Forest Resources Assessment Working Paper 160

Case Studies on Measuring and Assessing Forest Degradation

Assessment of Forest Degradation by Local Communities: The Case Study of Ghana

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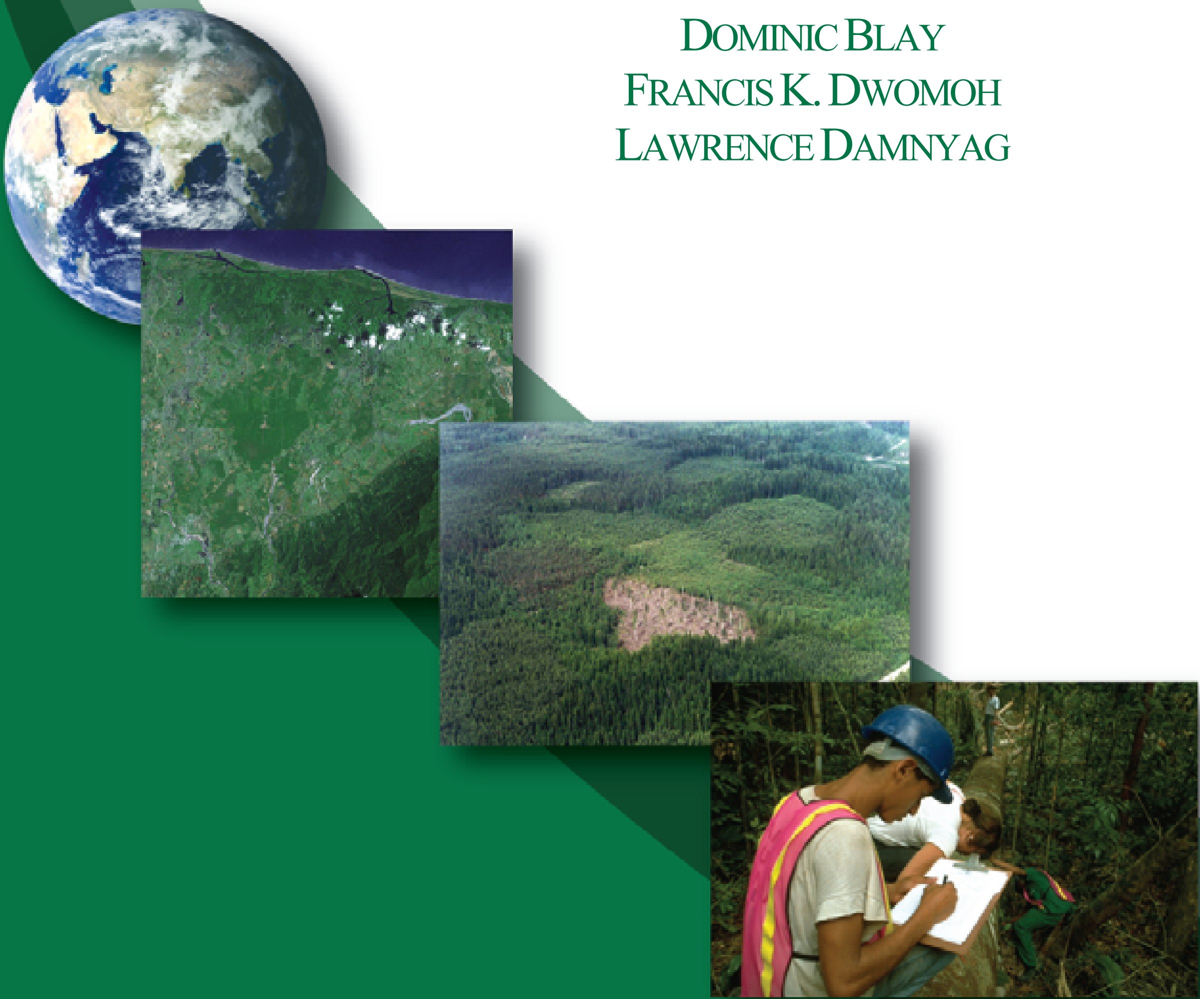

December, 2009

Sustainably managed forests have multiple environmental and socio-economic functions which are important at the global, national and local scales, and they play a vital part in sustainable development. Reliable and up-to-date information on the state of forest resources - not only on area and area change, but also on such variables as growing stock, wood and non-wood products, carbon, protected areas, use of forests for recreation and other services, biological diversity and forests' contribution to national economies - is crucial to support decision-making for policies and programmes in forestry and sustainable development at all levels.

Under the umbrella of the Global Forest Resources Assessment 2010 (FRA 2010) and together with members of the Collaborative Partnership on Forests (CPF) and other partners, FAO has initiated a special study to identify the elements of forest degradation and the best practices for assessing them. The objectives of the initiative are to help strengthen the capacity of countries to assess, monitor and report on forest degradation by:

- Identifying specific elements and indicators of forest degradation and degraded forests;
- Classifying elements and harmonizing definitions;
- Identifying and describing existing and promising assessment methodologies;
- Developing assessment tools and guidelines

Expected outcomes and benefits of the initiative include:

- Better understanding of the concept and components of forest degradation;
- An analysis of definitions of forest degradation and associated terms;
- Guidelines and effective, cost-efficient tools and techniques to help assess and monitor forest degradation; and
- Enhanced ability to meet current and future reporting requirements on forest degradation.

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Forestry Department
Food and Agriculture Organization of the United Nations

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Abstract

The rate of forest degradation is continuously increasing throughout Ghana. To mitigate the effect of degradation, the International Tropical Timber Organization (ITTO) funded a project to rehabilitate some degraded forests with the collaboration of local communities. Due to resource constraints, three sites were to be selected from five potential sites *Asukese*, *Bonsam Bepo*, *Southern Scarp*, *Afrensu Brohuma* and *Pamu Berekum* within three forest ecological zones on the basis of perceived rates of degradation. Thus to select the final three areas for the project, assessment was done using indicators developed collaboratively with the local communities based on their experience on what had been the state of the forest before degradation as well as how their livelihoods have been impacted because of degradation. The indicators were developed through Participatory Rural Appraisal (PRA) and workshops. Based on this, five main indicators were identified as indicators of degradation in the high forests of Ghana. These indicators were:

- Number of plant species in the forest;
- Level of soil fertility as indicated by the presence of indicator plants of poor soil fertility;
- State of riparian vegetation;
- Number of plant species used as Non-Timber Forest Products (NTFP); and
- State of fire attack in the forest.

