Final report

CSLP Environmental services and spatial planning position

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Cover photo: GIS and spatial planning training with Shama GoG officials, credit: Evelyn Asante-Yeboah

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Acronyms

AFOLU	Agriculture Forestry and Other Landuses
CSA	Climate smart agriculture
CSLP	Coastal sustainable landscapes project
GIS	Geographic Information Systems
GoG	Government of Government
GPS	Global positioning system
LUSPA:	Landuse and Spatial Planning Authority
TCPD:	Town and country planning department
USAID	United states agency international development
USG	United states government
VSLA	Village savings and loans associations

Background

The Ghana Coastal Sustainable Landscapes Project (CSLP) is a United States Agency for International Development (USAID) Feed the Future initiative and a U.S. Forest Service-managed intervention being implemented in the six coastal districts[1] of Ghana's Western Region. The project, originally a three-year project (2013-2016) funded with USAID Climate Change monies, was extended initially for another three years through September 2019[2] with Feed the Future funding, based on successes achieved within the initial phase. It worked to promote low emissions development in Ghana's Western Region by strengthening community-based natural resource management and monitoring, and improving livelihoods in farming and fishing communities.

The project's second phase, under the U.S. government's Feed the Future Initiative, had a specific objective to reduce poverty and increase resiliency in the target communities through improved natural resource management, livelihood diversification, value chain development, and ecosystem conservation and restoration. The project interventions covered 43 core coastal communities with smallholder farmers and fisher folks as the main beneficiaries. In total, project actions of one sort or another had reached more than 82 communities as of early June 2018.
The interventions of the CSLP were guided by two main outcomes: (i) increased incomes from livelihood diversification and, (ii) improved environment and natural resource management. Specific activities included agroforestry and forestry best practices, short- and medium-term livelihood improvement activities (e.g. beekeeping, climate smart agricultural, CSA, vegetable production), on–farm tree planting of commercial and agroforestry species and management of greening areas / urban greeneries. Others included wetland/mangrove conservation, spatial planning, Village Savings and Loan Associations (VSLAs) and youth engagement (via formation of environmental clubs in public schools).

The CSLP used in-field consultations, targeted trainings, strategic capacity building, detailed technical assistance, and participation in institutional/policy level discussions and workshops based on field-level experience to achieve project objectives.

[1] Shama, STMA, Ahanta West, Nzema East, Ellembelle and Jomoro Metropolitan/Municipal/District Assemblies (MMDAs)

[2] This was subsequently reduced to only two years, to September 2018, due to lack of financial resources in USAID/Ghana's budget

Introduction

The CSLP Environmental services and spatial planning position was to respond to two main USAID climate change indicators and to contribute to other USAID Feed the Future indicators. The specific standard indicators are;

Standard Indicator 4.8-7 ***Quantity of greenhouse gas (GHG) emissions, measured in metric tons of CO_2e, reduced, sequestered or avoided as a result of USG assistance,*** **and**

Standard Indicator 4.8.1-26 ***Number of hectares of biological significance and/or natural resources under improved NRM as a result of USG assistance***

Additionally, the position contributed to the following USAID feed the future indicators;

4.8.2-29: Number of person hours of training in Climate Change

4.8.2-14 Number of institutions with improved capacity to address climate change issues as a result of USG assistance

3.2-1: Number of individuals who have received USG supported short-term agricultural sector productivity or food security training

Approaches and Methodologies used (spatial planning)

Detailed information on the initial methodologies used, challenges encountered and the revised methodologies under spatial planning is explained in Annex 1

Standard Indicator 4.8.1-26 *Number of hectares of biological significance and/or natural resources under improved NRM as a result of USG assistance*

Summary on methodology used for indicator 4.8.1-26.

Based on specific intervention on Natural Resource Management an interested farmer receives, the following were done together with the farmer

- The interested famers, parcel of land will be mapped with the handheld GPS unit, a GPS recording Datasheet was used to collect this data. The sheet also record the specific landuse/landcover type.
- This mapping was done with the assistance of some trained community personnel's, whom CSLP referred to as community Assistant' (CAs).
- After the farms have been mapped, the data is brought to the office and a software, that CSLP ordered, which is basically use to calculate area of land parcels and convert coordinates in to shapefiles, (works faster than using normal QGIS or ArcGIS) is used to calculate the area of the parcel and create its shapefile.
- These area are then calculated per community and per land use to estimate the number of ha. Under biological significance.
- Examples of these biological significance were, farms that have receive tree seedlings from CSLP and planted, fallow lands and secondary forests that are been conserved and used for bee keeping, degraded lands that are now been converted to woodlots, wetlands and mangrove sites, open space areas that are receiving boundary planting from CSLP, among others.

- The individual shapefiles are then merged and its attribute created per community and per district which will form part of each districts Geo data base.
- To this end, sixteen (16) CAs from 10 communities have been trained and are good in the use of handheld GPS units for land parcel mapping

Summary methodologies for the Standard Indicator 4.8-7 Quantity of greenhouse gas (GHG) emissions, measured in metric tons of CO2e, reduced, sequestered or avoided as a result of USG assistance,

In calculating for carbon emissions, most often the quantitative method is used. This usually involve tree measurement, destructive sampling, and laboratories analysis and the generation of allometric equations. However, using these methods was not possible given the short period of the CSLP project, hence there was the need to use alternative methods to arrive at estimates. One alternative used is the look-up tables which considers means of different carbon pools. The formulae for using look up table to estimate CO2e is a multiplication of the area of a land parcel by the mean of the specific carbon pool. Which is often multiplied by the area of the intervention site or land parcel.

Land use classes are the basis for estimating the metric tons of CO_2e sequestered. The average values of greenhouse gases (GHG), reported as metric tons (Mt) of CO_2e per hectare (ha) within a land use class, are calculated from an average value obtained in a lookup table. For Ghana, the land use classes are adopted from those recognized by international agriculture, forestry and other land uses (AFOLU) sources and reported under Ghana's Forest Preservation Program (PASCO 2013).

