Review Article

THE SUSTAINABILITY OF CARBON MARKETS FOR CLIMATE-SMART AGRICULTUREAMONG SMALLHOLDER FARMERS IN UGANDA

Abstract

This study is intended to assess the sustainability of Uganda's Carbon markets from Climate-Smart Agricultural practices that contribute to the sustainable development goals. It integrates the dimensions of sustainable development in addressing food security and climate concerns in a forward-looking perspective.Climate-smart agriculture practices are meant to support the sustainability and efficiency of smallholder agriculture production. Farmers earn revenue by selling Carbon environmental services such as reduced greenhouse gas emissions and carbon sequestration. Carbon can diversify incomes and contribute to the resilience of smallholder livelihoods. Smallholder farmers look forward to the development of the carbon market and the management of future demand and price of carbon credits.The major challenge is the carbon buyers and brokers' projects deliver large volumes with low transaction costs and minimum uncertainty. Large numbers of farmers' involvement and additional work required aggregatesthe carbon sequestered. There is an increasein transaction costs and uncertainty, resulting ininadequate carbon revenue returned to the local communities or the farmers. There is inadequate capacity or skills for project implementation, monitoring, and verification. The carbon sequestration uses complex proceduresthat require input from qualified experts, which increases costs. The limited number of methodologies approved for carbon sequestration in agricultural soils and the complex procedures hinder the work progress. Most projectsapplied for both independent assessments and self-reporting and submitted annual reports to Plan Vivo. Verification is done by Plan Vivo through a review of the annual reports and occasional field visits, then an independent third partydoes the verification exercise. Despite the significant co-benefits obtained from carbon projects carbon prices are still low.The study therefore recommends the role of national or international organizations and schemes providing the link between the farmer groups and the Carbon market. Government policies with incentives for farmers to render environmental services can be part of a national strategy to implement sustainable development goals.For payment of ecosystem services to become a viable mechanism for smallholders, national policies shouldto developed and co-invest schemes initiated together with the private sector for sustainability. In conclusion, sustainable climate-smart agricultural linkages of farmers to the carbon market contribute to the increased co-benefits;and provide direct benefits of carbon diversification incomes, revenue, poverty alleviation, andbiodiversity conservation.

Keywords: Climate -Smart Agriculture, Carbon markets, Carbon prices, Smallholder Farmers.

1.0.Introduction

Climate-smart agriculture (CSA) has been defined and presented by the Food and Agriculture Organization (FAO) at the Hague Conference on Agriculture, Food Security and Climate Change in 2010 and it contributes to the achievement of sustainable development goals. It integrates the three dimensions of sustainable development that is the economic, social, and environmental

aspects by jointly addressing food security and climate challenges (FAO, 2010). It is guided by the three pillars of sustainably increasing agricultural productivity and incomes by adapting and building resilience to climate change and reducing and/or greenhouse removing greenhousegas emissions, where possible.Climate-smart agriculture contributes to the goals of making sustainable development concrete (FAO, 2013). The three dimensions of sustainable development address food security and climate concerns in a forward-looking perspective. Climate-smart agricultureis guided byprinciples that aimfor more resource efficiency and resilience in Agriculture.

Many agricultural, land,and forestry management systems and practices for example sustainable land management, integrated food-energy systems, and Agroforestry are climate smart. Some of the adopted CSA technologies or practices increase the carbon content of the soils and aboveground biomass and enhance productivity and resilience. Mitigation and adaptation co-benefits can be enhanced through integrated landscape management by seizing mitigation opportunities of any particular landscape through increased biomass production.Climate-smart agriculture is not a new agricultural system, nor is it a set of practices. It is a new approach, a way to guide the needed changes inagricultural systems, given the necessity to jointly address food security and climate change. Climate-smart agriculture shares sustainable development and green economy objectives and guiding principles. It aims at increasing food security and contributes to preserving natural resources. In addition, it has close links with the concept of sustainable intensification, which has been fully developed by FAO for crop production (FAO, 2011b) and is now being extended to other sectors and a food chain approach.