Using these indicators and methods based on quantitative inventory, ethno-botanical survey and habitat assessment, three sites namely *Pamu Berekum*, *Afrensu Brohuma* and *Southern Scarp* were selected for implementation of the project.

Advantages of the methodology included the following:
(i) Local people were directly involved in data collection and interpretation;
(ii) Where monitoring was linked to the decisions of local people, simple and cheap methods requiring few resources were used;
(iii) These straightforward methods can be used by anybody with very minimal training, and therefore can be used by local communities whose livelihoods are impacted by degradation;
(iv) They required no sophisticated and expensive equipment such as remote sensing tools and other ‘externally driven’ approaches;
(v) They can be used to support any advanced methodology;
(vi) They can build local capacity and facilitate cooperation between local people and the authorities; and can thereby stimulate local action and result in rapid forest management interventions;
(vii) They could contribute to monitor reduction in emissions from forest degradation by local communities, because they could promote accountability of carbon emission reduction efforts.

The main disadvantage of the methodology is that due to the level of the personnel involved, the methodology was not subjected to any scientific statistical analysis to verify their accuracy. The main principles to be learnt are that when local communities are made aware of the importance of projects to be implemented on their livelihoods, they are very likely to collaborate. Local communities have extensive knowledge on the forest and have essential information necessary for forest inventory.

KEY WORDS: Forest degradation, REDD, Ghana, remote sensing based monitoring, local communities, indicators

1. Introduction

1.1 Background

Degradation of the forests in Ghana is assuming alarming proportions. Although the total area degraded is not known, there are estimates for rate of deforestation, which is the precursor for degradation. At the turn of the 20th century it was estimated that Ghana had 8.1 million ha of forest land (Ghartey, 1990). At present, the total area of forest estates of Ghana occupies an area 2.1 million ha with 1.8 million ha in the high forest zone (Dykstra et al. 1996) and only 0.3 million ha in the savannah. Outside the gazetted areas, an estimated 400,000 ha of forest cover still exist (off-reserves). There are 266 forest reserves of a total area of 1,634,100 ha but analysis by Hawthorne and Abu Juam (1995) showed that of the total area, some 90,000 ha is in reasonable condition and the remainder is mostly degraded or has no significant forest left. Figure 1 describes the condition of forest reserves in the High forest Zone of the Ghana in percentage terms.

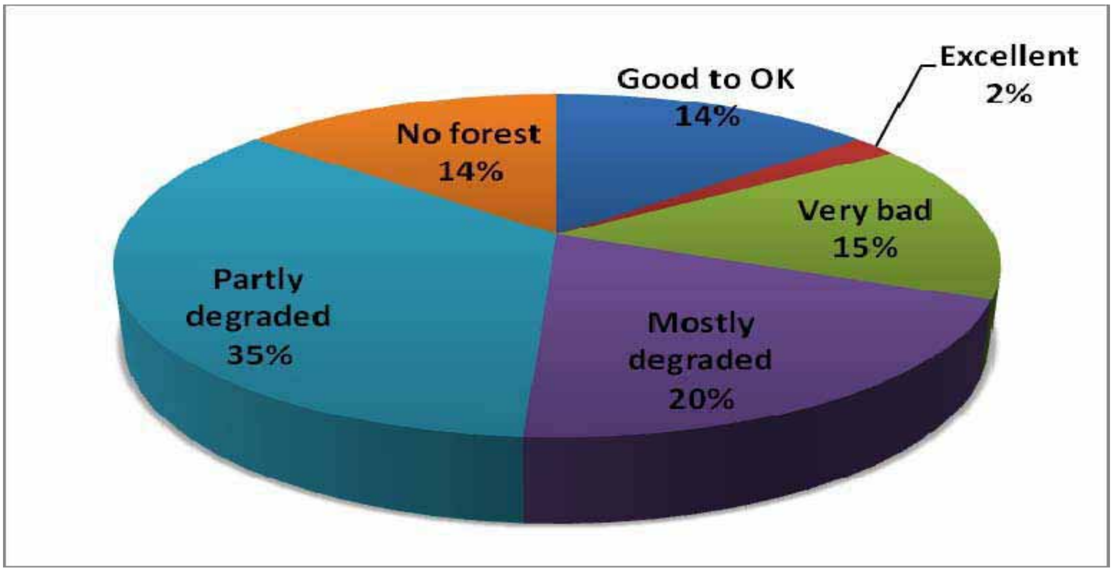

Figure 1: Condition of forest reserves in the High forest Zone of the Ghana
(source: Hawthorne and Abu Juam, 1995)

The impact of this degradation which affects human livelihood and the environment are shortages of firewood and other wood; shortages of non-timber forest products; increased sediment deposits, floods and land slides; drying up of springs and water bodies; siltation of dams; increased incidence of water-borne diseases; loss of biodiversity; climate change. On the basis of this continuous degradation of the forest resources of Ghana, the Forestry Research Institute of Ghana applied for a research grant from the International Tropical Timber organization (ITTO) to rehabilitate some of the degraded areas with the collaboration of forest fringe communities.

Although there were proposed sites in the project proposal, due to limited resources and time factor these sites had to be reduced. Thus there was the need for prioritisation of the proposed sites based on the degree of degradation. Hence the development of indicators for the assessment was undertaken in collaboration with the local communities. They have intimate knowledge of the composition of the forest prior to degradation and are therefore aware of what has disappeared from the forest. They are also the stakeholders, whose livelihoods are impacted most by the degradation and therefore know what they had depended on in the past and is no more available. They therefore provided information on the timber resources that were in the forests but are no more available, the state of biodiversity especially in terms of NTFPs that had been available in the forests, the state of the streams and rivers in the forests, how protected the forests are from fire, and how the degradation had impacted on their livelihoods in terms of what has been lost. This case study is therefore related to the following thematic areas: Forest health and vitality; Biological diversity; Productive functions of forests; Protective functions of forests; and Socio-economic functions of forests.