The lookup table (a portion appears as Table 1), provides a mean value in Mt of CO_2e/hectare for six carbon pool sources for established land uses within Ghana's nine climatic zones. The six carbon pool sources are:

Aboveground (AG)	Litter
Belowground (BG)	Non-tree
Deadwood	Soil

The geographic area of the CSLP's interventions is entirely within the Moist Evergreen climatic zone and the estimated mean values for five LULC classes are available as shown in Table 1. The aboveground and belowground values are derived from allometric equations developed from destructive sampling of tree species occurring in the sample plots. Values for the other carbon pool sources are from laboratory analyses of data from the sampling plots.

Table 1. Mean values in metric tons/hectare of CO_2e sequestered in Ghana's Moist Evergreen climatic zone within carbon pool sources[+].

Land Use	Carbon pool source						Total
	AG	BG	Deadwood	Litter	Non-tree	Soil	
Closed forest	511	89	297	10	2	324	1,233
Open forest	146	11	65	4	6	172	404
Cropland	124	9	16	13	1	219	382
Grassland	0	0	11	0	7	NA	18
Mangrove*	13,828	4,376	NA	NA	NA	1,291	19,495

[+]*Source:* PASCO 2013. [For closed forest, open forest, cropland and grassland land use classes]
**Source*: Adotey 2015. [For mangrove and wetlands land use class]

Approaches and methodologies used for Trainings

Three main trainings were conducted. These were;

- Spatial planning (basic GIS technology) for GoG officials and basic GPS trainings for selected Community Assistants
- Introductory trainings on food security trainings for farmers
- Climate change trainings for community member within the GAW,

All these tree trainings contributed to indicators
4.8.2-29: Number of person hours of training in Climate Change
4.8.2-14 Number of institutions with improved capacity to address climate change issues as a result of USG assistance
3.2-1: Number of individuals who have received USG supported short-term agricultural sector productivity or food security training

Spatial planning trainings

Spatial planning trainings were needed to bring GoG officials to a basic level of appreciating the need to understand spatial data and how to handle it. Initial training were a generalized training conducted for interested people in each district. An open invitation was threw to interested staff for this training hence No precautions were taken in selecting participants. The trainings used basic classroom methodology with PowerPoint presentation, hands-on trainings and field exercises

Photo 1: Evelyn Asante-Yeboah, CSLP's Env. Services and Spatial Planning Specialist facilitating a training session

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At the end of the four-day trainings for each of the 5 coastal districts, participants expressed much enthusiasm to implement basic GIS tools and concepts in their work schedules. After two months, there was a follow-up program to assess how participants were using knowledge gained and to address any challenges they were encountering before rolling out the advanced level of GIS. To our dismay, except the Physical planning unit who has the mandate to handle spatial data, none of the other department had used the knowledge and skills in their line of duty. The inserted table is a summary of participants present for the first training.

SUMMARY OF PARTICIPANTS PER DISTRICT

District	Training dates	Male	Female	Total
Half Assini	10th -12th May, 2016	22	1	**23**
Ellembelle	12th -15th July, 2016	21	2	**23**
Nzema East	1st to 3rd June, 2016	18	0	**18**
Ahanta West	11th to 14th Oct, 2016	18	6	**23**
Shama	23rd to 26th August, 2016	16	6	**22**
Regional office escorts		3	2	**5**

To gain greater impact of trainings conducted in terms of its implementation, a strategy to involve the Regional and dsitrict coordinating directors, was developed. A dialogue meeting was then organized. It was attended by fourteen (14) government officials (all males). Participants came from three regional institutions namely; the Landuse and Spatial Planning Authority (LUSPA), Economic Planning Unit (EPU) and Ministry of Food and Agriculture (MoFA); heads of Town and Country Planning departments (TCPD) from five coastal districts; and all coordinating directors in the five coastal districts to discuss the way forward with CSLP on spatial planning trainings at the district level.

It was concluded in this meeting that specific applications in GIS technologies be conducted for targeted departments, while basic understanding of GIS be conducted for the general departments. Also, it became necessary to assess each district's specific spatial training needs so trainings can be merged based on specific training demands. Hence after this meeting, ample time was dedicated to the district by district trainings needs assessment. This exercise also documented each districts staff capacity to handle GIS knowledge and the state of equipment for GIS manipulations and data handling.

After the successful undertaking of this training needs assessment, the next target training was prepared. This training was intended for department whose direct activities are involved with the natural environment, which included the following participants:

Physical Planning Department		2 participants
Development Planning Department		1 participant
Department of Food and Agriculture		1 participant
Parks and Gardens		1 participant
Works Department		1 participant
NADMO	-	1 participant

Training topics and participants involved

Training Topic A	**Participnats**
1. Introduction to GPS unit for collecting real world data 2. Introduction to QGIS for analyzing real world data, creation of attribute data and performing basic data manipulation	Session A (STMA, Reginal office, Shama, Ahanta West) Session B (Nzema East, Ellembelle, Jomoro)
Training Topic B	
1. Geo referencing of image and geo data, and coordinate conversion/ standardization of data	Session A (STMA, Reginal office, Shama, Ahanta West) Session B (Nzema East, Ellembelle, Jomoro)

It was the aim to follow up on this training and assess its implementation, yet the project had to end, however CSLP believes that once the interest of the coordinating directors as well as the regional directors were sought, participants will be tasked by their respective departmental heads to use it in their line of work.

