The Rufford Small Grants Foundation

Final Report

Congratulations on the completion of your project that was supported by The Rufford Small Grants Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Tuyeni Heita Mwampamba
Project title	Carbon Sequestration in Soils and Biomass of Regenerating Tropical Forests in Tanzania
RSG reference	09.02.06
Reporting period	06 June 2006 to 31 Jan 2008
Amount of grant	£4,946.00
Your email address	thmwampamba@ucdavis.edu
Date of this report	25th February 2008

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Conduct vegetation surveys			143 plots 160 tree cores	The objective was 150 plots in order to capture the high variability of the study area. Rains and staffing were the greatest obstacles; I had to introduce tree coring to understand remnant trees, which increased the time spent per plot ; Plant specimen were collected for the first 54 plots and identified at the Botany Department of the University of Dar es Salaam
Conduct soil surveys			~ 750 samples collected	Surveys were conducted in subplots within the main plots. Eventually it required additional staffing as it was drastically slowing down the vegetation work.
Analyse vegetation data		40%		The first 54 plots were analysed to determine statistical power and the way forward. It was then that I decided to increase the total plots to 150. I am currently analysing all the above-ground biomass data and expect to be completed by the end of April 2008.
Measure bulk density of soils		70% completed		Bulk density measurement was conducted concurrently with the soil surveys, by the Sokoine University of Agriculture soil laboratories. They are currently completing the last batch of soils and will send the data to me electronically.
Analyse soils for carbon & nitrogen content		10% completed		Soil from the first 24 plots was analysed for C & N at the University of Dar es Salaam. The results were disturbing in that they lacked a trend and seemed random. Moreover, the procedure is no longer being used in the analysis of C & N and I was concerned about the integrity of the results and my ability to compare my study with others' work. Consequently, I will be analysing the samples myself, here in the U.S. using

				newer and faster methods.
Develop, test & refine a carbon model	0%			A conceptual model does exist, but it always has. An actual model is impossible without the data, which is partially analysed for aboveground biomass and not yet completed for soils
Formulate strategy for initiating carbon offset projects in study area		40% completed		My counterparts and hosts in the study area, the Participatory Environmental Management programme by Tanzania Forest Conservation Group is now seriously considering carbon offsets as a way to mitigate forest loss, connect fragmented forests and improve the welfare of local communities. Further progress with these plans depends on the findings of this study and the subsequent carbon model. We have also identified where additional information is needed to better understand how offset projects would operate in the study area.
Produce manual for model operation in English & Swahili	0%			This component depends entirely on having a completed and functioning model.

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

The rains in the latter half of 2006 did not follow their usual pattern. They arrived two months early with double their usual intensity such that the first month in the field was mostly spent in a guesthouse planning and strategising with the Tanzania Forest Conservation Group staff my hosts & collaborators in Turiani. Consequently, it took longer than planned to survey the first 20 plots (50 had been the original plan). Five months later 54 plots, but a preliminary statistical analysis of the data indicated that many more plots would be needed to have sufficient power to determine whether or not cultivation history has an effect on the rate and amount of carbon sequestered in regenerating farmland. I spent six additional months in the field to acquire my final sample size of 143 plots.

When initially planning for the fieldwork I envisioned that I would need one field assistant. My first day in a trial plot dictated otherwise. While my assistant had many of the attributes that I desired, between the two of us, neither was sufficiently cognisant of local plants to be able to identify trees to the species level. It became necessary to hire a local botanist, and the agreement I arrived at with community leaders was that the botanist had to be village specific. I thus upgraded to a three-people team and had to train a different botanist for each village I worked in (total of 11 botanists). In the

second half of the fieldwork additional plots and an increase in the work required in each plot began to slow us down, and so a third assistant was placed on the payroll. As we moved higher up the elevation gradient, day trips to the field sites were no longer an efficient use of time and energy. I began setting up temporary camps that required us to be away from my base camp for up to four weeks at a time. During these times, someone had to remain at the campsite as a cook and guard while another person needed to be down at the base camp receiving soils and sending up supplies. Before I knew it, there were five people on the payroll neither of whom was redundant!