1.2 Usefulness of assessment results

The assessment served as a precursory study to the implementation of a five-year rehabilitation of degraded forests community project, funded by the International Tropical Timber Organization (ITTO). The aim of the project was to arrest the decline and degradation of tropical forests in Ghana. The project was subsequently carried out in ten local communities located in the three most degraded forest areas determined from the assessment.

A significant output of the project was the rehabilitation of 250 ha of degraded forest sites using nine indigenous and one exotic species as principal tree species in community plantations (Blay *et al.*, 2008; Blay *et al.*, 2007). This achievement practically demonstrated the potential of indigenous Ghanaian species as plantation trees suitable for rehabilitation. In addition, methods of establishing plantations in degraded forests were identified. The capacity of the participating local communities in plantation establishment was also built. Again, the project results demonstrated that reversing tropical forest degradation is possible when community-based approaches are adopted. Figures in appendix 1-5 show some highlights of the project results.

2. Methodology

2.1 Study sites

The study was undertaken in five forest areas representing different forest ecological zones where degradation appeared to be high. The forest reserves were *Asukese* and *Bonsam Bepo* forest areas in the Moist Semi-deciduous North-west (MSNW) forest zone, *Pamu-Berekum* in the Dry Semi-deciduous zone (DS); *Afrensu-Brohuma* Forest Reserve in the Dry Semi-deciduous Fire Zone (DSFZ) and the *Southern Scarp Forest Reserve* in Moist Semi-deciduous South-east (MSSE) forest zone. The above forest zones lie between latitudes 6° and 8° in the southern part of Ghana (Figure 1). The zone is the most floristically diverse and economically important forest in Ghana. Originally these are areas of highly stocked closed-canopy forest. These forests exhibited well-developed, multi-layered and continuous canopy. The height of emergent trees range 30-50 meters with a few reaching 60 meters (Hall and Swaine, 1976). Characteristically, lianas and large buttressed trees are present. The area hosts an abundance of non-timber forest products including wild fruits such as *Dacryodes klaineana* and *Chrysophyllum spp.* There are many useful tree species that are used for first aid and specialist treatments. These include *Kigelia africana, Spathodea campanulata, Newbouldia laevis, Lannea weltwitschii* and *Celtis species.* Wildlife is also prevalent in this area and hunting for these animals is a widespread activity here.

The size of area covered by these forest reserves are *Afrensu-Brohuma* 72.5 km^2, *Asukese* 265.0 km^2, *Bonsam Bepo* 124.3 km^2, *Pamu-Berekum* 189.1 km^2 and *Southern Scarp* 154.6 km^2 (Hall and Swaine, 1981). These forests appear in a matrix of agricultural lands and village settlements. Originally most of the adjourning areas were forest (off-reserve) belonging to communities. However, due to pressure from timber over-exploitation, unsustainable agricultural practices, settlement expansion and rampant wildfires most of these areas are currently degraded. Indeed, the dire extent of degradation in these off-reserve areas has further exacerbated degradation in the reserved forests.

All the forest reserves where the study was conducted belong to the category of tropical semi deciduous forest (UNESCO, 1978). It is instructive to note that in Ghana this zone has further been categorised by ecological zones, hence the aforementioned categorization of the study area. Fundamentally, forest characteristics in these areas do not vary much. Therefore comparison of degradation across different forest reserves was adopted in this study instead of comparison within the same reserves. This was also necessary to reduce the cost of fieldwork, as comparison within the same reserve would have called for more sample plots, which comes with additional cost.

