effective monitoring, ensure maintenance and collect data on the stand as well as assist farmers properly in the carbon credit.

5. Assessments and Analysis

i. Analysis and comments on the project rationale and the project identification: Stakeholder participation in the project formulation process

The CDM project originated from stakeholder interactions after the most floristic forest reserves in Ghana became degraded through bushfires and conversion of forest to agricultural lands. The pristine dry forest lands in Ghana (Pamu-Berekum) was among the degraded reserves faced with great wild fires leaving the previously intact forest with only *chromolaena odorata* and grassland; elephant grass (*Pennisetum purpurem*) as the dominant species. Due to the destruction, the ecological and biodiversity functions of the forest were compromised. It was therefore necessary that reforestation programme was urgently undertaken in Ghana to restore the degraded landscape for its continual functions. The project team were motivated to successfully implement the project to make positive impact to reforestation as there was a previous plantation programme with active community involvement in the western Ghana. Samartex had successfully developed and implemented a reforestation programme with the OCAP and such experiences were tapped into the CDM project to attain the development objectives of the project. The strategies applied included demarcation of the 450 ha OCAP plantations into compartments to facilitate easy enumeration and assessment of the stand. Tree species on the stand was inventoried and canopy cover of the stand was measured. The data compiled was analyzed to provide information on the stand's stock and closure. Carbon content was estimated from 5 trees of each of the 19 African tree species selected from the stand. The degraded dry forest land demarcated for the CDM project by the forestry commission, Ghana was reforested to approximately 100ha of valuable indigenous and exotic species using suitable pure and mixed planting designs. Effective monitoring and evaluation schemes have been put in place to assess the stand productivity and carbon sequestration. The established stands were maintained by regular weeding and fire belts were constructed to prevent wildfires. Capacity building of students, range officers and farmers was a considered in the project as it was relevant to establishing a viable and sustainable CDM forestry in Ghana. Farmers were trained in simple nursery management technologies and sustainable livelihood development programmes such as beekeeping, gari processing and snail rearing. Seedlings of some cash crops were nursed by farmers for sale and the project team assisted farmers in marketing of the honey produced from the beekeeping to provide alternative income for the farmers. This motivated them to actively participate in the CDM plantations program. As part of capacity building, intern students and farmers were given training in carbon estimation using the model CDM project plantation at Pamu-Berekum. Socioeconomic and environmental surveys were effectively conducted in the forest fringe communities within the degraded Pamu-Berekum reserve to assess level of participation of the farmers who are willing to be involved in the project. Awareness workshop and seminars on effective participatory strategies was organized for the framers and the communities to strengthen their interest in the tree planting. Successful CDM methodologies that could be helpful in implementing the national tree planting program and for climate change mitigation were documented for future use.

ii. The adequacy or inadequacy of the results of the identification process: definition of the problem, the project objective and the choice of the implementation strategy

Design of the project, from definition of the problem, project objective through the development of implementation strategies, the project initiators involved stakeholders in critical analysis of the issues. The main problem was the destruction of many forest reserve in Ghana including the

dry forest Pamu-Berekum which needed effective reforestation efforts. The pristine dry forest land in Ghana (Pamu-Berekum) was among the degraded reserves which suffered wild fire destruction. **Through active stakeholder interactions**, the CDM project sought to address this problem by engaging in Community CDM Forestry with viable poverty alleviation component to restore the degraded forest. The major barrier to successful implementation of local reforestation programmes in Ghana was that communities were deprived of incentives to be enthused in the plantations programme. Therefore the CDM project addressed this problem by introducing sustainable livelihood development activity as a motivational package for the participating farmers. Farmers' were trained on current technologies in bee-keeping, gari processing and snail rearing as an alternative livelihood activity. The project strategies included inventory, evaluating carbon stocks and canopy cover of the OCAP, successful participatory strategies of the community farmers were assessed and the OCAP model was replicated by rehabilitation of 100ha plot in the dry forest zone of Ghana. The socioeconomic and environmental survey revealed that the local people and the communities had the perception that trees have long rotation in reaching merchantable height for harvesting and some trees may hinder the crops yield hence feared to plant trees on their farms. The project team organized series of workshops and education campaigns to eradicate that perception of the community farmers. Farmers involved in the CDM project were introduced to relatively fast growing indigenous and exotic species that were compatible with the food crops in agro-forestry system. Training on simple strategies of plantation establishment and management were organized for the farmers. Various project steering committee meetings were held at the project executing agency to discuss the strategies to achieve the developmental objectives of the project. There were no major challenges in the project execution, the results of the identification process were adequate for the definition of the problem and objectives set were appropriate. The projects' overall goals were achieved with collective effort of all stakeholders of the project.