Climate Smart Agriculture takes into account the four dimensions of food security, availability, accessibility, utilization, and stability. Still, the entry point and the emphasis are on production, on farmers, on increasing productivity and income, and on ensuring their stability. As such it is centered on the key dimension of food security, - availability, which is associated with stability. It also has much to do with raising and stabilizing the incomes of smallholdersand accessibility to food (FAO,2011a). According to FAO(2016), CSA shares objectives and principles with sustainable intensification of crop production. Sustainable crop production intensification (SCPI) can be summed up in the words “save and grow”. Sustainable intensification means a productive agriculture that conserves and enhances natural resources. It uses an ecosystem approach that draws on nature’s contribution to crop growth, soil organic matter, water flow regulation, pollination, and natural predation of pests and applies appropriate external inputs at the right time, in the right amount to improvecrop varieties that are resilient to climate change and use nutrients, water, and external inputs more efficiently.

The Carbon Market intervention is a CSA approach designed to focus on immediate actions that can be taken to support a transformative process that would unfold over time. The CSA approach seeks to answer the question “Whatsteps can be taken now to move towards a more sustainable future in agriculture under climate change’, as opposed to focusing on the features of some future ideal system of sustainability (FAO2011b). The focus of CSA and more generally of FAO work on sustainable food and agricultural systems is on building transition strategies that are tailored to existing agro-ecological, socio-economic, and policy conditions, looking for key opportunities for opening a transition process, while taking constraints explicitly into account.

The Carbon Market policy was initiated under the CDM schemes and was set up under the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) to address climate change. Reduced Degradation and Desertification (REDD+) was a collaborative venture between three UN agencies, FAO, the United Nations Environmental Programme (UNEP), and the United Nations Development Programme (UNDP) meant to pay countries to keep rainforests untouched. UNFCCC which was initially not keen to accommodate REDD+, actually did under pressure from other UN agencies. However, Uganda has strategized to access carbon funds from different schemes. In 2006, the Uganda Carbon Bureau, the only full-service carbon firm, was registered. Among other things, it supplies carbon credits, provides information on climate change and carbon markets, and has a close relationship with Uganda's main donors, and international NGOs involved in climate change dynamics and carbon finance.

Climate-smart agricultural schemes and practices contribute to mitigation and provide adaptation measures to climate change are often mainstreamed into the agricultural development agenda. This happens regardless of incentives since CSA practices are meant to enhance the sustainability and efficiency of smallholder agriculture. Revenue from selling environmental services such as reduced greenhouse gas emissions and carbon sequestration (carbon) can diversify incomes and contribute to the resilience of smallholder livelihoods. Crucial to this happening is the development of the carbon market and the future demand and price of these credits. Designing payment for environmental services (PES) schemes that work sustainably in smallholder systems requires links between local action among farmer and community groups and other stakeholders at the national and regional levels. The farmers are the sellers who generate carbon; small farms are aggregated to cover and generate quantities large enough to sell to the market. The national and regionallevel stakeholders are governments, businesses, and non-governmental organizations (NGOs) that pay for carbon credit or regulate carbon trade.

Climate Smart Agriculture aims at increasing soil organic carbon through improvedCarbon market efficiency and resilience. The Carbon improves nutrient and water intake by plants, which increases yields and resource efficiency of land, nutrients, and water. It also reduces soil erosionand increases water retention in conservation agriculture. By allowing this combination the system will become more resilient to variability of precipitation and extreme events. Increasing carbon sinks in the soils also capture carbon, which contributes to climate change mitigation. For all these reasons, restoring degraded lands and increasing the level of organic carbon in soils is a priority action. All these will increase the carbon sink content hence increasing carbon markets(IPCC, 2007b; FAO, 2009b; FAO, 2010a; HLPE, 2012a).