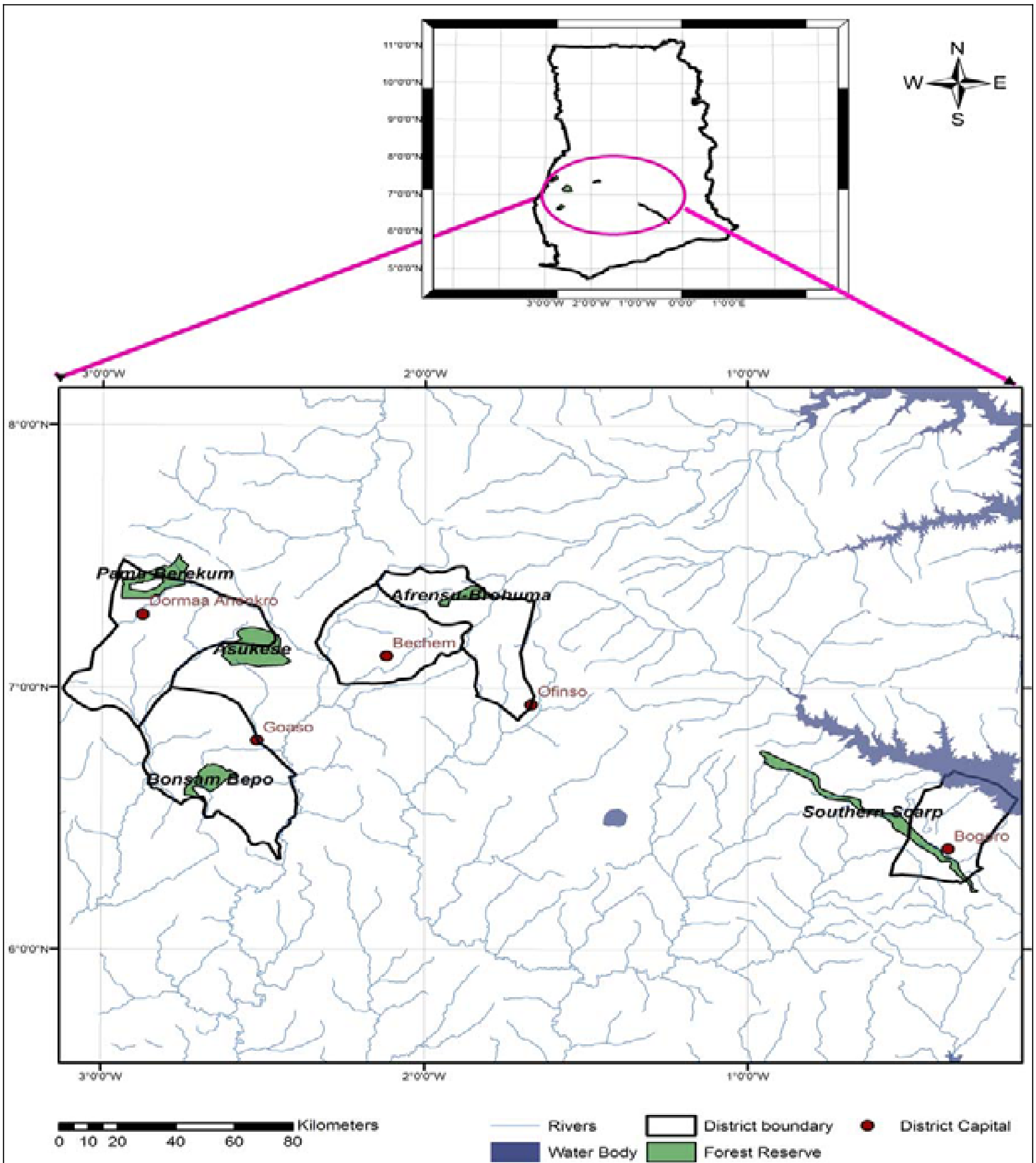

Figure 2: Map of Ghana showing the project sites.

2.2 Development of indicators

Socio-economic survey

Indicators for the assessment were identified through a socio-economic survey, undertaken through questionnaires that were administered to the members of 24 forest fringe communities. Before administering the questionnaire each potential respondent was briefed about the importance of the assignment to their livelihood and clarification sought if he or she wanted to participate before the questionnaire was administered. The questionnaires focused on:

(i) the state of forests at present as compared to about 20 years ago;
(ii) products that were obtained from the forest some years back and which are no more available;
(iii) the fertility of the land at present as compared to 20 years ago; and
(iv) the state of streams and rivers in the forests within the same time period.

The answers were compiled and presented to the communities at four separate workshops where in working groups they were asked to identify from the responses and from their own perspectives what were the indicators that showed degradation of forests in their areas. From the reports of the group discussions and in the plenary, a list of indicators of degradation was approved. Lists from all the workshops were compared and common indicators were selected as a final summary of indicators of degradation. The full list of indicators follows, followed by the summary of key indicators:

- Reduction in soil fertility
- Soil erosion due to burning of grasses
- Presence of fire adapted grasses in the area
- Presence of burnt areas in the forest
- Fire related suspended particulate matter e.g. hazy weather
- Reduced water supply and quality
- Absence of dense patches as fire breaks
- Reduction on forest food , honey, fruits, seeds, tubers, etc
- Reduction in medicine and herbs
- Decrease in game, wild animals and birds
- Reduction in materials for shelter (ropes, roofing, wood, bamboo, etc)
- Reduction in materials for households (pestles, mortar, firewood etc)
- Reduction in income (sale of rattan, cola nuts, wood, etc)
- Reductions in rainfall amounts and pattern
- Reduction in soil fertility
- Destruction of plantations
- Reduction on provision of services (provision of shade, wind break, etc)
- Vegetative cover destruction

The list was then refined to provide a summary of five key indicators of forest degradation for the high forest zones of Ghana:

- Number of plant species in the forest
- Level of soil fertility as indicated by the presence of indicator plants
- State of riparian vegetation
- Number of plant species used as Non-Timber Forest Products
- State of fire attack in the forest

These indicators can be used to measure the state of the following thematic elements of Sustainable Forest Management:

- Biological Diversity
- Protective function of the forest
- Forest Health
- Productive function of the forest

In effect, the results of the socio-economic survey (questionnaire) complemented the results obtained from the field inventory, in that through the socio-economic survey it was possible to develop a list of indicators of degradation which was then later refined to provide the summary list of key indicators of forest degradation.

2.3 Indicators and methodology used for assessment of degradation

To undertake the assessment of the forest to determine the degree of degradation each forest fringe community nominated volunteers who could be trained in the assessment. The volunteers were provided with theoretical background to the assignment before being attached to the project team members for the field assessment, thus, equipping them with the capacity to monitor the state of forest resources.

As a result of the identification of key indicators assessment was done to determine the following indicators in the forest:

(i) Biological diversity of the forest with regards to floral resources including timber and non- timber species available in the forest was assessed through vegetation surveys and measures of the number of plant species;
(ii) State of NTFPs that communities depend on were assessed through vegetation surveys and a measure of the number of plant species used as NTFPs;
(iii) Protective functions of the forest in terms of state of the streams in the forest through habitat assessment of riparian vegetation;
(iv) Health of the forest with regard to fire and soil fertility through a measure of the history of fire incidents and presence of species indicative of poor soil fertility.

2.4 Assessment of biodiversity (Timber and Non Timber Forest Products)

In each selected forest, one hectare sample plots of dimensions 100m by 100m were demarcated for the assessment of timber and non-timber forest products. Each 1-ha plot was further divided into five stripes using four access lines cut at 20 meter intervals along the 100m boundary. This plot layout was necessary to minimize errors during enumeration and also to facilitate movement. Sample plots were replicated four times in each of the selected forest areas. Plot set up was done using wooden poles, nylon ropes, a prismatic compass and linear measuring tapes. Local community members on the inventory team were trained in basic tree identification, visual estimation of vegetation cover, tree diameter measurements and height estimation techniques.

The enumeration teams included: tree spotters, who were local community members, a recorder and assistant(s). Moving clock-wisely, all trees of size ≥10cm in diameter at breast height (DBH) were identified to species, measured with diameter tape and recorded. Height of trees was obtained using ocular estimation. Specimens of unidentified trees were collected and sent to the herbarium for identification. DBH was taken at 1.3m from the ground and in the case of buttressed trees 10cm above the point of convergence of the buttress.

Natural regeneration were assessed by establishing four rectangular plots of 2m wide by 5m long with an access line dividing the 2m into 1m at either side. Within each plot all natural regenerating plant species were identified, counted and tabulated.

2.5 Assessment of state of NTFPs

For the assessment of the state of NTFPs, local community members on the inventory team were asked to identify species they use as NTFPs from the list of flora species encountered in the biodiversity assessment. These were species they considered to contribute to their livelihood.