GPS trainings for Community Assistants

Land parcel mapping, especially small patch of farms is very time consuming and laborious task that the CSLP Spatial Planning Specialist could not handle alone. To address this challenge two community assistants (who had been selected to assist in all other CSLP interventions within the community) from each of the 17 core communities were invited to a training on the basic concepts and use of a GPS unit. The training equipped CAs to be able to map all land parcels on which CSLP interventions have been carried out in their communities. The training was very basic using PowerPoint presentation, printed slides of the

presentation and hands-on training sessions. The content of the presentation carried pictures of GPS units and how it functions. A picture was taken on each step needed from switch on button through to satellite acquisition and coordinate recordings. Sources of errors and how they can be minimized were also explained to CAs. Hands-on practical trainings took majority of the time for these trainings. Periodic refresher trainings and field monitoring were also carried out to ensure the CAs were doing the right thing on the farms.

Food security and climate change trainings

CSLP as part of its activities engaged with rural farmers in the six coastal districts to help address issues of rural food insecurity and unstainable farming practices through capacity building, farm-based demonstrations and organic inputs support. Basic climate change trainings were given to farmers to enable them understand the basic concepts and definition of ensuring food security, and to appreciate the efforts of CSLP in helping farmers to contribute to food security. Climate change trainings sensitized the community members on how anthropogenic activities contributed immensely to causing the current changes in climate affecting many aspects of their lives. Prior to these trainings, some farmers had no knowledge of these issues.

A curriculum was developed for all trainings. The curriculum spells out:

- the training topic and content of the presentation
- The target audience and the mode of delivery/style of presentation
- estimated participant and duration of the training
- Objectives and expected output

These training curriculum or modules serves as a guides to the type of information the presentation slides should carry. It also aids in logistical planning as well.

Summary Results.

- ✓ Under Hectares of biological significance

To date, 2014 to 2018, number of hectare of biological significance and/or natural resources under improved NRM as a result of USG assistance resulted in:

Actual as at 2018	**Hectares**
Biological significance	3456.92
All other areas	2,438.47
Total	5,895.39

- ✓ Details per communities

#	Communities	No. of Farms	Total Area (Hectors)
1	Adubirim	396	810.0
2	Adusuazo	37	75.6
3	Aketakyi	11	22.50
4	Asonti	221	452.0

5	Ayawora	109	222.9
6	Fawoman	35	71.5
7	Navrongo	47	96.14
8	Tumentu	11	22.50
9	Tweakor 1	74	151.38
10	Tweakor 2	43	87.96
11	Yabiw	62	126.8
12	Fiasolo	60	122.74
13	Sendu	36	73.64
14	Bokro	38	77.73
15	Cape three Points	12	24.54
Total		1192	2438.47

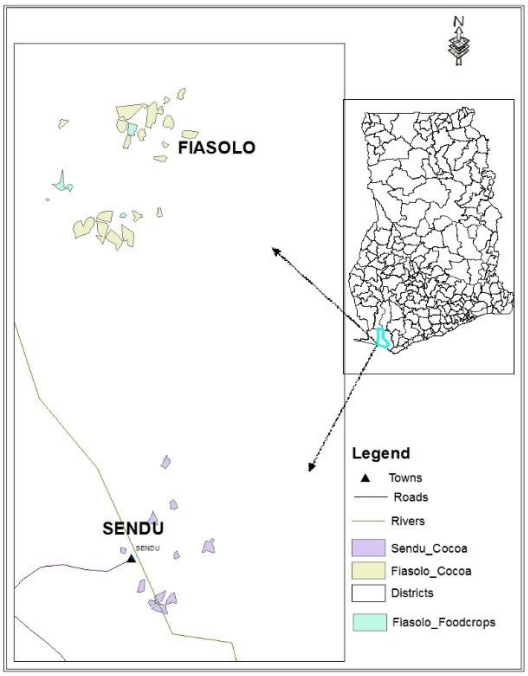

Fig: One of the maps prepared per community district on farms mapped

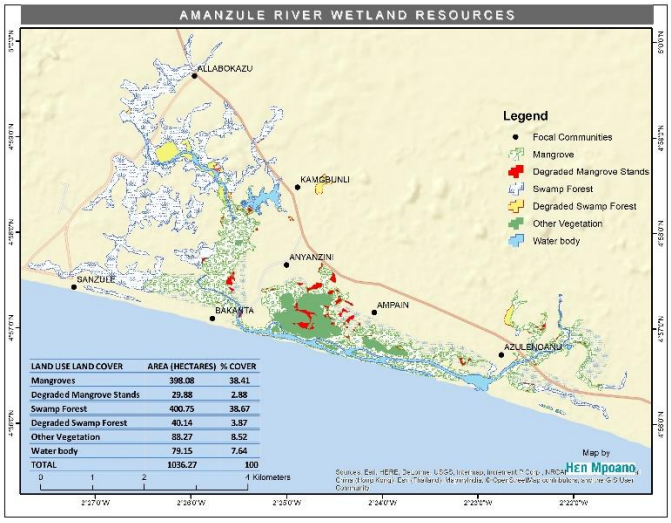

Fig: Final Amazule wetland map

Carbon accounting

The entire landscapes contributed to **18,203,590.97 CO2e** of reduced, sequestered as a result of USG assistance.

Spatial planning trainings

The last targeted training involved 33 participants, 4 females and 29 males from the six coastal districts participated in the trainings.

