

## Opportunities and Capacity for Community-based Forest Carbon Sequestration and Monitoring in Ghana

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International efforts to address global climate change will certainly include Africa's forests, for example through efforts to reduce emissions from deforestation and forest degradation (REDD) (Sandker et al. 2010). Whether these efforts harm or provide new opportunities for rural people will depend on how programs are designed. In Ghana, as in many developing countries, there are few reliable data for estimating current forest carbon stocks. Newly established forest plantations constitute one of the largest and most immediate sources for changes in carbon stock in the country. The government and other organizations are presently establishing forest plantations at a rate of 20,000 hectares annually. Monitoring carbon in forest plantations will be an important component of REDD efforts in Ghana. While methods based on remote sensing can support country-level assessments (Patenaude et al. 2005), ground-based measurements and ground truthing are needed to validate remote sensing results and to provide more reliable estimates of change. While ground-based forest inventories are expensive, approaches that involve local people directly in data collection and interpretation have been shown to overcome resource limitations while at the same time improving conservation project success by linking monitoring to the decisions of local people and building cooperation between local people and the authorities (Blay et al., 2008; Appiah, 2009).

Over the past ten years the Forest Research Institute of Ghana (FORIG) has been working in a benefit-sharing scheme with ten forest fringe communities to restore degraded forest reserve land (Blay et al., 2008). Forest plantations using mostly native tree species have been established through a modified taungya agroforestry system.

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While plantations are established through agroforestry, the use of tree native species and subsequent growth of native understory vegetation and vines after cropping ceases are intended to ecologically approximate forest restoration in a way appropriate for forest reserve lands. Under the agroforestry system, community members have been: (1) provided with tree seedlings, training in reforestation and tree care, and tools, and (2) given access to forest reserve land on which they could plant trees, grow crops until the canopy closed, and receive a share of later economic benefits. While economic benefits would typically come from timber harvest, payments for carbon sequestered in the plantations may offer another line of benefits. We know of no published papers on community-based carbon sequestration and monitoring efforts in rural communities like these. Sandker et al. (2010) used a participatory modeling approach to analyze possible tradeoffs and landowner decision-making in a cacao growing region of southwestern Ghana. Our cases differed from the one modeled in being public—private collaboration, with payments to community members being made for carbon sequestered in forest plantations established on government lands inside of forest reserves.

### **Methods for Community Assessment**

In conjunction with work to develop measurement techniques for community-based carbon-monitoring (Stanturf et al., 2010), we developed and tested a rapid appraisal approach for assessing opportunities and capacity for community-based forest carbon sequestration and monitoring in forest restoration projects in Ghana. Our work focused on two critical areas: (1) an assessment of how forest restoration fits into community land use and household economic strategies, and (2) an assessment of community technical and institutional capacity for forest carbon monitoring. A team of two US Forest Service and three FORIG scientists worked in three villages bordering two forest reserves to assess the capacity of local communities to monitor forest carbon stocks and assess the role that payments carbon sequestration can play in land use decisions and local economies. The communities had all been involved in FORIG's projects on restoring degraded forest reserve land through local benefit-sharing, although only some members of each community participated.

In each community we convened a group of diverse and representative community members, with due consideration to age, gender, and income diversity, and including both participants and non-participants in FORIG projects. We began with a series of activities drawn from Participatory Rural Appraisal toolkits (WRI, 1991) to clarify community and household livelihood strategies, land use, forest uses and values, and social institutions. We then conducted individual and focus group interviews to address specific questions about forest use, agroforestry, forest values, climate change, and carbon monitoring. All work took place in local languages, with on-site translation.

### **Results and Discussion**

All communities were immediately adjacent to Forest Reserves. Reserve vegetation in all cases was very degraded and presently dominated by grass and/or ferns and subject to endemic bush fires. Hunting and gathering of forest products took place on both Reserve and adjacent private lands. Each of the communities involved grew a different cash crop—shade grown cocoa, palm products, and cassava. These cash

crops led to differences in the spatial arrangements of trees into cropping systems on private lands, and also in the use of trees. Trees were often better cared for on private lands than in reserves, suggesting that forest care is associated with receipt of direct benefits from trees. Because communities had insufficient land of their own, agroforests on forest reserve lands provided critical access to land for crops and forest products. Communities differed in access to crop land, and those with less community land had more interest in collaborative projects that provided access to additional land. Communities also had very different levels of economic status, education, community organization, and social cohesion and trust. The latter, in particular, was an important determinate of desired institutional arrangements for future projects. Members within the community varied in their knowledge of climate change and carbon sequestration, but all expressed interest in hypothetical projects in these areas.