The major challenge with CSA is that the carbon buyers and brokers'projects deliver large volumes with low transaction costs and minimum uncertainty. There are large numbers of farmers involved and additional work aggregates the carbon sequestered. There is an increase in transaction costs and uncertainty, resulting in inadequate carbon revenue returned to the local required communities or the farmers. There is inadequate capacity forprojectimplementation, monitoring, and verification. Carbon sequestration uses complex procedures that require input fromqualified experts, which increases costs. The limited number of methodologies approved for carbon sequestration in agricultural soils and the complex procedures hinder the work progress. Most projects have applied for both independent assessments and self-reporting and submitted annual reports to Plan Vivo. Verification is done by Plan Vivo through a review of the annual reports and occasional field visits, then an independent third partydoes the verification exercise. Despite the significant co-benefits obtained carbon prices are low. The price of carbon credits is

too low but farmers receive many co-benefits from group advisory services and improved productivity which keep up their interest.

2.0. Contribution of Carbon Projects to Sustainable Development

Carbon Projects under the CSA are cooperative community carbon offsetting schemes in Uganda. The smallholder farmers are in Business to the voluntary carbon market. Oborn (2014) commends these projectsto combine carbon sequestration with rural livelihood improvements through small-scale, they also farmer-led forestry or agroforestry projects while reducing pressure on natural resources. Project participants undertake a suite of land-use activities that provide carbon sequestration, biodiversity conservation, watershed functions, and food security. He continues to highlight the practices promoted these include mixed woodlots of native or naturalized tree species and fruit orchards. The carbon credits belong to individual farmers but they sell them together—group marketing. According to Oborn (2014),Trees for Global Benefits (TGB)similar to The International Small Group and Tree Planting Program (TIST)has been transformed into a self-financing mechanism that provides upfront funding for farmers to initiate forestry activities, and that uses the market to increase cash flow and invest in expanding the number of participating farmers.

The Carbon projects seek to reduce the unsustainable exploitation of forest resources and the decline of ecosystem quality while diversifying and increasing incomes for rural farm families. Oborn (2017)explains how this operates as an innovative financial mechanism that motivates farmers to engage in activities that generate sustainable income and reverse ecosystem degradation for improved ecosystem health while generating capital to recuperate investments and scale up participation and diversity. Usually, the participating farmers receive cash incentives for increasing carbon stocks on their land. The structure of payments allows farmers to consider long-term investment horizons, using part of their land to develop assets that not only provide short-term cash from annual crops but also long-term benefits from materials and income from trees.

Thecarbon projectswork with established community structures to mobilize farmers and enable ongoing monitoring of land management plans. Farmers from the targeted communities receive training and attend workshops to identify agricultural forestry activities that are suitable to their needs. Once the smallholder farmers are registered, they enter into sale agreements specifying sale quantities and conditions. Through the farmer groups, they identify new areas that may require the development of technical specifications, as well as financing and market opportunities. Linking carbon projects and companies aggregate credit from the various farmer groups and, on behalf of the farmers, negotiates prices with multiple buyers either directly or through brokers. This ensures that the smallholders who would not normally access this market can do so. These companies also support the building of capacity of local institutions that will enable the farmers to use the income from the carbon revenues to diversify their livelihood and thus build resilience to climate change hence a sustainable development.

The Carbon Markets are measured, reported, and verifiedusing the Plan Vivo Standard which is a set of criteria for project design, monitoring, and reporting against which carbon offsetting activities (and the projects' co-benefits) can be certified or verified. The technical specification for each planting system spells out the different land tree management stages, the milestones and targets at those stages, and the expected payment on achieving the target. The Carbon project is a long-term project with ex-ante carbon credits calculated over a 20-year crediting period in the case of single-species woodlots and 25 years in the case of mixed native

woodlots. The long-term carbon sequestration potential of project activities is estimated from measurements of tree-growth rates, and carbon estimates are derived using allometric equations provided by the National Biomass Study. The project applies both independent assessments and self-reporting and submits annual reports to Plan Vivo. Verification is done by Plan Vivo through a review of the annual report and occasional field visits; independent third-party verification is done by Rainforest Alliance every five years. The approval of the annual report triggers the annual issuance of certificates to the Environmental Market Registry. The projects manage their database that traces each credit to the farmer that generated it, the buyer and keeps track of the amounts, the price, the crop grownor tree planting progress, and the payment installments.