✓ **Food security trainings**

No.	District	Group trained	Training date	Participation			Training venue
				Total	Males	Females	
1	Jomoro	farmers	21 feb, 2017	41	19	22	Fawoman
2	Ellembelle	farmers	23 Feb, 2017	47	22	25	Kamgbunli
3	Ellembelle	Farmers	21 March 2017	40	25	15	Sendu
4	Ellembelle	farmers	23 March 2017	39	13	26	Ampain
5	Ellembelle	farmers	6th April, 2017	28	10	18	Kamgbunli (2nd batch)
6	Ellembelle	farmers	20th December 18	32	17	15	Adubrim
7	Jomoro	farmers	24 Jan, 18	37	14	23	Navrongo
8	Jomoro	Farmers	24 Jan, 18	39	21	18	Tweako 1
9	Ellembelle	farmers	25 Jan 18	20	12	8	Ayawora
10	Nzema East	farmers	25 Jan 18	41	25	16	Bokoro

Challenges encountered

Three greatest challenges encountered in this position were the necessity to work with GoG officials, mapping parcel of land under improve biological significance/NRM and the need to use standardized internationally accepted carbon accounting procedures for greenhouse gas accounting. Engaging GoG officials to adopt to methods and techniques that are not part of their national procedures becomes a challenge. During this position implementation, it was realized that when there is the need to acquire any spatial data or maps for any reason by the different department within the district, the mandate was on the Town and Country Planning Department, modern day Physical Planning Department (PPU) to provide such spatial data. However the PPU also shared their sentiment, that, most often data available was scanty, in that the respective department do not provide them with adequate spatial information of their area. Therefore, their database are often not up to date especially in the case of the Department of Food and Agriculture so not much data is available on suitable lands for agriculture, hence in the demarcation of lands or the preparation of local plans, such suitable lands may end up in other land uses.

This issue was taken up by the CSLP to bring to a basic level, the acquisition and understanding of basic geoformation science technology, so that each responsible department can handle basic GPS unit and manipulate spatial data in basic open source software such as QGIS for their own readily needed spatial information. However, from the top national and regional local government authorities, it was the sole mandate of the LUPSA to handle and prepare spatial data, using the basic knowledge on GIS in the day to day activities of trained participant was not demanded hence not monitored by their direct supervisors. A few trained participants, up to

date still articulate the GIS knowledge and skills in their work. It was the hope of CSLP to further training to advance levels of GIS with these few interested staff.

Challenges in achieving the estimated targets for the two indicators

The main challenge to achieving the targets for these two indicators comes from the time required to simply collect data. An improved systems approach to the use (and continued training) of the GPS units, the use of enhanced software used to plot the spatial data and create maps of the land classes, and the addition of temporary office labor has resulted in better and more accurate capture of information.

This also means more reliable cataloging of the data being collected on each farm and more confidence in the data as it is being reported. Being able to use locally collected and science-based estimators with the GHG data applied to the areas being measured is also giving more confidence moving forward, and with the knowledge that it can be of more use at the district and regional levels.

The sheer amount of time required to collect the data (along with monitoring its accuracy and thoroughness) is the piece that constantly keeps the project in the deadline crosshairs. The areas being measured are not large but the access to them is often very difficult. Once at the site, obtaining the land steward's cooperation on a particular day and at particular time is often confounded by weather, cultural events, family health and other issues that are normally easily dealt with in a phone call or two. But on this landscape, communication too often depends on a physical meeting, and in these cases most certainly more than one just to record coordinates and site attributes on a hectare or less. Multiply that by 600 to 800 farmers, each with multiple land uses and varying CSLP interventions, spread across the landscape and the difficulties in obtaining the raw data become a little more obvious.

Observations

- ✓ Trainings:

The trainings were very interactive and educative. Participants showed enthusiasm in the training content. However, it was observed that even though it was stated in invitation letters that participants should attend the trainings with laptops, not all participants had laptops.

Secondly, there were energetic participants who were eager to learn especially from the Town and Country Departments (Physical Planning Unit), development planners etc., however very few who were lagging behind. These were the elderly staff who had challenges with the modern day technologies. Lessons learnt from this training includes the fact that, in every target or generalized training, definitely not all participants will be willing to learn, however, since there are always some good people among the lot, such training shouldn't be discouraged but the few good ones should be followed up in order to ensure that the knowledge is put to its maximum use.

- ✓ Land parcel mapping and Co2 e estimation

Data and information being collected in association with these two indicators is at a scale that certainly has not been undertaken in Ghana before. The areas being added under NRM and the emissions being avoided from these lands are being measured at farm and community levels. The Ghana Forestry Commission program through its Forest Investment Program (2012) and its REDD+ initiatives (Forest Carbon Partnership Facility, 2014; PASCO, 2013), addresses reduced emissions issues mainly at regional and national scales and noted the importance of district-level data. Community-level and farm-level information that can actually contribute to individual district information crucial to realistic planning is indeed rare (Sasu, 2015).

Lessons learnt

Working with GoG officials

Firstly, in order to engage GoG officials effectively in any project, always start from the top officials, preferably with regional or district coordinating directors to get their buy-in, and collaboration. Get them to understand the relevance of your project support and its intended outcomes. If possible when organizing platforms for knowledge exchange, let them spearhead such meetings buy issuing letters on their letter heads to invite their own people on your behalf and allow them to facilitate most sessions. This is because most GoG staff takes direct instructions form their superiors, so if their superiors understand what the project is doing and is actively involved in your project, they are likely to issue orders to their subordinates to give you the needed assistance you need.

Secondly, one cannot do away with staff transfers within the public sector. Most often, during the lifespan of a project, it is not likely to work with the same local service staff from start to finish. At a point, there will be transfers. What then do you when very dedicated people who really understands your project aims are transferred and replaced with completely new people? Do you start everything again? Definitely no. the CSLP used the approach of trained staff preparing operational guidelines, which articulates the procedures for using GIS technology in the specified of discipline.

Most project partners are fence sitters, they only want to see what worked and what did not are criticize you for them. If you are not getting the collaboration of such partners, it's better to drop them and pick on new ones. Always look for someone within the department or institution who understands your project and is prepared to defend it to his higher authority.

The need to use standardized internationally accepted methods

The target revisions for the two standard indicators (4.8-7 and 4.8.1-26) for FY 2016 reflect the experience gained from working closely with the farmers and communities on the landscape. They are substantially more realistic than the initial estimates assembled in FY2014. More is known about the communities, the farms and the farmers' capacities to adopt (and adapt) the practices that do contribute to improved natural resources management (and add to the amount of GHG emissions avoided) on this landscape.