(iii) The most critical differences between planned and actual project implementation

The CDM project was implemented according to the planned activities in order to obtain the project outputs. The schedule of activities within the project duration was systematically executed by all stakeholders of the project to enhance the attainment of the developmental goals set. In the third year of the projects' implementation there were few activities which were yet to be completed and therefore after the steering committee meeting it became necessary that the executing agency sought for 6 months extension from ITTO to facilitate the completion of such activities. This extension of project activities was done within the budget approved for the projects' execution and no additional expenditure was incurred. Thus within the period extended, the remaining activities was completed successfully. The differences between planned and the actual implementation was very necessary to the successful implementation of the project.

iv. Time and project Inputs quality and quantity: personnel and equipment, financial resources, knowledge and expertise

The project execution considered effective involvement of stakeholders and capacity building of farmers, students and the project field team which was relevant to documenting the successful strategies of the CDM forestry in Ghana. Data collection from carbon stocks of 19 African tree species in the OCAP and canopy cover of the stands were disseminated through publications in refereed journals. The project had good expertise in carbon stocks determination, socioeconomic surveys and knowledgeable data collection team which all contributed to the achievement of the projects developmental objectives. The equipment, financial and human resources were adequate for successful execution of the planned project activities.

v. Anticipation and reality of external influences, assumptions and risks etc. and the effectiveness of mitigating measures

The implementation team anticipated effective community and farmers' participation in the CDM forestry as the plantation establishment on the degraded reserve was an opportunity for farmers to plant more food crops with the trees. The difficulties in accessing farming lands especially for the immigrant farmers in the fringe communities of the Pamu-Berekum forest reserve offered hope to the project team for sustainability of the project. The community farmers assured us of their strong collaboration for successful implementation of the CDM forestry. The project team anticipated farmers' perception on the carbon credit from the trees planted during the project. The implementation team embarked on widespread education and sensitization to inform the communities well on the actualities of the project in order not to raise any false outlook concerning the project. There is hope that with this sensitization program in place, the project objectives will be met. Seedlings were supplied to meet the high demands of farmers and many community farmers embraced the tree planting initiative of the project. Carbon stocks estimation was done without any challenges. The project team managed all project activities that were quite expensive in terms of personnel and the associated cost within the budget approved to obtain the developmental goals. Successful CDM methodologies that could enhance the national tree plantation projects were documented. All the stakeholders of the project were very committed to strategies of implementing the activities as planned and that influenced the successful attainment of the project outputs.

vii. The participation of anticipated and actual project beneficiaries in project implementation and how they have and will be benefited from the project

The Forestry Commission, National Plantation Development Center, Forest Industries, Private Plantation developers and local community farmers involved in the CDM forestry were the anticipated participants/beneficiaries of the project findings. Representatives of these relevant

stakeholders were usually involved in the project steering committee meetings to seek their views on the project design and implementation techniques. Project findings were presented to the stakeholders and their concerns were given critical attention to improve benefits from the project.

The project team collaborated with the Forestry commission to guide farmers in selecting the most suitable plantation designs that could maximize yield of their food crops while not compromising the growth and productivity of the trees. Best agro-forestry and mixed plantation designs were introduced to the farmers involved in the project. The project execution agency signed MOUs with the collaborators/beneficiaries on the project to allow for effective management of the planted stands.

viii. Sustainability after Project Completion

The project execution considered all the stakeholders as vibrant human resource whose capacity were built to sustain the project after completion. These included community farmers, students, Staff of the forestry commission especially the climate change unit, Dormaa forest District, scientists and technicians from FORIG. Training in simple carbon estimation strategies have been given to all the stakeholders and that has strengthened their skills to conduct regular assessment of the established stands both at the OCAP and Pamu-Berekum. Strategies for sustainable community forest management of the OCAP plantations have been established by Samartex and FORIG. Farmers are also willing to maintain the trees through regular clearing and monitoring, fire belts have been constructed around the farmers fields to guard against spontaneous wildfires. Fire fighting volunteers were organized in all the project sites to enhance the protection and sustainability of the CDM project. CDM capacity building component to the project in training of a PhD student in estimation of carbon and other forestry practices that improves the stands productivity at Michigan Technological University is a major component for ensuring sustainable management.