Their project has both benefits and co-benefits forexample the TIST and TGB farmersreceive their payments in installments after activities have been monitored. Each farmer is paid according to the number and species of trees planted, the agroforestry system adopted, and the crop or tree growth rate over 10 years. Farmers who do not meet their respective targets are requested to undertake corrective action before they get paid. The TGB project generates significant benefits beyond carbon sequestration, which include economic (improved livelihoods), environmental (biodiversity conservation; building resilience of communities and ecosystems) as well and social benefits (building social capital).The adopted Plan Vivo Standard has strict requirements for the documentation of co-benefits and therefore excludes projects with high chances of adverse impacts on the environment. Some of the carbon revenue is used to facilitate smallholder farmers to integrate tree planting as part of their livelihood strategies. Farmers can gain access to local and national markets for timber, pole wood, medicinal extracts, and fuel wood; the production of fruit and fodder improves both human and animal nutrition, while nursery establishment and seedling production provide income opportunities. Through social networks and regular meetings, the communities can find solutions to marketing challenges, often in the form of group marketing. An example is the Bunyaruguru carbon group that has created a beekeepers' association through which the honey has been processed, branded, and marketed as 'Escarpment Honey'. This is a very successful model that other resource-use groups such as fruit growers, medicinal extracts processors, and milk producers will be facilitated to learn from and form their marketing groups.

2.1. Causes of Low Carbon Payments to Farmers in Uganda

According to Oborn (2017), Carbon credits are generated and claimed based on a newly developed and approved Verified Carbon Standard (VCS) methodology. The methodology addresses the need for a robust but cost-efficient monitoring system and at the same time assists CSA smallholder farmers to reach their objectives of high productivity, food security, and climate resilience. He complements that the VCS methodology requires accounting for three carbon pools that is live aboveground biomass, live belowground biomass, and soil organic carbon)and four emission sources burning biomass, nitrogen-fixing species, burning fossil fuel, and fertilizer application).

Field data required to estimate GHG emissions and removal are obtained through an annual farm-level survey. After some assessments of the baseline agricultural activities for example the adoption of SALM is monitored as a proxy of the carbon stock changes using activity-based model estimates and a Roth-C Model to quantify changes in soil carbon(Oborn, 2017). Usually, Carbon credits in Uganda are obtained for soil carbon and biomass (tree) carbon, and this has been the basis for the development of a methodology that accounts for soil carbon sequestration. The majority of carbon projects in sub-Saharan Africa are offered only for

forestation (afforestation and reforestation) projects, leaving out other important sink activities relevant to smallholders such as agroforestry and carbon sequestration in agricultural soils. The major challenges with CSA are that there are sustainable lack of methodologies and complexities in measuring and monitoring the impacts of soil-based mitigation activities.There is inadequate capacity or skills for project implementation, monitoring, and verification. Carbon sequestration uses complex procedures that require the input of qualified experts, which increases costs. The limited number of methodologies approved for carbon sequestration in agricultural soils and the complex procedures hinder the work progress. Most projects have applied for both independent assessments and self-reporting and submitted annual reports to Plan Vivo. Verification is done by Plan Vivo through a review of the annual reports and occasional field visits, and then independent third parties do the verification exercise. These complexities have caused carbon projects to lose some interest in carbon trading. This in return discourages farmers from practicingsmart agriculture.

The farmers face the challenge of low carbon prices, an issue for smallholder groups entering into the volunteer carbon market. Despite the co-benefits received by farmers, are significant and these have been driving the success so far.The smallholder projects buyers and brokers prefer projects that deliver large volumes with low transaction costs and minimum uncertainty. Large numbers of farmers usually in remote geographic locations are involved and additional work required to aggregate carbon sequestered increases the transaction costs and the uncertainty, and results in that not all the carbon revenue is returned to the local communities or the farmers. There is also inadequate capacity or skills for project implementation, monitoring, and verification. Complex procedures require the input of qualified experts, which increases costs. The limited number of methodologies approved for carbon sequestration in agricultural soils and the complex procedures hinder the development of new methodologies. However, these carbon projects apply the methodologies approved by VCS for soil or tree carbon sequestration