Annex 1

Supplementary information

Achieving Targets for Select 2016 CSLP Indicators

Achieving the original targets for two of the Coastal Sustainable Landscapes Project (CSLP) standard indicators has been a challenging task for the first two years of this three-year funded project. This memo discusses some of those challenges and provides a rationale for revising targets to realistic figures for the third year of the project and into the proposed extension period for the two indicators listed below.

Standard Indicator 4.8-7 ***Quantity of greenhouse gas (GHG) emissions, measured in metric tons of CO_2e, reduced, sequestered or avoided as a result of USG assistance,*** and

Standard Indicator 4.8.1-26 ***Number of hectares of biological significance and/or natural resources under improved NRM as a result of USG assistance.***

A general background is first presented that summarizes some of the key parameters linked to the two indicators. Then, each indicator is discussed separately (although for several of the CSLP activities there are direct linkages between the two). A methodology is presented on how the project collects and reports the data. For each indicator, the revised target is presented along with a timeline for its achievement. Finally, the memorandum discusses important challenges encountered with these two outcome indicators along with other general observations.

Background summary

When the targets were established there was very little known about which communities would be chosen, or even details about the landscapes within the six coastal districts. There were no on-the-ground data about the communities that were eventually selected (in the 3rd quarter of FY 2014) for project interventions or about how many farmers would be involved, or even the types of land cover and land use on these farms. Actual activities to be promulgated were not established, nor had any community assessment been undertaken.

At the end of the first year of the project, more than 500 farmers in 17 coastal landscape communities had expressed their interest in participating in the menu of activities[3] being promoted by the CSLP. Community members were free to participate in one or more of the activities being extended with project support. As of the beginning of FY2016, there are 18 baseline communities with their participating farmers that are providing the data on which the indicators are being tracked and carbon stocks monitored. Until the land use/land cover types and their areas on these farms are known, estimates of carbon stocks cannot be realistically made.

[3] Following the in-depth community assessments the activities deemed most in demand by community members which were also within the scope of the project's objectives (and budget) included: beekeeping, conservation/climate-smart agriculture, tree planting, village savings and loan associations, farmer managed natural regeneration, improved charcoal production.

Beginning in early FY 2015, the CSLP has been working to come up with realistic estimates of these areas by:

- Working with interested farmers to map selected land uses/land cover (LULC) types on their farms;
- Training community assistants to use hand held GPS units (among other tasks) to collect data on individual farms that would allow the spatial dimensions of these LULC areas to be determined and mapped and become part of a district-level database; and
- Continuing to follow-up with updating farmers' areas as they adopt activities that enhance the sequestration of carbon on specific LULC types.

As additional communities and community members participate in the CSLP activities, their LULC attributes get added to the baseline and changes monitored.

The GPS training and subsequent mapping is a laborious and time-consuming process; it has taken much longer than originally planned for a number of reasons. And as with any new activity, errors have also been made and numerous lessons have been learned that have resulted in adaptations and corrections to the data collection and the analytical processes. A substantial amount of the original data collected for mapping was also fraught with errors and had to be methodically cleaned. At this writing, the collection of spatial data for the baseline has been completed in 13 of the original 17 communities on more than 225 individual farms.

As the GPS training and initial data for mapping was being collected, the CSLP staff worked with local farmers to ensure the conservation of what was viewed to be the most obvious source of carbon stocks on these farmed areas: the secondary forest plots and extended fallow areas. With the farmers' assurances to safeguard these areas (as stocks for medicinal herbs and plants, as apiaries, and as a source for selected tree harvests), they were mapped and became the source of the initial amounts of carbon emissions avoided reported in the FY 2015 quarterly and annual reports. These secondary forest areas and extended fallows are still being identified in some of the initial 17 communities; when they are, the CSLP works with the farmers to ensure their productivity as carbon sequesters and discourages their clearing and burning for other uses (cocoa, rubber, palm plantations, or for short-term agricultural production); these become part of the total quantity of GHG emissions reduced or avoided total.

For FY 2016, the CSLP has been expanding its work with the coastal communities in the six districts. There are 23 additional communities where the CSLP is working in collaboration with the NGO Hen Mpoano (via a small grant mechanism) to bring about formal, recognized co-management strategies for the Greater Amanzule Wetlands (GAW). There are also some secondary forest and extended fallows in these 23 communities, but their natural areas are predominantly mangrove and wetland areas, which are much higher in carbon (Ajoina et.al. 2014, Tang et.al. 2015) than the more upland communities that have occupied the CSLP in FY 2014 and FY 2015. It is these latter GAW land cover types that the CSLP and its collaborator, Hen Mpoano, are working to inventory, map and capture as areas under improved NRM through the co-management process.

Standard Indicator 4.8-7 Metric tons of CO_2 equivalent (CO_2e) reduced, sequestered, or avoided as the result of USG assistance

The original targets established for this indicator (in March 2014), were purely estimates based on "best guesses" using global carbon multipliers applied to broad land cover types. The estimated targets for the three years of the project were:

2014: 3,060 Mt 2015: 20,496 Mt 2016: 43,108 Mt

As noted above, when the targets were established little to nothing was known about which communities were to be selected for project interventions, how many farmers would be involved, what the area of their holdings might be, or even the types of land cover and land use on these farms. (Annex A lists some of the assumptions used to arrive at the yearly targets.)

Now, as farmers actively participate (under a self-selection process) with the CSLP's technical and behavior change activities, selected land cover/land uses on individual farms are inventoried, located spatially with a GPS unit, mapped and monitored. As farmers continue to adopt CSLP-supported practices on these lands, or as new farmers are added, they are also mapped and monitored. The areas (in hectares), per land use/land cover type per farm, are calculated from the mapping exercise and totals for each LULC class (or type) are aggregated and reported by community.