2.6 Protective functions of the forest (habitat assessment)

The quality and extent of riparian vegetation is a critical component of habitat index. Soil characteristics and plant communities in riparian areas indicate the presence of free, unbound water, associated with the margins of streams, rivers, ponds, lakes, springs and other wetlands (Fitch and Adams 1998; Gregory *et al*., 1991). For the assessment of protective functions of the forest, the condition of streams within the forest was assessed since trees are important in the regulation of water bodies. This was done by assessing the percentage canopy cover of riparian vegetation and classifying them as shown in Table 1.

Canopy cover was determined using visual estimation techniques. To obtain this four sample plots measuring 20m x 20m were randomly located within the riparian vegetation along streams and rivers. In each plot visual estimates of tree canopy cover was done by estimating the proportion of the ground covered by the crown of trees. Observations were made at the centre of each sample plot. Figures obtained in these plots were averaged to obtain the canopy cover percent for that forest area.

In addition, the soil fertility within the subplots was also assessed by counting the number of plants of species indicative of poor soil fertility (*Striga hermontica* and *Tridax procumbens*) in four $1m^2$ (1m x 1m) plots randomly located in each subplot.

Table 1: Classification of riparian vegetation based on crown cover percentage

Excellent	**Good**	**Fair**	**Poor**
75-100% crown cover	50-75 % crown cover	25-50% crown cover	<25% crown cover
Total vegetative cover over the stream banks zone up to 30m wide.	Good vegetative cover but with some few gaps in the vegetative cover	Vegetative cover present but has many gaps	Very minimal or no vegetative cover

2.7 Forest health

The state of health was assessed by determining the fire history of forests. Thus within the one hectare plots established for the assessment of biological diversity, subplots of 50m x 50m were established. Within these subplots, the number of trees with burn scars was counted and recorded. The area of forest floor with burnt vegetation and or regenerating from burning was also assessed.

3. Results

Results from the Questionnaire

Table 2 shows the percentage of local communities indicating resources and services they had obtained from the forest in the past but which are now no more available. Table 3 shows local community's perception about the effect of vegetation cover destruction in the forest. Table 4 shows the proportion of respondents indicating impact of wildfires.

In Table 2, tree products include latex, wild cocoa, gums, fruits, flowers, seeds and species, whilst forest products for food include snails, mushrooms, bush meat, palm fruits, tortoise, snakes, foodstuff-plantain, cocoyam that 441 local community respondents indicate that they used to obtain from the forest in the past. For these community members, combinations of these forest resources are very useful to them. However, forest products for food seem to be the most important resource as indicated by over 80 percent of these respondents in Table 2.

Table 2: Percent of local communities indicating resources obtained from the forest in the past but which are no longer available (total respondents (N) = 441)

Forest resources	Number of responses	Percent of total respondents (N= 441)
Tree products[1]	295	66.9
Plant materials[2]	324	73.5
Forest products for food[3]	375	85.0
Climate control/ regulation[4]	165	37.4

Note:
[1] latex, wild cocoa, gums, fruits, flowers, seeds and species
[2] medicinal plants, chewing sticks, fodder for animals, rattan/ropes for weaving and buildings, leaves for roofing, wood for cooking, kitchen equipments-pistols, motor etc
[3]snails, mushrooms, bush meat, palm fruits, tortoise, snakes, foodstuff-plantain, cocoyam
[4] regular rainfall

Forest cover

84% of respondents indicated that there had been a loss of forest cover. In addition, respondents indicated that there had been destruction of the beauty of forest, destruction of watershed and catchments, and loss of soil fertility as indicated by 40%, 28% and 24% of a total 602 respondents respectively (Table 3).

Table 3: Local community's perception about the effect of vegetation cover destruction in the forest and forest savannah transition ecological zones (Total number of respondents (N) = 602)

Perception about effect of vegetative cover destruction	No. of responses	Percent of total respondents (N=602)
Soil fertility	142	23.6
Loss of forest cover	503	83.6
Watershed & catchments area destruction	171	28.4
Destruction of beauty of forest	241	40.0
Less water in wells	47	7.8
Destruction of crops by rain storm	35	5.8
Rainstorm destroys houses	19	3.2
Poor air circulation	1	0.2
Poor rainfall pattern	13	2.2

Health of the forest with regard to Fire

Table 4 describes community perception of the impact of wildfire on forest health in 5 forest districts, which is affecting them. From these results, reduction in soil fertility and presence of resistant grasses seem to be the most significant environmental impact on these communities due to the effect of wildfire on the forests. This is indicated by 72% and 58% respectively of the 265 community members that responded to this question (Table 4).

Table 4: Proportion of respondents indicating environmental damage affecting them due to wildfires (Total number of respondents (N) =265)

Environmental impacts	No. of responses	Percent of total respondents (N= 265) in all 5 forest districts
Soil erosion due to burning of grasses	39	14.7
Presence of fire adapted grasses in the area	153	57.7
Reduced water supply and quality	26	9.8
Absence of dense patches as fire breaks	10	3.8
Decrease in game, wild animals and birds	69	26.0
Fire related suspended particulate matter e.g. hazy weather	24	9.1
Reductions in rainfall amounts and pattern	81	30.6
Reduction in soil fertility	190	71.7
Destruction of plantations	28	10.6
Deforestation	4	1.5
Others+	7	2.8

+High temperature level, reduction in forest products, reduction in availability of food

Results of field assessment

The field assessment took account of the key indicators that were determined through the socio-economic questionnaire and measured each of the 5 indicators in the different forest areas, using the methods described in sections 2.3 – 2.7. When the five key degradation indicators were measured for each location, it was possible to rank the different locations according to their degree of degradation and indicate which were the most degraded.

Results from the field assessment are presented in figures 3 - 8 below.
Figure 3 shows the results of number of species that were enumerated during the plant biodiversity assessment, Figure 4 shows the results of number of plants which indicated soils with poor fertility, Figure 5 shows the crown cover percentage of riparian vegetation, Figure 6 indicates flora used as NTFPs in the study areas and Figure 7 shows the history of fire in the forests studied. A summary of the pattern of the level of indicators in the study areas are presented in Figure 8.