There are many co-benefits from group advisory services and improved productivity which keep up their interest. There is a need for national or international organizations and schemes toprovide strong and sustainable linkage between the farmer groups and the market. It is crucial to have sustainability both for market access and for the required monitoring, evaluation, and verification. Building on lessons learned, there are ways forward for smallholder carbon payment schemes and projects. In addition, through tree planting and sustainable land management practices, farmers are contributing to controlling soil erosion and improving soil fertility through nitrogen-fixing trees thus leading to improved productivity which ultimately results in improved food security and improved livelihoods for rural.

Regardless of all the difficulties with its implementation, the concept of putting a price on GHG emissions and installing a market-based price-setting mechanism through certificate trading provides a powerful instrument of climate finance. Carbon markets could be a large source of international funding for CSA activities. However, the inclusion of carbon credits from agricultural GHG reductions in compliance with carbon markets has been a matter of continuous controversy for at least two decades. Some of the concerns are related difficulties to in ensuring environmental integrity concerning possible leakage, uncertain permanence, and additionality of GHG reductions. There are also high transaction costs, especially through the coordination of large numbers of smallholder farmers that would be required to make soil carbon Certified Emission Reductions profitable and thehigh opportunity costs through the diversion from conventional climate change efforts towards the complex process of achieving carbon market readiness. This concerns about the potentially adverse effect on food security through increases in food price volatility and displacement of food production in favor of more effective carbon

sinks. Another question is about the use of untested technologies to create easily calculated GHG reductions. These issues are usually embedded in a more general rejection of carbon markets as a tool for agricultural mitigation, highlighting the unstable situation of carbon markets overall and concerns about shifting the burden of emission reductions to developing countries.

2.2. Strategies for Sustainable Carbon Markets for Small Scale Farmers Practicing CSA

Carbon markets will become stable if changes required by the agricultural and food systems are supported by institutions and enterprises to provide services and inputs to smallholders, fishermen, and pastoralists, and transform and commercialize their production more efficiently. Similarly, these changes will also require major investments from both the public and private sectors. For this reason, they will drive economic development and create jobs, especially in rural areas and in countries where agriculture is a major economic sector. (FAO, 2016)elaborates on how changes in the field require the introduction of new inputs, techniques, and services. It is accessible to smallholders' pastoralists, fishermen, and foresters both physically and financially. This situation in turn creates opportunities for the development of small local enterprises dedicated to providing inputs and services to farmers.

When establishing CSA practices, local organizations and institutions can play positive roles in producing and sharing technical knowledge, this should relay rapidly throughout the community new information on weather, climate, and options for agriculture (FAO, 2013). The Carbon markets should consider providing financial services (including credit) and access to markets, there is a need to channel micro-finance effectively, to kick-start new practices, technologies, and behaviors among farmers. Provide credit, insurance, social safety nets, and payments or rewards for environmental services. There is a need to stimulate local markets, build links with national and international markets, and improve market literacy among smallholder farmers.

The current dynamics in international climate finance are in favor of CSA with significant potential for new and additional opportunities to use international financing for turning public and private agriculture investments into CSA investments. Fragmentation of climate finance sources has been a particular challenge for concepts like CSA that draw their comparative advantage from the utilization of cross-cutting synergies. With the ongoing shift in focus towards integrative approaches, exploring ways to sensibly and effectively combine thematically separated channels of funding, this barrier to accessing international funding for CSA projects is gradually diminishing. This conceptual change should be reinforced by an overall increasing attention on agriculture in a climate change context, representing not only the arguably most important sector for climate change adaptation, but at the same time one of the world's largest sources of GHG emissions. Especially in combination with forest degradation and competing land use, agriculture is increasingly recognized as one of the crucial parts of the global climate challenge.