(i) The understanding and appropriateness of the roles and responsibilities of the institutions involved with the project implementation

The project team members and institutions involved in the project implementation focused on identifying reliable and practical mechanisms to achieve the developmental objectives of the project. The project outputs, state of the various activities and the progress made were clearly disseminated to stakeholders during steering committee meetings and that enhanced the smooth implementation of the project. Representative from the climate change unit of Forestry Commission, Ghana chaired the meetings to ensure that suggestions and various recommendations given could improve the quality of the CDM project. Active stakeholder involvement was realized throughout the project execution. The expert in carbon accounting and ecological studies from MTU participates in the steering committee meetings and frequently visits the project site to inspect the established stands. Evaluation schemes for the stand performance yield, biomass and carbon sequestration were conducted. Thus, effective

collaboration from all stakeholders influenced the successful implementation of the project without any major challenges.

6.0 Lessons learned from project identification, design and implementation

(a) Project identification and design matters

Most of the pristine forest landscapes in the tropics realized vast deforestation and degradation. These areas were hotspots for supply of environmental and ecological services, maintenance of biodiversity and carbon sequestration to mitigate impacts of climate change. A model CDM project was needed to develop a national plantation program for Ghana which will ensure that the degraded areas are reforested. A major barrier to effective plantation development geared towards mitigating climate change was the loss of incentives and income generation for community farmers. The model CDM project incorporated alternative livelihood activity that encouraged effective community participation. The design of the project in a form of agro-forestry system which were stocked with food crops for subsistence and market mixed with the trees were sustainable avenue which attracted many farmer to embrace the CDM project. Practical training on nursery techniques equipped farmers to establish and maintain the community nurseries. socioeconomic surveys and workshops were organized regularly to assess level of participation of the fringe communities and measures to improve the project. Active stakeholder involvement in the project implementation as set by the project design influenced the achievement of the project specific and developmental objective.

- **Additional arrangements that could improve cooperation between the relevant parties interest in the project**

The level of commitment and involvement of community farmers in plantation development programmes in the past was generally low in Ghana. Lack of incentives and income generation avenues which will improve the livelihood of the rural poor involved in the plantations establishment for restoration. Also equity issues on communal land leased by the local authorities for various farming activities posed a challenge to the initiation of any restoration programmes which demanded the involvement of local communities. The CDM project team devised strategic approaches that resolved these issues to enhance effective participation of community farmers in the project. Ownership of the planted stands were made understandable to all parties including the Forestry Commission, Samartex and the community farmers to guard against possible chaos that could arise from claims for owning the stands. Community farmers involved in the project were educated on the criteria and indicators for qualifying for Carbon credit from the planted trees. This boosted their morale to ensure full commitment in the establishment of the CDM plantations.

- **Aspect of project design which most contributed to its success or failure in achieving the Development objective**

The project strategy of involving stakeholders and targeted beneficiaries throughout the implementation of the project was key to the achievement of the developmental objective of the

project. Also the expertise of the project team and their commitment to achieve sustained interest of the stakeholders in the project contributed significantly to achieving the development objective of the project. The project in the field could have failed if the farmers were not co-operative.

- **Actions to be taken to avoid variations between planned and actual implementation**

Any variation that will affect the budget significantly had to be avoided. However since the project is applied research, there was the need to make room for unplanned activities during implementation. Stakeholder participation had to be encouraged at the formulation of the project idea and subsequent project development

- **Factors which will most likely affect project sustainability after completion**

The projects intended to enhance CDM forestry in Ghana through payment for environmental services and preservation of the ecological integrity of degraded forest landscape. Practical and easy to adapt strategies that will ensure effective restoration of completely degraded forest lands were put in place and applied in the project implementation. Community farmers and well equipped personnel have been developed and their capacity to sustain the project after completion. A major aspect for sustainability of the project was through participation of the project leader in meetings held by the Forestry commission Ghana on the CDM concepts and its feasibility. The project team led in the definition of forest and classification of the CDM as part of its preparation and participation in the REDD+ at the national level. Scientists and the project team at FORIG and Samartex will continue to assess, monitor and maintain the established stands as part of their routine activities. culture. The project has also enhanced the capacity for estimating carbon and allometric equations have been developed for carbon credit. This has increased the awareness of the forestry staff and other stakeholders to engage in the national plantations program geared towards participating effectively in the REDD+.