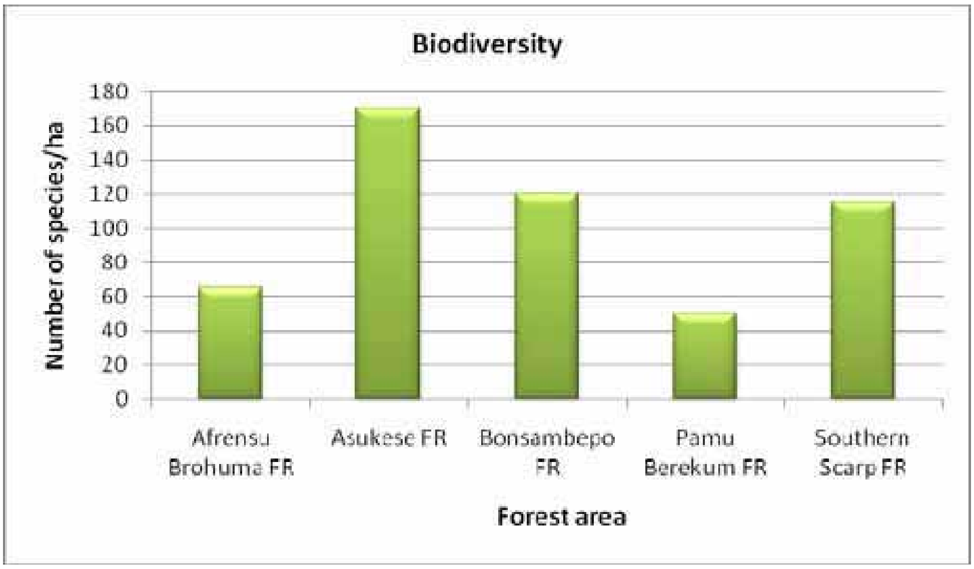

Figure 3: Number of plant species/ha in the forests areas

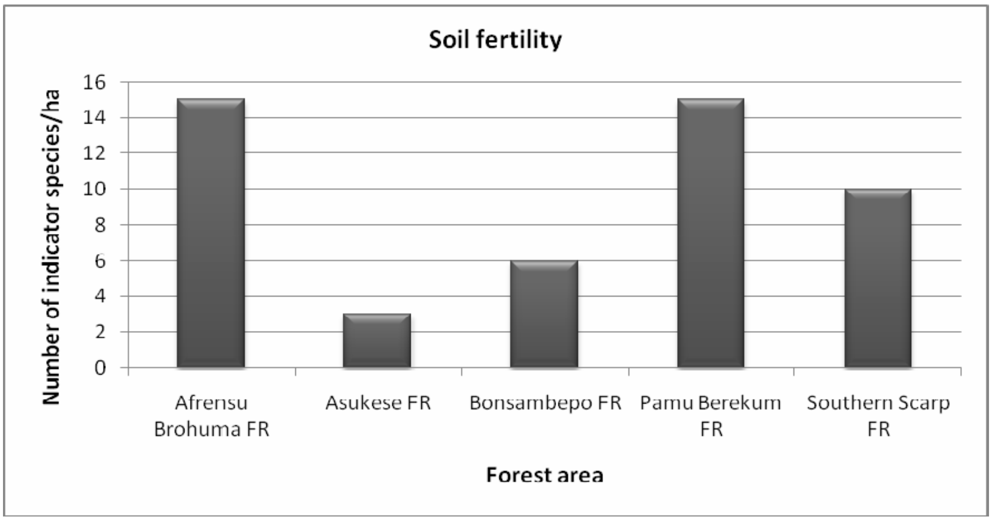

Figure 4: Level of soil infertility as indicated by the presence of poor fertility indicator plants

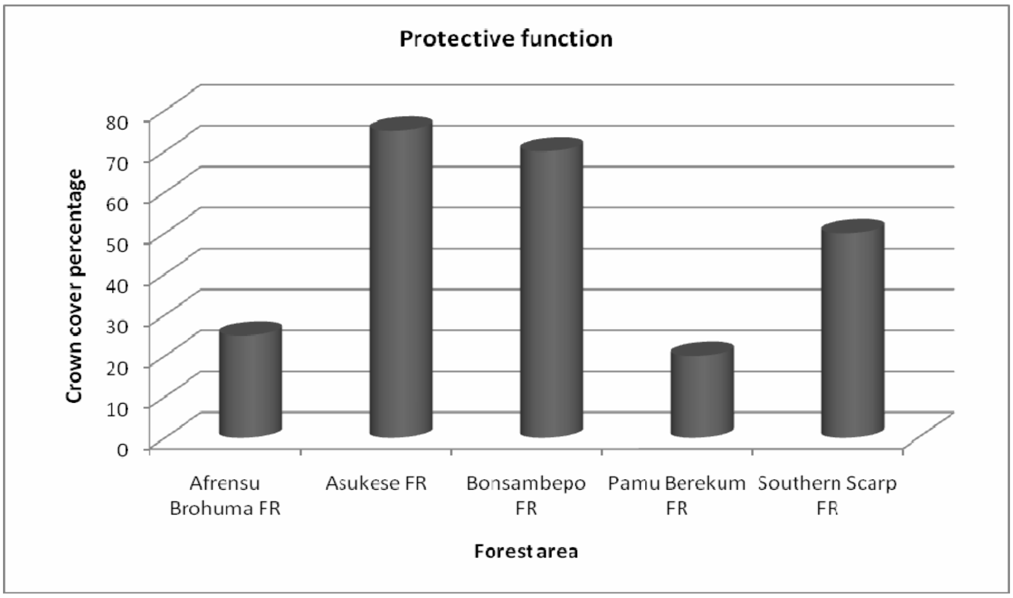

Figure 5: Protective function of the forest as indicated by vegetative cover in the riparian zone