The land use classes are the basis for estimating the metric tons of CO_2e sequestered. The average values of greenhouse gases (GHG), reported as metric tons (Mt) of CO_2e per hectare (ha) within a land use class, are calculated from an average value obtained in a lookup table. For Ghana, the land use classes are adopted from those recognized by international agriculture, forestry and other land uses (AFOLU) sources and reported under Ghana's Forest Preservation Program (PASCO 2013).

The lookup table (a portion appears as Table 1 below), provides a mean value in Mt of CO_2e/hectare for six carbon pool sources for established land uses within Ghana's nine climatic zones. The six carbon pool sources are:

Aboveground (AG)	Litter
Belowground (BG)	Non-tree
Deadwood	Soil

The geographic area of the CSLP's interventions is entirely within the Moist Evergreen climatic zone and the estimated mean values for five LULC classes are available as shown in Table 1 below. The aboveground and belowground values are derived from allometric equations developed from destructive sampling of tree species occurring in the sample plots. Values for the other carbon pool sources are from laboratory analyses of data from the sampling plots.

The majority of the initial amounts of CO_2e reported as being sequestered, reduced, or avoided through the CSLP's assistance in FY 2014 and FY 2015 came from secondary forest areas in the initial 17 communities. As noted earlier, farmers agreed not to clear these areas as originally intended, but

to use them instead as apiaries, as a source of medicinal plants and other non-timber forest products, and for the harvest of selected commercial tree species.

Table 1. Mean values in metric tons/hectare of CO_2e sequestered in Ghana's Moist Evergreen climatic zone within carbon pool sources[+].

Land Use	Carbon pool source						Total
	AG	BG	Deadwood	Litter	Non-tree	Soil	
Closed forest	511	89	297	10	2	324	1,233
Open forest	146	11	65	4	6	172	404
Cropland	124	9	16	13	1	219	382
Grassland	0	0	11	0	7	NA	18
Mangrove*	13,828	4,376	NA	NA	NA	1,291	19,495

[+]*Source:* PASCO 2013. [For closed forest, open forest, cropland and grassland land use classes]

**Source*: Adotey 2015. [For mangrove and wetlands land use class]

These patches of secondary forest and extended fallows were relatively easy to classify, measure spatially using GPS units, and map. Their areas were also counted under Standard Indicator 4.8.1-26 (see below). The CO_2e for these initial areas were calculated using different mean values from those presented in Table 1. The PASCO (2013) report and the mangrove data provided by Alotey (2015) cited in Table 1 were not available until late in FY2015. Estimates provided by other sources (Chave et.al. 2005) were used initially despite their being much more generic and not necessarily tied to Ghana's climatic zones. Spatial data collected in FY 2016 (and going forward), is now being applied against the mean values presented in Table 1 to determine the estimated CO_2e on community members' lands participating in the CSLP activities. The project has also noted significant irregularities in the data initially collected. These data are being cleaned and the CO_2e equivalents will be re-calculated using the mean values in Table 1 to ensure that all estimates have the same baseline.

The CSLP's estimates of CO_2e reported for this indicator come from LULC classes on areas where community members are adopting practices promulgated by the project. Annex B lists the LULC classes being used by the project.

Each CSLP activity with land use implications has the area with the adopted practice recorded and measured (using a GPS unit). For each, the data recorded includes the community name, the land steward's name, an identifying number, the LULC class and the geographic location (latitude and longitude from the GPS units). In the CSLP office, a polygon (map) of the area is generated and its area calculated and stored with the other attributes of the area measured. These data become the baseline for future activities linked to the individual areas managed by the community member(s). These spatial data have been collected with the district Town and Country Planning offices in mind and are being collected with training for the counterparts where appropriate. The data will then be transferred to the district offices for use as part of planning efforts, and with the hope that it can be managed and updated thanks to the accompanying training efforts of the CSLP

Revised targets, FY 2016, Standard Indicator 4.8-7

Based upon the above discussion, the targets for this indicator are revised to reflect the availability of carbon stock estimators specific for Ghana. These estimators have been documented scientifically and can be readily applied to area and cover class data now being more rigorously collected by the CSLP.

The estimated target for the quantity of greenhouse gas (GHG) emissions reduced, sequestered or avoided as a result of the CSLP's interventions in FY 2016 is 5,000,000 Mt CO_2e, a significant difference from the original as shown in Table 2.

Table 2. Comparing original and revised targets for FY 2016 estimates of CO_2e

	Original target	**Revised target**
Target basis for FY 2016 estimates	43,108 Mt CO_2e	5,000,000 Mt CO_2e
	Included only aboveground carbon sources	Includes aboveground, belowground, deadwood, litter, non-tree and soil carbon sources
	Higher carbon content values of mangrove/wetlands not factored in	Mangrove/wetland areas added & carbon estimated added for the first time in FY 2016

These amounts will come from:

- Areas where project-registered farmers and communities adopt actions during the fiscal year that improve natural resources management (see the next section on Standard Indicator 4.8.1-26);
- From existing farm areas (with project interventions) that had not yet been mapped/measured by land use;
- Areas where the project has undertaken mangrove restoration; and,
- Areas in the GAW where community conservation committees organized by the CSLP and Hen Mpoano that are being set aside for management also figure into the total target estimated for FY 2016.

Most of the total linked to improved NRM practices on farmlands will be achieved by the midpoint in the fiscal year. The high carbon content of the area's mangrove and wetland areas provide the greatest opportunities for avoided GHG emissions in the CSLP's geographic area. By the end of the second quarter, the mapping and spatial data collection in one wetland area will be complete and a community management planning effort started. Because of the high carbon content of mangrove cover classes (Adotey, 2015; Hutchinson et.al. 2014), this site, along with the quantities captured from other sources, will contribute more than three quarters of the target goal for the year. By the end of the third quarter, close to 90 percent of the target will be achieved. Other mangrove areas in the GAW will help secure the balance of the target in the fourth quarter as community conservation committees become organized in their roles and earmark conservation areas in their management planning efforts.