(b)Operational Lessons

- **Project organization and management**

The project had a project directorate led by the project leader under the supervision of the director of the executing agency. Project steering committee meetings were held regularly with active participation of all stakeholders as well as the community framers to update the team on achievement of the project activities and how to sustain the success gained. Formal and informal meetings and interactions with project team members to deliberate on project results and expectations were also undertaken. Project facilities were made accessible to all project team

members and bureaucracies were avoided as much as possible. The project was most successful due to the cordial environment provided by the project directorate and the field crew.

- **Flow of funds**

The funds from ITTO and collaborating agencies were provided as planned. Michigan Technological Universities support to the masters student on the project was consistent with the project objectives. Samartex was also very supportive throughout the project execution. The project directorate avoided misappropriation of the funds as such all activities was done within the budget approved. Usually funds were requested upon depletion the all the fund in the project accounts which sometimes caused some financial stress for the project.

- **Definition of the roles and responsibilities of the institutions involved in the project implementation**

The institutions involved in the project were;

- Forestry Research Institute of Ghana (FORIG)
- Forestry Commission
- Samartex Timber and Plywood Company limited
- Logs and Lumber Limited(LL)
- OCAP Community Farmers
- Pmau-Berekum community farmers
- School of Forest Resources and Environmental Science, Michigan Technological University (MTU)

Ghana Government/Forestry Commission representative chaired the steering committee meetings and provided policy advice to support the project implementation

Director of the Forestry Research Institute of Ghana, supervised the overall implementation of the project as the director of the executing agency

- **Timber Industry Association representative** provided advice on the expectations of the timber industry and also was the link to inform the industry of the research outputs
SAMARTEX was a collaborating timber organization in the implementation of the project. Samartex was involved in most of the project activities and their contributions at the steering committee meetings were useful in directing research activities and making our practical and user friendly to the timber industries
- **Michigan Technological University** was a collaborating organization. The Experts from Michigan Technological University provided funds and trained one

masters student in carbon accounting and estimation. The experts participation at the steering committee meetings helped to improve project implementation

- **ITTO representative** guided project steering committee to implement the project as defined in the project document as part of the Technical monitoring role of ITTO.
- **Pamu-Berekum and Kranka Community Farmers** represented community farmers and served the interest of farmers at the fringe areas of the degraded forest who were actively involved in the project implementation at the steering committee level to that their concerns are considered.

b) Project documentation

A scheme of record keeping, reporting, monitoring, project documentation and publication was developed to track progress of the project. The project directorate ensured that biannual progress reports were submitted to ITTO and project results were delivered as presentations at workshops and conferences to stakeholders. Electronic copies of all the documents were loaded on the ITTO POLM, and hardcopies were kept safely. Project financial documents and reports were kept according to financial standards of the Forestry Research Institute of Ghana and were fully audited to ensure that the expenses on the project activities were within the budget approved. Project technical reports and student that used project research material for their research theses write up were kept electronically and in hard copies at the project secretariat.

c) Monitoring and evaluation

The project directorate organized forums to engage the project participants in interactions to solicit for their opinions on the project implementation techniques and ways to achieve the project outputs and also to monitor the progress of their activities.