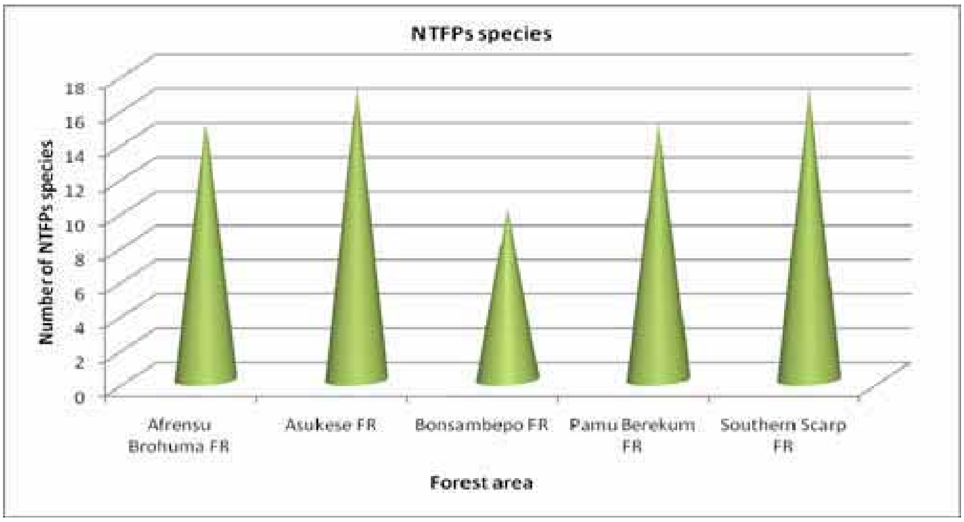

Figure 6: Number of flora species used as NTFPs in the various forest areas

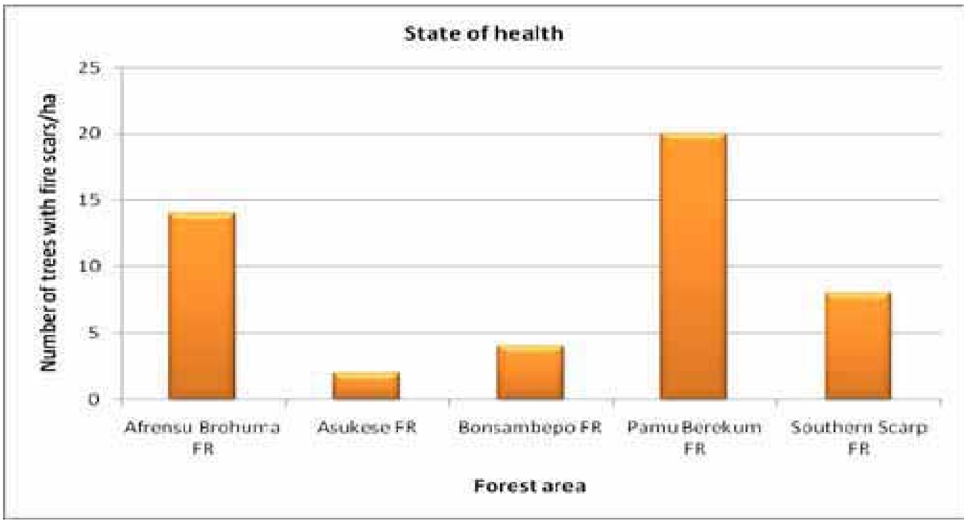

Figure 7: State of forest health as indicated by level of fire attacks.

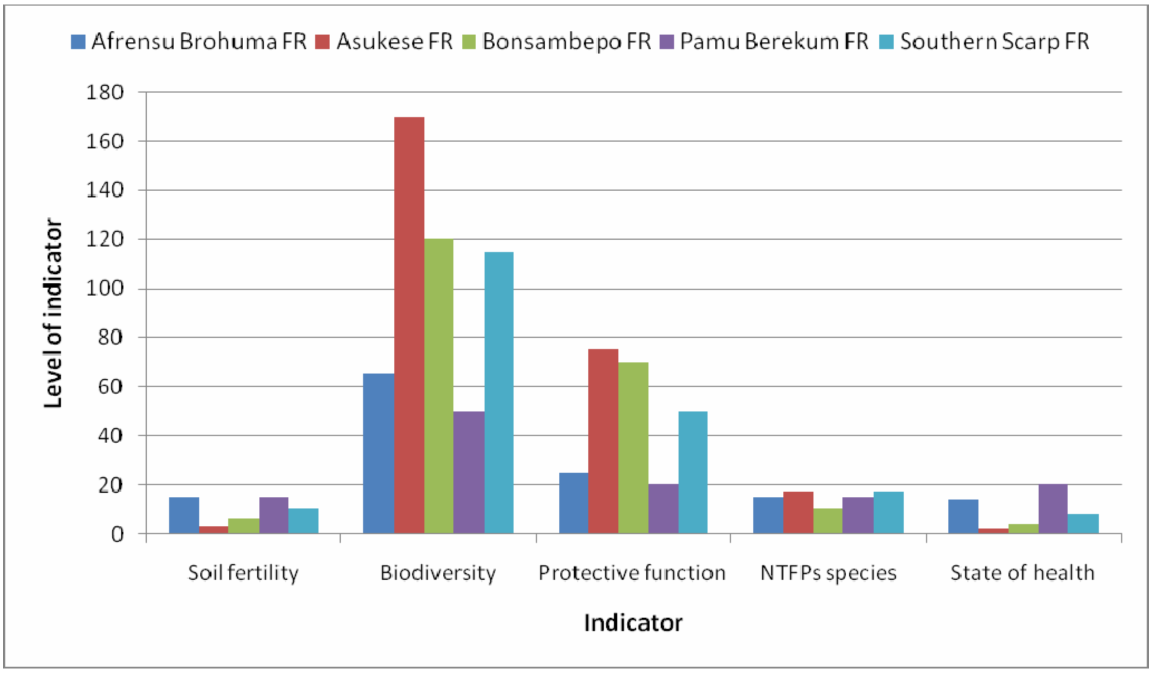

Figure 8: Summary of the pattern of indicators in all the forest areas

4. Discussion

The vegetation survey in terms of the number of species, showed that the number of species found in the study sites occurred in descending order from the highest at Asukese, through Bonsam Bepo, Southern Scarp, and Afrensu Brohuma to Pamu Berekum.

In terms of forest health, soil fertility, as in highest soil fertility or lowest infertility (with least number of species indicative of poor soils), could be described as descending from Asukese, through Bonsam Bepo, Southern Scarp, and Pamu Berekum to Afrensu Brohuma.

In terms of crown cover in the riparian vegetation Asukese had the highest cover followed by Bonsam Bepo, then Southern Scarp, Afrensu Brohuma and Pamu Berekum in descending order.

With respect to the number of plant species used by local communities as NTFPs the trend was that the highest number were recorded from Asukese and Southern scarp followed by Afrensu Brohuma and Pamu Berekum to Bonsam Bepo.