A carefully followed and evaluated pilot project of carbon sequestration payments may be the best way to learn exactly how people will respond to opportunities to participate in carbon sequestration and monitoring activities. Our work suggests several factors that should be borne in mind when designing such projects.

First, a steady stream of benefits is important to maintain community involvement and care of forest plantations over time. The greatest benefits of the modified taungya system are in the initial 2 or 3 year cropping phase. Limited access to crop land correlated with high interest in agroforestry suggested that access to crop land was one of the prime motivations for communities to participate in agroforestry projects. People were able to list many mid- and long-term benefits of reforested areas, such as the provision of non-timber forest products and environmental services, but discussions suggested that these forest uses made only small contributions to local livelihoods. We suggest that maintaining interest in and protection of forests is more likely to be sustained if: (1) projects continue to provide opportunities for local people to establish new agroforestry plots, thereby maintaining critically important short-term food cropping opportunities; (2) long-term economic benefits from trees, including both timber harvesting and carbon sequestration, are formalized and agreed upon at the beginning of the project; (3) direct mid-term benefits are provided through collection of non-timber forest products and game, enhanced where possible by projects to enrich agroforests with these products.

Second, there was clear and strong interest among local people for receiving payments for carbon stored in agroforestry plantations as a potential source of income to supplement other sources of scarce cash income. We currently have no estimates of what these payments might amount to and could not provide any estimates to interviewees in the communities, but at least in the short run the amount will probably be modest and may be below expectations. Payments in the longer term may be higher, particularly with further development of the REDD process, implementation of a climate agreement, and/or further development of carbon markets. Sandker et al. (2010)'s modeling suggests that the opportunity costs of conserving forests instead of growing crops, may lead people to drop of carbon payment programs over time. It is important that payments for carbon storage be integrated into a comprehensive package of short-, mid-, and long-term benefits from forests that includes continual expansion of agroforestry to restore forest reserves. The carbon payments are likely to start accruing in the mid-term, a time where there

are at present few cash benefits from the forest plantations. While carbon payments may be low they will be more likely to influence behavior if they fill the gap between short- and long-term benefits derived from agroforestry.

Third, processes for benefit payments need to be developed with input from local communities. Community members felt that benefits should go to the individuals who planted and cared for the trees, not to the community at large. They stressed the need for written agreements that clearly specify the rights which actively engaged participants have to payments related to trees they have planted and protected. In the planning stage it will also be important to clarify the permitted uses of the forest and to know how various uses affect carbon stocks. In particular, knowledge and rules are needed about the relationship between economic benefits from timber harvesting and carbon payments and the relationship or impact of harvest of firewood and other subsistence products to carbon storage and related payments. We found great variation among local institutions and, particularly, in trust in these institutions and in the individuals who played major roles in running them. Because trust may be low, a fair and transparent disbursement process that is agreed to by participants, is crucial for success.

Fourth, although there were varying overall levels of education in the communities we visited, all communities had some literate individuals capable of carrying out the forest measurement work and record keeping. Community-based monitoring must use simple and streamlined measurement processes and record keeping, and training, technical assistance, and auditing will be required before and during the process, suggesting an important collaborative role for NGOs and research institutes such as FORIG.

Finally, appropriate institution building to control wildfires in and adjacent to reserves will be required. All communities involved reported the occurrence of frequent wildfires originating in part from fires set by hunters and shifting cultivators. Community members had low levels of participation in existing Forestry Commission fire protection efforts and community forest committees. Enhancing the benefits that people receive from forests adds an incentive for participation in such activities, but specific institution building programs oriented around forest care and restoration will also be necessary.

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