Workshops and seminars were organized frequently in the participating communities to create awareness of the need to engage in plantations establishment to enhance ecological cycles, climate change mitigation and also to disseminate new strategies developed to the farmers. The annual steering committee meetings with representation of ITTO and all the major stakeholders and beneficiaries of project results put the team on track and ensured that all scheduled activities were done to expectation to meet the set objectives. During one of the steering committee meeting it was identified that the field crew the farmers were advised and encouraged to and consider the stands established as their asset like they do for the cocoa farms and therefore ensure effective protection and sustainability. farmers at the Fringe Communities of Pamu-Berekum willingly formed a fire patrolling group to guard the CDM stands from uncontrollable bush and wild fires. monitoring and evaluation of the established stands was conducted on regular basis and research outputs were presented at the PSC meetings for suggestions.

d) External factors that influenced the project implementation

The establishment of community nurseries at Pamu-Berekum facilitate the smooth access to seedlings for planting. Farmers were introduced to series of sustainable livelihood development activities which boosted the interest of community farmers to involved in the project. Training in maintenance of the nurseries, beekeeping, gari processing endowed the framers with extra jobs that generated income for their subsistence. The project external expert in carbon estimation and accounting helped in the project implementation contributed immensely to the success of the project. Simple methodologies for establishing large scale plantations that mimics the natural forest for supply of carbon in the global sphere has been developed to facilitate the Ghana's REDD+ program.

7. CONCLUSIONS AND RECOMMENDATIONS

(i) Conclusions and Recommendations

• Identification

The main goal of the project was to improve capacity for CDM forestry in Ghana via a community forest targeted at poverty alleviation in conjunction with SFM. This goal was realized through the collective efforts of all stakeholders involved in the project implementation. The project identification process should be collaborative and participatory as possible involving all relevant stakeholders and target beneficiaries of the project results. This enhanced the capacity of Ghana's initiative in undergoing REDD+ and mitigating global climate impacts.

• Design

The project design was very unique in its the participatory approach which involved many stakeholders as collaborators to have their views integrated into the project design. The design was simple, taking into consideration stakeholders' capabilities, skills and expertise, level of education and capacity to use and adapt the technologies to be developed.

• Implementation

The project overall goals was achieved successfully without any major challenges. The success and achievements were attributed to the unflinching support from all the projects stakeholders and their constructive input in executing the project activities. The project executing agency was helpful and time conscious in guiding the team members to carry out the scheduled activities as planned. Frequent monitoring and evaluation strategies were adopted to promote that all community and the field staff be on track to enhance the attainment of project goals of reforesting large areas of the degraded forest and also promoting the ecological integrity of the forest.

The established stands on the community lands which had agreement with the industry (Samartex) was done with their own staff, farmers and the project field team such that they would be familiar with the design and application of management strategies to sustain the stand. Established stands at the Pamu-Berekum forest were often evaluated to ascertain the growth and

productivity. Successful implementation strategies of the project impacted on policies for relevant stakeholders and other investors interested in plantation development for green carbon and marketing.

Technologies developed under the project was embraced by stakeholders and this has promising impact on the national plantation development plan of rehabilitating degraded landscapes and promoting payment for environmental services. Active involvement of the director of plantations and climate change unit of the Forestry Commission and his association contributed to the acceptance and success of the project.

- **Organization**

The project directorate by the led by the project leader under the supervision of the director of the executing agency ensured the successful completion of the project. Formal and informal meetings which included PSC meetings, workshops, and participatory rural appraisal were organized regularly for the project team, stakeholders, and community famers to deliberate on strategies to implement the scheduled activities and to attain the development objectives of the project. The project results were disseminated through publications and expectation of the project were also made known to all the partners of the project. Project team members including student interns were exposed to the project facilities and possible bureaucracies which could mild the progress of the project activities were avoided. Cordial environment were provided to stimulate innovations and better outputs. In addition to the formal meetings, a channel for free flow of information was created for the stakeholders including the community farmers to interact and share problems which were highly considered to enhance the success of the project.

- (i) **Potential for replication and/or for scaling up**

The CDM project was interesting and timely Ghana as part of the discoveries and initiative of entering into REDD+. Stakeholders and beneficiaries of the project outputs were enthused on the practical approaches utilize by the project team in engaging communities of diverse socioeconomic backgrounds to successfully established commercial plantations. Capacity building of the farmers, students, forestry staff in carbon estimation is a major achievement for future development of any national plantations program. Even though the project has ended, neighbouring communities in the Pamu-Berekum and Koradaso area which were not included in the project expressed their interest to participate in futher forestry projects at the area. It is expected that these farmers will show up in the national plantations program to make the goal of mitigating global climate change a reality in Ghana.

Responsible for the project

Name: Dr. Emmanuel Opuni-Frimpong

Position held: Project Leader

Sign:

Date:

Annex1 Project financial statement

Annex 2 Project cash flow statement