In terms of forest health from the point of view of fire attacks, the least number of fires were reported from Asukese, followed by Bonsam Bepo, Southern Scarp, and Afrensu Brohuma, with Pamu Berekum showing the greatest number of trees with fire scars.

Thus considering the degree of degradation in terms of the indicators, the degree of degradation would be considered increasing in the following order: Asukese, Bonsam Bepo, Southern Scarp, Afrensu Brohuma and Pamu Berekum. Hence the forest areas selected for the study were Pamu Berekum, Afrensu Brohuma and Southern scarp.

Advantages of the Methodology

The advantages of the methodologies are:

- Local people are directly involved in data collection and interpretation, where monitoring is linked to the decisions of local people, using methods that are simple, cheap and require few resources;
- Methods used are very simple and can be used by anybody with very minimal training, therefore it can be used by local communities whose livelihoods are impacted by degradation;
- Requires no sophisticated and expensive equipment such as remote sensing tools and other 'externally driven' approaches;
- Can be used to support any advanced methodology;
- Can build local capacity and cooperation between local people and the authorities, and can thereby stimulate local action and result in rapid forest management interventions;
- Could contribute to monitor reductions in emissions from forest degradation by local communities because it could promote accountability of carbon emission reduction efforts. Secondly, they appear effective in incorporating evidence-based assessments in decision-making at the local level, and thus have considerable potential to influence on-the-ground management activities in favour of sustainable forest management. Thirdly, they can generate ownership to carbon emission reduction efforts, and they can encourage equitable benefit-sharing at local levels and contribute to build social capital.

Effectiveness of Methodology

The methods used were very effective both in terms of money and what they were supposed to measure, because:

- The payments made to the local communities were very minimal as compared to what would have been paid to experts;
- The work used simple equipment through which it was relatively cheap to obtain information on the local ecosystem, tree species distribution, age distributions, plant associations, which is the information needed for inventories.

Disadvantage of Methodology

The disadvantage is that due to the level of the personnel involved the methodology was not subjected to any scientific statistical analysis to verify their accuracy.

Principles to be learnt are that

- When local communities are made aware on the importance of activity to be implemented on their livelihoods, they are very likely collaborate;
- Local communities have extensive knowledge of the forest and how it has looked, the species and their distribution, any threats that the forests has suffered and any other information that is needed in forest inventory;
- Local communities are always eager to learn new things and thus when provided with a little professional advice on inventory techniques they can make adequate and reliable stock assessments;
- Rural communities have been used to receiving hand incentives from projects and thus need to be informed if they will receive incentives. When these promised incentives are not received it demotivates them.

Practices that might be considered particularly successful include the following:

- Creation of awareness to local communities of the importance of their activity to their livelihood;
- Making the local communities utilize their indigenous knowledge;
- Provision of requisite training for the successful implementation of the activity;
- Provision of incentives that had been promised to the local communities.

Research and information gaps – what do we know and what more do we need to know

As already mentioned degradation is occurring throughout the forests of Ghana. However this case study involved only some few forest areas in Ghana. There are general drivers for deforestation and degradation; while specific drivers will vary from one forest area to another.

The monitoring of the degradation is minimal because it is being done using remote control and other sophisticated equipment. It is known that local communities have either not been involved at all or have been involved only minimally in monitoring the rate of degradation although they have indigenous knowledge on the information that is needed for any serious assessment. Although they have knowledge and the potential to conduct assessments of forest degradation, they lack knowledge on inventory techniques as well as mapping necessary for the assessment.

In order to get people on the forest fringes and local communities involved in the assessment and monitoring of forest degradation, guidelines and manuals for the development of indicators must be developed that are adapted for use by local communities. At the same time capacity building needs to be provided.

5. Conclusions

Most efforts to develop protocols for monitoring degradation in forests have focused on remote sensing tools and other ‘externally driven’ approaches, e.g. calibrating carbon storage to what is visible on a satellite image and developing an operational system with computer-based user facilities. In these approaches, it is generally professional researchers from outside the forest area to be monitored who undertake the setting up, running, and analysis of results. Such remote sensing based monitoring is often seen as paying inadequate attention to the objectives of key stakeholders, especially local communities whose livelihoods are often closely impacted by the resources concerned.

The approach described in this paper is reliant on skills that are locally available in many communities and on using indicators which are based mainly on visual assessments. There is therefore high potential for replication of this assessment in other parts of Ghana.

However the method could be greatly improved through improving the skills of the local communities in the development of indicators to be used for the assessment, as well as in techniques for the use of the indicators and mapping. Building the capacity of local communities to analyze data could also improve the approach.

Capacity building could be undertaken in collaboration with other stakeholders such as Care International and other NGOs, the Faculties of Renewable Natural Resources and the Forestry Technology of the Kwame Nkrumah University of Science and Technology.

The methodology was not subject to any statistical analysis. It could be improved using an additional indicator such as soil fertility which could be subjected to laboratory analysis and also statistically analyzing this and all other data collected. Furthermore, integration of participatory mapping tools, which actively engages the local people in resource mapping, would greatly enhance the methodology.

The primary constraint against replication of the study and any kind of capacity building are the financial resources needed to undertake such an exercise. The main prerequisite for such a study is the creation of awareness in the forest areas about the importance of such a study and especially how it affects the livelihoods of the local communities.

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Appendix

Figure 1: A degraded forest landscape in *Pamu Berekum* Forest Reserve prior to project activities. Photo: Dominic Blay

Figure 2: Restored forest site on a project site at *Pamu-Berekum* Forest Reserve, Dormaa Forest District. Photo: Francis K. Dwomoh

Figure 3: Community forest nursery established and managed by the ITTO project farmers at *Twumkrom*, near *Pamu Berekum* FR, in Dormaa Forest District. Photo: Kwaku Asumadu

Figure 4: A strip of 4-year old *Khaya ivorensis* growing in a *Khaya species*-dominated mixed plantation in the project site at *Afrensu Brohuma* Forest Reserve. Photo: Francis K. Dwomoh

Figure 5: A strip of 4-year old *Terminalia ivorensis* in mixed species plantation at a project site in *Southern Scarp* FR at Begoro Forest District. Photo: Dominic Blay and Francis K. Duomoh