Standard Indicator 4.8.1-26 ***Number of hectares of biological significance and/or natural resources under improved NRM as a result of USG assistance***

As with the GHG indicator (4.8-7), the original targets established for the number of hectares coming under improved NRM were estimates based on "best guesses" for an area where little was known about which communities were to be selected for project interventions, how many farmers would be involved, what the area of their holdings might be, or even the types of land cover and land use on these farms. The original estimated targets for the three years of the project were:

2014: 300 ha 2015: 1,200 ha 2016: 1,800 ha

At the end of the first year, the original target was achieved through cooperation with more than 500 farmers who had expressed an interest to participate. All of the target area came from "low-hanging fruit" such as secondary forestland and the CSLP's cooperation with B-BOVID (and its NGO affiliate, TRACTOR). Given the first years' experience, it was obvious that the original target would be difficult to achieve given the effort (training and tree planting) that would be required to get farmers to adopt the practices. The target for FY2015 was halved to 600 hectares, and that number was still not achieved. One significant reason was the amount of time required for measuring and mapping areas where the adopted practices were occurring. Many of the farmers were using tree seedlings provided by the CSLP (in agroforestry configurations, improved fallow, for soil conservation and as shade for cocoa) late in FY 2015, but the actual measurement and confirmation was occurring in the first and second quarter of FY 2016.

So (and as noted above), as farmers participate (under a self-selection process) with the CSLP's technical and behavior change activities, selected land cover/land uses on individual farms are inventoried, located spatially with a GPS unit, mapped and monitored. As farmers continue to adopt CSLP-supported practices on these lands, or as new farmers are added, they are also mapped and monitored. The areas (in hectares), per land use/land cover type per farm, are calculated from the mapping exercise and totals for each LULC class (or type) are summed and reported by community.

Revised targets, FY 2016, Standard Indicator 4.8.1-26

Given the CSLP's experiences in the first two years of the project and the improved knowledge of the landscape and the farmers working with the project the target for the third year is estimated at 1,300 ha. This also captures areas where farmers adopted practices in FY 2015, but went unreported because the data was not cleaned properly and/or the mapping tasks that confirm and document the practices were not complete. Table 3 provides a summary of what areas on the landscape will come under improved NRM in FY 2016.

Table 3. Area under improved NRM by land use land cover classes, FY 2016.

Source	Area (ha)	Comments
Improved NRM in crop lands-A	570	Practices adopted/mapped
Improved NRM in crop lands-B	450	Practices adopted/mapped, not reported
Cassia spp. woodlots	20	Improved management & best practices
Mangrove/wetlands + restoration	210	Includes 21 ha of restored mangrove
GAW improved NRM in crop lands	15	Livelihood diversification activities

GAW improved NRM in mangroves	35	Co-management with Hen Mpoano
Total	**1,300**	

The CSLP estimates that about 650 hectares of the target figure will be achieved by the midpoint of the fiscal year and almost 90 percent by the end of the third quarter. The gains coming in the third quarter are expected from the backlog of on-farm areas that have adopted improved NRM practices, but had not previously been reported. The last quarter, which coincides with the end of the rainy season, will have the final balance coming from cropland areas being planted with seedlings and community mangrove areas in the GAW being formally designated for management.

Challenges in achieving the estimated targets for the two indicators

The main challenge to achieving the targets for these two indicators comes from the time required to simply collect the data. An improved systems approach to the use (and continued training) of the GPS units, the use of enhanced software used to plot the spatial data and create maps of the land classes, and the addition of temporary office labor has resulted in better and more accurate capture of information. This also means more reliable cataloging of the data being collected on each farm and more confidence in the data as it is being reported. Being able to use locally collected and science-based estimators with the GHG data applied to the areas being measured is also giving more confidence moving forward, and with the knowledge that it can be of more use at the district and regional levels.

The sheer amount of time required to collect the data (along with monitoring its accuracy and thoroughness) is the piece that constantly keeps the project in the deadline crosshairs. The areas being measured are not large but the access to them is often very difficult. Once at the site, obtaining the land steward's cooperation on a particular day and at particular time is often confounded by weather, cultural events, family health and other issues that are normally easily dealt with in a phone call or two. But on this landscape, communication too often depends on a physical meeting, and in these cases most certainly more than one just to record coordinates and site attributes on a hectare or less. Multiply that by 600 to 800 farmers, each with multiple land uses and varying CSLP interventions, spread across the landscape and the difficulties in obtaining the raw data become a little more obvious.

The CSLP anticipates more than 250 new farmers requesting seedlings for planting on their cropland in FY2016's rainy season. That works out to about 400 additional hectares that will need to be measured and the land classes verified. Given the project's experience completing the data acquisition, verification and data plotting these farms will not be completely accounted for until probably well into the second month of the next fiscal year, even though the NRM improvement that could be counted was done in August and September.

In the Greater Amanzule Wetlands, the CSLP and grantee Hen Mpoano started last quarter to map the mangrove and wetland resources of 23 of the area's communities. Here again, it is the time commitment (and labor) that presents the biggest hurdle. The mangrove area in the community of Effasu (see Annex C) provides an example; and in this case, a relatively easy example. The area around the mangroves is quite even and the adjacent land uses easy to discern and to walk around with a GPS unit. The water access can also be made with a boat without too much difficulty. The area in the

Effasu case, once completely mapped, provided a total of 21 hectares of mangrove, degraded mangrove sites and water. The data collection effort required 6 person days. The data transcription, verification and mapping added another 1.5 to 2 days. The combined total, therefore, of mapping a relatively small community resource with easy access was 7.5 to 8 person days.