The original plan was that all my soil samples would analyse for bulk density, and for carbon and nitrogen content by the Sokoine University of Agriculture (SUA) and the University of Dar es Salaam (UDSM), respectively. This would have made it possible for me to leave Tanzania with all the necessary soil data and to begin the statistical analyses and model generation soon after my return. Carbon and nitrogen analysis of soils from the first 24 plots, however, proved worrisome and demonstrated unusually 'perfect' trends. The data looked 'cooked'. With further investigation, it was discovered that halfway through the analysis, the technician decided to change the procedure. After discussions with my soil advisor, we decided that analysing the soils at U C Davis would be the best option and not much more expensive than sending them to other labs within East Africa. With the new arrangements, I will be the one conducting the analyses which will give me the freedom to ask additional questions relating to the soil carbon pool dynamics.

3. Briefly describe the three most important outcomes of your project.

a) It may seem trivial, but I think that the most important outcome of this project is that it has generated optimism for forests in the Eastern Arc Mountains (EAMs). Before going to my field sites, the literature I had read and the conversations I had had with ecologist and biologists working in the EAMs painted a very gloomy picture of the fate of forests there and of the biodiversity that they house. I would not find regenerating farmland, they told me: "Everything is under cultivation; nothing is regenerating".
Contrary to their warnings, I 'found' 143 plots to sample and these were selected from many other regenerating plots. Having spent 12 months in the field, I now know that regenerating farmland in a large and important component of the landscape of the South Nguru Mountains (SNMs) and am very eager to measure its contribution to total ecosystem value. Locally, this is important information for conservation initiatives, but globally, the findings of this study will provide much needed evidence for including regenerating forests as a means for generating carbon credits within the Kyoto Protocol's Clean Development and Joint Implementation Mechanisms, currently restricted to afforestation and reforestation projects. Furthermore, the existence and persistence of forest regeneration can, for the most part, be attributed to local farming practices and local land use management strategies. Contrary to conventional conservation approaches (which present farmers as threats to conservation success), I think that in the South Ngurus, farmers should be viewed as opportunities for success. The objective of my study has thus expanded to identifying those local practices that enhance both biodiversity conservation and carbon sequestration. For now, while I am still in the process of data analysis, the optimism is felt only by me. In the next 12 months, however, the findings will be used by the Tanzania Forest Conservation Group (TFCG) and myself to formulate ways in which offset projects could improve the welfare of local farmers and meet conservation objectives.

b) From the outset, my incentive to collaborate with the Tanzania Forest Conservation Group (TFCG) was because they had contemplated carbon offset as a means to meet the dual

objectives of forest conservation and community development in the Eastern Arc Mountains. Partially as a result of the study that I have conducted, and because of the recent opportunities presented by the United Nations' approval of Reduced Emissions from Deforestation and Forest Degradation (REDD) at the December 2007 Bali Climate Change Conference, TFCG is currently developing proposals for an offset project in the South Nguru Mountains. I have been invited to contribute to this process and to the ensuing developments mostly because of the data and insights I am able to provide. Consequently, upcoming offset projects in the Ngurus will be guided by area-specific ecological data, a rare attribute for many ecosystem-type projects in Tanzania.

c) Above 600 m elevation, small-scale cocoa and coffee farms are important cash-generating agriculture activities in the South Ngurus that I had been aware of but was not going to dedicate any of my fieldwork to. As I spent more time in the area, talking to farmers and surveying vegetation, I began conceptualising how carbon offset could work for those who do not have land adjacent to forest reserves but still contribute to carbon sequestration by growing permanent wood crops such as cocoa and coffee. I thus sampled 15 cocoa farms in one village to get a sense how much carbon is sequestered in plant biomass and in soils, and to use these plots as a form of control for my natural regenerating plots. It is very unlikely that carbon offset projects on their own will solve the development and conservation problems of the area, and I hope that the cocoa plots will provide insight to additional opportunities in the area for sequestering carbon, for maintaining other ecosystem services and for adding value to ongoing agricultural activities in the SNMs.

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

For the fieldwork component of this project, involvement of local communities was limited to the botanists that I worked with in each village. Their involvement was on a one-to-one basis with me and was compensated for in monetary terms.