While underdeveloped financing channels, like private sector investments or carbon markets, are likely to provide only limited financing for specific niches like manure management or product certification in the midterm, bilateral as well as multilateral public financing is starting to put more explicit emphasis on CSA activities. For example, the ongoing process of the GEF-6 replenishment is pointing in this direction (FAO,2013). Perhaps most importantly in the mid-term future, the current design process of the Green Climate Fund might be influenced by this overall dynamic, which bodes well for the development of CSA financing

Tohave successful access, but more importantly to effectively use increasing volumes of international CSA financing, developing countries will have to ensure that the necessary

prerequisites are in place (World Bank 2011). While significant readiness activities have been ongoing in REDD+ for a long period, there are still more gaps to be filled in the agricultural sector to improve the basis for larger-scale CSA investments. Challenges include the usual suspects, such as the quality and quantity of available data, the effectiveness of monitoring systems to institutional and technical implementation capacity as well as the suitability of policy and legal frameworks. Existing knowledge and experiences on CSA as well as the wealth of climate change needs assessments and priority setting at the national level for example through NAPAs, Nationally Appropriate Mitigation Actions can provide a solid basis for concrete and country-specific preparatory measures. To get a head-start on CSA, developing countriescould consider putting the fundamentals in place now to be ready to use new CSA opportunities as they maximize Carbon markets.

3.0. Conclusion

Climate Smart Agriculture seeks to support countries in securing the necessary policies, as well as the technical and financial conditions. This enables them to sustainably increase agricultural productivity and incomes, build both the resilience and the capacity of agricultural and food systems to adapt to climate change, and also to seek opportunities to reduce and remove GHGs to meet their national food security and development goals. To sustain the reimbursements from Carbon markets, CSA will take into consideration the synergies and trade-offs between multiple objectives that are set in diverse social, economic, and environmental contexts wherever applied. CSA builds upon sustainable agriculture approaches, using principles of ecosystem and sustainable land/water management and landscape analysis, as well as assessments of resource and energy use in agricultural and food systems. All these will promote the carbon markets, whereas farmers gain from the co-benefits too.

4.0. Recommendations

To have a sustainable carbon market there is a need to reduce monitoring costs, which so far has mainly been covered by development funds since it is too expensive to sustain from the carbon credits. To make it sustainable and increase ownership, farmers have been trained to record their own plans, implementation, and performance/yield data. The data are aggregated at the group level by the group leaders who also do some data verification before submitting the data using an SMS system. To be sustainable, the farmer groups need to be organized at a larger scale so they can do the monitoring and evaluating and sell the carbon.

Most Carbon projects are women-led. There should be gender and social inclusion in mainstream projects from the start. In the TIST leadership committees, both the women and men must be represented for each location. The task of the committees is to give and receive feedback from farmer groups on the TIST implementation. Oborn (2014) presents that from experience women are always marginalized and has shown that when men are responsible for the revenue there is a risk that women are marginalized. This inclusion strategy will ensure thecommunity participation of marginalized groups. This includes providing multiple income-generating options and a household approach involving both spouses and older children.

Land ownership is another crucial aspect; however, the payment is given to the person managing the land, not to the owner. One other social inclusion aspect is that farmers with too little land will have difficulty carrying out the required practices and taking part in carbon

projects. These projects strengthen and protect the community's rights to community forests through the formation of Communal Land Associations for the management of community forests.

For payment for ecosystem services to have fair carbon markets for smallholder farmers, a viable mechanism of operation. This is where the national policies will bedeveloped and co-investment schemes be initiated together with the private sector. The Government policies on carbon markets should identify incentives for farmers to render environmental services and be part of a national strategy to implement sustainable development goals.

Institutions should identify carbon market sources from other private funding sources like philanthropic contributions. The funds are usually channeled through charitable foundations or international non-governmental organizations. Organizations like the Rockefeller Foundation, the Cooperative for Assistance and Relief Everywhere, Oxfam, and Conservation International have all invested in CSA activities (Shames *et al*., 2012). The Rockefeller Foundation's Developing Climate Change Resilience Initiative is one of the most visible programs in this context. The Howard G. Buffett Foundation supports CSA projects in Tanzania, Burundi, Sierra Leone, and Sudan through a partnership with the Cooperative for Assistance and Relief Everywhere.

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