The total area of mangroves and wetland in the GAW is over 400 hectares, with some areas being extremely difficult to access. This project won't obtain information on the total GAW wetlands, but it will collect and accurately present information on a substantial portion. Nonetheless, it will demand significant time.

Other observations

The data and information being collected in association with these two indicators is at a scale that certainly has not been undertaken in Ghana before. The areas being added under NRM and the emissions being avoided from these lands are being measured at farm and community levels. The Ghana Forestry Commission program such as the Forest Investment Program (2012) and its REDD+ initiatives (Forest Carbon Partnership Facility, 2014; PASCO, 2013), address the reduced emissions issues mainly at regional and national scales and noted the importance of district-level data. Community-level and farm-level information that can actually contribute to individual district information crucial to realistic planning is indeed rare (Sasu, 2015).

The CSLP's data collection, coupled with the data collected with the grant to Hen Mpoano, is in a format that is readily useable by the district Town and Country Planning Departments (TCPD). The two organizations are also working together to ensure that the TCPDs in the six coastal districts will have the capacity to use these data more effectively in the future and to integrate them into their medium term development planning efforts and activities.

The target revisions for the two standard indicators (4.8-7 and 4.8.1-26) for FY 2016 reflect the experience gained from working closely with the farmers and communities on the landscape. They are substantially more realistic than the initial estimates assembled in FY2014. More is known about the communities, the farms and the farmers' capacities to adopt (and adapt) the practices that do contribute to improved natural resources management (and add to the amount of GHG emissions avoided) on this landscape.

The number of hectares added in FY2016 is slightly lower than what was originally projected, but the amount of GHG gases measured in Mt CO_2e has increased significantly. The reasons for the latter figure's increase over original estimates are two-fold. First, the estimate now includes aboveground, belowground, deadwood, litter, non-tree and soil carbon sources while the initial estimates included only aboveground sources. Secondly, the mangrove and wetland areas are significantly higher in carbon than what was accounted for originally, and these classes are only being added/measured for the first time in FY2016.

As the CSLP plans for an extension and expansion phase, significant effort will be made to better estimate areas of intervention in the coming three year period and the estimates of impacts on these two indicators. The time and effort required to initially map, collect land use attribute data and calculate areas will require a balance with monitoring the project's impacts on the land uses over the

long term. Other new indicators related to Feed the Future funding sources will also need to be added.

The lessons learned from the first phase of the CSLP will help inform the team as planning for the next phase takes place and they will better inform the Performance Monitoring Plan and associated targets for future years. This compilation document, which includes the scientific basis for the calculations and estimates along with the history of how they have been derived, will become a part of the CSLP's knowledge management portfolio and shared with relevant local, national and international partners contributing to the learning process as carbon monitoring and tracking grows throughout the world. As mentioned, being the first of its kind in Ghana, we are confident the lessons being learned with this effort will prove useful with other partners and stakeholders into the future.

Resources Consulted

Adotey, J. 2015. Carbon stock assessment in the Kakum and Amanzule estuary mangrove forests, Ghana. PhD dissertation submitted to Dept. of Fisheries and Aquatic Sciences, School of Biological Sciences, University of Cape Coast. 123p.

Ajoinna, G.N., T. Agardy, W. Lau, K. Agbogah, and B. Gormey. 2014. Mangrove conditions as indicator for potential payment for ecosystem services in some estuaries of Western Region of Ghana, West Africa. ***In***: Diop, S., et.al. *The Land/Ocean Interactions in the Coastal Zone of West and Central Africa, Estuaries of the World*. Springer International Publishing (Switz). Pp. 151-165.

Asante, W. N. Jengre, and E. Dwamena. 2013. Landuse and carbon stocks dynamics associated with palm cultivation in the high forest zone of Ghana. Solidaridad, IPAM, and National Conservation Research Centre. 46p.

Chave, , J. C. Andalo, S. Brown, M.A. Cairns, J.Q. Chambers, D. Eamus, H. Folster, F. Fromard, N. Higuchi, T. Kira, J.P. Lescure, B.W. Nelson, H. Ogawa, H. Puig, B. Rie'ra, and T. Yamakura. 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. Oecologia 145: 87-99.

Forest Carbon Partnership Facility. 2014. Ghana's Emission Reductions Program for the Cocoa Forest Mosaic Landscape (Cocoa Forest REDD+ Program). Emission Reductions Program Idea Note (ER-PIN). 67p.

Forest Investment Program. 2012. Ghana Investment Plan. FIP/Ministry of Lands and Natural Resources, Accra. 69p + annexes.

Hairiah, K., S. Dewi, F. Agus, S. Velarde, A. Ekadinata, S. Rahayu and M. von Noordwijk. 2010. Measuring carbon stocks across land use systems – A Manual. Bogor (Indonesia) World Forestry Centre/ICRAF. 155p.

Hutchinson, J. et. al. 2014. *Mapping the mangroves and measuring their carbon.* Letters, May/June 2014, 7(3), 233–240. Accessed March 2016 at: http://www.forestsclimatechange.org/forests-climate-change-mitigation/image-mapping-the-mangroves-and-measuring-their-carbon/

PASCO. 2013. Mapping of forest cover and carbon stock in Ghana. FC-RMSC, CSIR-FORIG and CSIR-SRI, Ghana. 218p.

Sasu, O. 2015. Project communication. Office of Foreign Assistance, Ghana Forestry Commission. West Legon, Accra.

Tang, W., W. Feng, M. Jia, H. Zuo, and C. Trettin. 2015. Assessment of biomass and carbon mangroves in West Africa: a spatially explicit analytical framework. Wetlands Ecological Management DOI 10.1007/s11273-01`5-9474-7.

U.S. Environmental Protection Agency. 2014. Greenhouse gas equivalencies calculator. Accessed March 2016 at: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator