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REPORT ON IMPROVING WOODLOT BASED CHARCOAL LIVELIHOODS IN SHAMA DISTRICT:

Training in best management practices and pilot use of mobile metal charcoal kiln

COASTAL SUSTAINABLE LANDSCAPES PROJECT

CSLP *AUGUST 2018*

This document was produced for review by the United States Agency for International Development Mission for Ghana (USAID/Ghana). It was prepared by US Forest Service International Programs.

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Citation: USFS-IP (2018): Report on improving woodlot based charcoal livelihoods in Shama District; Training in best management practices and piloting of the use of mobile metal charcoal kiln, 13pp.

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Disclaimer: This publication is made possible by the generous support of the American People through the United States Agency for International Development (USAID)/Ghana. The contents of this report are the responsibility of the Coastal Sustainable Landscapes Project (CSLP) and do not necessarily reflect the views of USAID or the United States Government. Agreement

Number: AEG-T-00-07-00003 for "Coastal Sustainable Landscapes Project (CSLP) for the Western Region of Ghana

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1. 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.

1.1 Introduction

Charcoal producers in the Shama District had gathered wood from natural forest and fallows areas to produce charcoal until the early 1990's when they turned to cassia woodlots they had established on their own. During discussions with communities in the early phase of the CSLP, it was learnt that charcoal actors had realized that by indiscriminately felling naturally regenerated trees without re-planting, they had caused deforestation and forest degradation. Having faced scarcity of raw material for charcoal production, they felt the need for sustainable wood sources to support their livelihoods. Some charcoal producers as well as land users began

[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

establishing small scale commercial woodlots to serve as raw material for the burgeoning charcoal market. These self-motivated individuals, with virtually no external support, have been able to establish hundreds of hectares of cassia woodlots, some of which, have already gone through up to six rotations of about three years intervals. The CSLP identified this locally driven sustainable livelihood initiative as option for support improved natural resources management and livelihoods within the Shama District.

Given that the Shama District has become urbanized in the past decade and the fact that land has become scarce for expansion of woodlots due to competing demands for other land uses, it became imperative to train charcoal woodlot practitioners on innovative strategies for sustainable practices that could potentially result in win-win outcome for landscape restoration and benefits to woodlot owners. The CSLP, therefore, implemented two interventions in the woodlot charcoal systems at Krobo and Yabiw in the Shama District with the following objectives:

1.2 Intervention Objectives

I. Build capacity of woodlot charcoal producers to adopt best management practices that enhance woodlot productivity, biodiversity and carbon sequestration.

II. Pilot use of mobile metal kiln for production of charcoal t

2. METHODOLOGY

In order to achieve the above-mentioned objectives, the ensuing methods and strategies were used.

2.1 Rapid Assessment of Woodlots in Shama District

Photo 1: Michael Ackon of Yabiw (standing) is a pioneer cassia woodlot farmer, narrating the history of cassia woodlots in Yabiw

An initial visit to three communities in Shama District namely Yabiw, Krobo and Dwomo was made to enable the CSLP team learn about cassia woodlots that predominated the landscape. It was found that cassia woodlot was a local initiative that was taken as a response to scarcity of natural wood previously used for charcoal production. Michael Ackon (Photo 1) is the initiator of cassia woodlot at Yabiw about three decades ago.

2.2 Focus Group Discussions (FGD)

An outline of questions was developed for discussions with women and men grouped involved with the charcoal enterprises. The questions for discussions sought to elicit understanding of the woodlot charcoal system, learn about problems or challenges with the system and the actors' own suggested solutions for the problems identified.

2.3 Training on Woodlot Best Management Practices

On the basis of suggestions made during the FGDs for solving some of the pressing challenges in the charcoal woodlot system, the CSLP developed training curricular to train charcoal producers on woodlot best management practices as well hands-on training on operations of mobile metal kilns. Each of the training modules comprised one-third theory or concepts and two-thirds hands-on. An outline of the content of training modules is presented in Appendix 1. Thirty charcoal producers and one staff person each from the Forest Service Division (FSD), Environmental Protection Agency (EPA) and National Board for Small Scale Industries (NBSSI) participated in the training on best management practices (Table 1).

2.4 Training on Operation and Piloting of Mobile Metal Charcoal Kiln Use

With regards to piloting operations of mobile metal charcoal kilns, a trainer with experience of using mobile metal kiln to produce bamboo charcoal was brought on board to facilitate hands-on training of woodlot charcoal producers at Yabiw and Krobo, on how to operate the kilns. This hands-on training was also used to pilot the use of mobile metal kiln to produce cassia woodlot charcoal. Forty-seven (47) individuals (i.e. 24 men and 23 women) from Krobo and Yabiw (Photo 2) were freshly trained in operations of mobile metal charcoal kiln (see Table 2). A refresher training was organized after the kiln had been re-designed. This refresher training involved 33 participants comprising 18 men and 15 women.

Photo 2: Hands-on training on operation of mobile metal kiln at Yabiw

Table 1: Number of charcoal woodlot best management practices training participants

Community /Government of Ghana Institution	**Number of Training Participants**		
	Men	Women	Total
Yabiw	15	2	**17**
Krobo	12	1	**13**
FSD	1	0	**1**
EPA	0	1	**1**
NBSSI	1	0	**1**
TOTAL	**29**	**4**	**33**

Table 2: Number of Training participants for Operations of mobile metal charcoal kiln

Community	**Number of Training Participants**		
	Men	Women	Total
Fresh Training			
Yabiw	13	12	**25**
Krobo	11	11	**22**
TOTALS	**24**	**23**	**47**
Refresher Training			
Yabiw	11	11	22
Krobo	7	4	11
TOTALS	**18**	**15**	**33**

2.5 Fabrication of mobile steel charcoal kilns

Two mobile metal kilns were locally fabricated for training and piloting. This approach was adopted for two reasons. There was no local manufacturer of metal charcoal kilns beside the fact, that for a pilot intervention it was going to be very costly to procure standard kilns from Kumasi[3]. The contracted local fabricator (i.e. Sailer Metal Works) completed first fabrication, which was inspected by a known experienced[4] operator of mobile metal kiln used mainly for bamboo charcoal. The fabricator incorporated some recommendations from the experienced operator to complete the design. The fabrication was refined again after trial use (piloting) revealed some design failures such as limited air inlet, tight lid, difficulty in assembling some parts of the kilns. To address these lapses, the fabricator was transported to a private mobile steel kiln charcoal production facility at Ewiadaso in the Wassa East District to learn the mechanism of operations so that the kilns were effectively redesigned.

Photo 3: Local fabricator (in long sleeve shirt) learning the mechanism of mobile metal kiln in operation at Ewiadaso to improve design efficiency

[3] Kumasi was the only known place for procuring mobile metal charcoal kiln.

[4] Based at Tandan in the Ellembelle District where a bamboo charcoal centre had been set up by the International Network for Bamboo and Rattan (INBAR)

3. LESSONS LEARNED AND CRITICAL ANALYSIS

This part of the report describes key observations and results of interventions on woodlot charcoal implemented so far. It also provides a critical analysis of these findings. The section is sub-divided into three namely FGD findings, best management practices training and piloting of mobile metal charcoal kiln

3.1 Focus Group Discussions Results

The charcoal woodlot owners gave a vivid description of how they operate their woodlot charcoal system. Lessons learnt from the discussions are summarized below.

3.1.1 Problems of Woodlot Charcoal Producers in Yabiw and Krobo

Problems of charcoal production from woodlot strongly expressed by most of the participants of the FGD in order of priority are as follows:

1. Financing cassia harvesting operations, often times, is difficult to the extent that most of the woodlot owners take advance payments from prospective charcoal buyers. The latter intentionally end up paying less than the market price for a bag of charcoal. Other farmers instead of converting the wood to charcoal themselves, resort to selling the woodlot to other charcoal producers who then convert the wood to charcoal for sale. In this case, profit margin of the woodlot owner becomes small.
2. Flaring of wood due to inadequate material for covering the pile of wood in the earth mound kilns during the season as well as ineffective monitoring of the carbonization process.
3. Intense heat and smoke from the carbonization process poses risks to the health of practitioners. Most of them reported illness after each charcoal production cycle.

3.1.2 Land preparation

Most of the woodlots are established on lands considered by the farmers as already degraded and unproductive for crops. When such unproductive lands with dominance of noxious weeds are chosen for woodlots, the most feasible land preparation method adopted by most woodlot owners is slash and burn. The farmers perceived that unless the bush is slashed and burned, it is difficult to have a successful establishment of the woodlot. This mode of land preparation gives no room for important local species present on the site. However, three farmers prepared their land for woodlot establishment by first weeding strips of about 70 – 100cm width where the cassia will be sown. The strips are subsequently cleaned of weeds until the established cassia trees close canopy. At this point, the planted cassia is capable of outcompeting most weeds. Learning from the experiences shared by woodlot owners who did not use slash and burn, five more participants have successfully trialed strip planting without burning. The advantages of this method are many including reduced labor cost, allowing existing important trees to regenerate and low to zero emission of carbon dioxide.

3.1.3 Choice of tree species and alternatives for charcoal woodlot

The only tree species used for the woodlot is cassia. On the basis of experience of marketing, farmers explained their preference of cassia stems from its superior attributes. These attributes include fast growing (harvestable at age four-five from seedling stage and three years for coppiced stands), fast rate of drying, excellent coppice ability and good non-smoke, no-spark charcoal. The farmers mentioned that even though some of local species such as Esa, (*Celtis spp.)* and *Albizia spp.* are good for charcoal, they are of inferior attributes to cassia. They were, however, willing to adopt other tree species of similar or even superior quality to cassia. Some of the participants asked about how they could integrate other valuable trees without any deleterious effect on the woodlot. Some of these and other questions were addressed in a training on best management practices for charcoal woodlots.

3.1.4 Felling cycle and mode of harvesting of woodlot

The cassia woodlot is an even aged monoculture, first established from either directly sown seeds or seedlings. The first felling takes place at about age four to five depending on the site (soil) conditions. During harvesting, all the trees in the stand are felled (clear-felling). Only one person (the pioneer who introduced cassia woodlot to Yabiw) leave few cassia and other important timber trees to grow (to avoid complete exposure of the site to sunlight). But after the first cutting and coppicing, the felling cycle reduces to about three years. The farmers consider the coppice harvesting age as acceptable, yet still they would be happy to get hold of any tree that has a faster coppice growth rate than cassia. It was further gathered that each stump produces six or more coppice shoots which were not managed. In most cases all the shoots that develop from the stump are left un-thinned though occasional weeding (slashing) is done. Most woodlot farmers have the notion that by allowing all the shoots to grow into the next crop, they would harvest more wood for charcoal.

Felling is done manually by using axes and machetes. Chainsaw is considered by many as expensive and not necessary for the felling. All felled wood is cross-cut, aligned in the rows and left for a period of about one month to dry. Then the dried wood and with their branches are collected, transported and arranged at the earth mound kiln site for carbonization.

3.1.5 Charcoal production process

Dried wood is collected and piled or stacked on a one-foot sunken ground. The pile is then covered with a layer of cut grasses or leaves and then covered with soil. It is then covered with a layer of soil before it is fired. An average sized earth-mound kiln takes about one month to completely carbonize the wood. This demands 12/24 hours a day of monitoring. The problems identified to be associated with this process is that whilst the kiln operators go home during the night, flaring may arise. Again, gathering soil and grass in the dry season is very difficult. The process of charcoal production also exposes the operators to excessive smoke and health which leaves most of charcoal producers often sick. There were therefore looking for modern methods that would reduce charcoal producers' risk of exposure to excessive smoke and heat. Hence a recommendation was made by a female charcoal producer who had seen a mobile metal charcoal kiln being operated successfully for several years at Ewiadaso in the adjoining Wassa-East District.

3.1.6 Niche for naturally regenerated indigenous trees and shrubs in cassia woodlots

Prior to the CSLP, only two woodlot owners in Yabiw allowed trees they know to be valuable to naturally regenerate in their woodlots. The rest of woodlot owners did not realize any importance of allowing other tree species to grow in a monoculture of cassia woodlot. However, during transect walks in the Yabiw-Krobo landscape, it was observed that advanced regeneration of trees such as wawa (*Triplochiton scleroxylon*), odum (*Milicia excelsa*), odwono (*Baphia nitida*) and esa (*Celtis mildbraedii*) existed. Meanwhile, most woodlot farmers could not identify these species they knew only by name. This appears to have contributed to less attention the farmers previously gave to natural regeneration. Farmers primarily wanted to maximize returns from woodlot in terms of quantity of cassia wood they could harvest to produce charcoal. However, by and by, they have learnt from the CSLP that retaining some local tree species that have gone extinct through their previous felling activities could provide other benefits such as timber, medicine and biodiversity. These were benefits that have eluded the farmers in the two communities since deforestation and forest degradation become obvious decades ago.

3.2 Best Management Practices

One key intervention regarding charcoal woodlots in Shama district was to build woodlot practitioners' capacity to adopt best management practices in order to enhance woodlot productivity, biodiversity and carbon sequestration.

Coppicing is well understood and the usual practice by woodlot farmers. A recommendation to thin coppice shoots to about two to three stems was not readily received by most of the participants. They explained that thinning involves a lot of time and that it will reduce the volume of wood they could carbonize at each felling/coppicing cycle. Nonetheless, other farmers had observed that thinning increased diameter of trees

With regard to incorporating other practices such as short life cycle crops (e.g. maize and some vegetables in the first to sixth month of new coppice, some of the farmers realized an untapped potential in this. Hitherto, some of them had thought it was not possible to interplant in the rows of cassia because of the exceptionally fast growth rate of cassia coppice shoots. But again, *Obofour* and Charles Baidoo from Dwomo shared their experiences of good maize yield from intercropping in the coppice. This has motivated experienced shared motivated Peter Ackon to successfully grow organic cucumber at Yabiw.

According to the pioneer woodlot farmer at Yabiw, Michael Ackon, when planting strips are made through the bush and kept clean for the first year, the cassia is capable of growing very fast to emerge above the bush within one year. It is after this stage that the remaining vegetation can be conveniently cleared without burning. He further noted that the stands he established with this method appears healthy all the time. As of last year, at least 10 farmers had experimented zero burning during land preparation.

In terms of integrating indigenous trees, farmers' interests lie in trees that grow fast and can coppice, aside from those that can provide other products such as spices and medicine. Rare but locally useful trees were of interest to participants.

Through monitoring visits, it has been observed that some participants of the training on "Charcoal Woodlot Best Management Practices" have adopted some best practices that improve conservation of biodiversity. For example, Peter Ackon, Michael Ackon, Obed Cobbinah (both of Yabiw) and Kwasi Asiedu (of Krobo) now allow other indigenous trees species to grow in their cassia (*Sena siamea*) woodlot. Kwesi Asiedu and more than twenty other woodlot farmers in the year 2015 and 2016 planted black mahogany (*Khaya anthotheca),* emire (*Terminalia superba*), ofram (*T. ivorensis*) and prekese (*Tetrapleura tetraptera*) seedlings on their woodlot plots.

The possibility of leaving some portions of established woodlots intact for beekeeping and enrichment planting has been demonstrated by Ignatius K. Acheampong of Yabiw who has maintained about two acres of cassia woodlot as an apiary.

The stated results notwithstanding, there is still a challenge with practicing harvesting in alternative rows or alternating cutting cycles to avoid clear-felling at a time. This is because most of the woodlots are on small size parcels of land (i.e. usually less than a quarter hectare). This renders it impractical to adopt alternate row harvesting.

3.3 Lessons learnt from piloting of mobile steel charcoal kiln

The local steel kiln operation "expert" that was recommended to provide practical training support for free had experience with bamboo charcoal but not cassia charcoal. Therefore, it was difficult to determine when carbonization of cassia had been achieved. This led to second and third trials of carbonization with varying period and levels of success. The third trial led to a successful charcoal production under the following conditions:

1. Allowing enough air into the kiln at the early stage of the process and monitoring the wood burning process in the first six hours and thereafter progressively limiting air entry to zero.
2. Shorter air inlets.
3. Cutting wood into shorter length and arranging them horizontally rather than vertically.
4. Making sure to start the cooling process as soon as carbonization has been achieved, i.e. when no more smoke exits the chimneys.

The kiln size used for the pilot was smaller than what is used elsewhere for commercial production. The smaller size manufactured for this piloting was decided on the basis of ease of transporting it in the undulating terrain of the two project sites where motor transport is non-existing. However, in terms of yield of charcoal, participants realized that a larger kiln size may be needed for efficient conversion of wood to charcoal and also for effectiveness.

In terms of fabrication of the kiln, as mentioned above, the size should be large enough to yield about 20 of size 5 fertilizer bags. The design of the kiln should be at a height does not present loading and of off-loading challenges. Thus, 1.6 – 1.8 height could be ideal for safe operation.

By taking the kiln manufacturer to see a mobile metal charcoal kiln in operation and to learn about the mechanism behind its design, the first kiln which could not efficiently carbonize cassia wood was effectively redesigned. It is therefore, important for future projects to make sure kiln fabricators fully understand the mechanism of operations before they are contracted to manufacture one.

Another interesting outcome of piloting of the kiln was that charcoal producers in each of the two communities organized themselves to form associations. The formation of these associations was triggered by the provision of the kilns. Members anticipated that the use of the kilns would reduce some of the challenges they faced in their charcoal-based livelihood activity. They made regulations for the use of the kilns including payment of token fees in cash or charcoal equivalent to finance future procurement of larger kilns.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Two interventions for enhancing livelihood potential and improving natural resource management in the woodlot charcoal production system of Krobo and Yabiw have been implemented successfully. The interventions were responses to challenges identified by charcoal stakeholders at the inception stages of the CSLP. Many practical lessons have been learnt from these systems and the interventions that were rolled out. Woodlot owners have adopted best practices with few challenges persisting. The charcoal woodlot owners require additional capacity enhancement to bolster practices to sustain the woodlot charcoal system and also to reduce health, environment and income loss risks associated with charcoal production.

Resources scarcity has triggered local response by establishing woodlot as sustainable source of raw material for charcoal production. However, woodlot-based charcoal producers must not be left to their own fate. With ongoing large-scale land acquisition by developers and land speculators, sustainable potential of this local energy production system could be limited and livelihoods lost.

5.2 Recommendations

Following lessons from the two interventions in the woodlot charcoal production system, it is recommended that;

1. Large scale land acquisition in and around Yabiw and Krobo should be managed well by local authorities so as to safeguard the livelihoods of woodlot dependent households.
2. Secondary processing of charcoal to briquettes could enhance the charcoal value chain. Therefore, institutions such as the NBSSI and Energy Commission could provide support in the form of large mobile metal kilns and briquetting machines to these local charcoal producers.

APPENDIX

Appendix 1:Outline of training modules

MODULE: Charcoal Woodlot Best Management Practices

1. Introduction to Charcoal Woodlots in Shama and Best Management Practices
   I. Deforestation and degradation of the landscape
   II. Charcoal producers' response to scarcity of wood from natural vegetation
   III. Key issues to consider
2. Specific Best Management Practices
   I. Land Preparation
   II. Spacing
   III. Thinning
   IV. Pruning
   V. Coppicing
   VI. Managing Rare Plants in Woodlots
   VII. Harvesting Strategy for Improving Soil Carbon Storage
3. Tapping potential of integrating other compatible uses of woodlot lands

MODULE: Operation of Mobile Metal Charcoal Kiln

1. Introduction of mobile metal kiln – pros and cons
2. Parts of the mobile metal kiln and their functions in the charcoal production cycle.
3. Transporting of the metal charcoal kiln
4. Assembling and dis-assembling the kiln
5. Preparation of material for operation of the kiln (carbonization)
6. Process of carbonization of wood using the mobile steel kiln/monitoring
7. Removing and packaging of product
8. Health and safety measures
9. Care and maintenance of the kiln