Benefits from the project by the larger communities are more subtle and will only be felt once a carbon offset project is under way. Inclusion of carbon sequestration in cocoa plots was driven by the desire to ensure that as many people as possible can benefit from the findings of this study. Once a carbon model has been developed and is fully operational, the contribution of this study will be more visible.

5. Are there any plans to continue this work?

Indeed, there are! Granted, the data collection stage has been completed, but the soil has yet to be analysed and the tree cores are only now being processed. Statistical analysis of the data is pending, and this is a necessary step before a carbon model can be developed.

Given that TFCG is eager to initiate a carbon offset project in the SNMs, the data analysis is congruent with discussions of how such a project would work. We are realising that we do not have a very good sense of who will benefit from a carbon offset project since farmers are not the same in terms of the amount of land that they are willing to allocate to sequestration. Identifying more clearly the objectives of TFCG as a conservation organisation and those of farmers as people wanting to improve their welfare, is necessary. I am currently developing a survey questionnaire aimed at

identifying the prominence of regenerating farmland in the study area and the willingness of farmers to participate in a carbon offset project given their accessibility to land.

Currently, the initiation of a carbon offset project in the Ngurus is very much dependent on whether TFCG and CARE Tanzania are able to secure funding through the REDD initiative of the Kyoto Protocol. With or without this funding, I would still be interested in pursuing a small-scale project that concentrates specifically on marketing forest regeneration for carbon credits.

6. How do you plan to share the results of your work with others?

The main recipient of the findings from this study is the Tanzania Forest Conservation Group who were my hosts and collaborators for the study in the South Nguru Mountains. The information, however, is valuable to others doing carbon work in Tanzania, such as the Valuing of the Arcs Project with whom I am already in communication? Also, I am part of the Tanzanian Natural Resource Forum Forestry working group where there are ensuing discussions on payment for ecosystem services through carbon in forestry.

This study has been the largest component of my PhD dissertation, and is expected to generate up to four peer-reviewed papers in ecological- and environmental-type journals. I will also be submitting condensed versions of the findings in the Miombo, the Tanzania Wildlife Conservation Society newsletter whose readership is both local and international. A Swahili version of the findings will also be developed for dissemination along with other TFCG material to the communities in the study area. I am applying for a SEED grant that will enable me organise a workshop with members from the nine villages I worked in to present the findings and to initiate discussions of how carbon sequestration projects could work in the area.

On the 14th of March 2008 I am presenting the preliminary findings to my lab-group here at U C Davis. This is a small group of five students and a professor who provide insightful comments and constructive criticism of the analysis and interpretations. Between the 7th and 11th of April 2008 I will be attending an Agrobiodiversity Workshop here at U C Davis in which I will bring in examples from the study to discussions about the role of agricultural systems in maintaining biodiversity. In July and August 2008, I will present the findings from this study at the Society of Conservation Biology and the Ecological Society of America Meetings, respectively. In September 2008, I have been invited to present the study in the context of tropical restoration to Karen Holl's Lab at the University of California, Santa Cruz.

7. Timescale: Over what period was the RSG used? How does this compare to the anticipated or actual length of the project?

The RSG was used from September 2006 to January 2008, a 17-month period as opposed to an anticipated 14-month period. The fact of the matter, however, is that the work anticipated to be completed within the 14-month period is not yet accomplished. Realistically speaking, the soil analysis, the data analysis and model development will not be completed until September 2008, which makes the actual project duration eight months longer than planned.

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Field equipment & supplies	£1,498.00	£1,011.21	£486.79	I decided not to purchase the electronic relometre /dendroscope and borrowed some of the equipment I used. Even so, I ended up spending thrice the expected amount on zip-lock bags which I needed for the soils (they were expensive in Tanzania, and too heavy to be taken as luggage from the U.S.)
Transportation	£3,158.00	£3,523.65	-£369.65	The price of petrol not only increased, but I ended up spending 12 months instead of 5 in the field, thus increasing my total km travelled.
Fees & Services	£1,382.00	£2,189.98	-£807.98	Soil analysis and identification of plant specimen were more expensive than anticipated. Also, because I was dissatisfied with the carbon & nitrogen analyses conducted there, I have had to transport 140 kg of soils back to the US.
Wages/compensation	£902.00	£978.71	-£76.71	I ended up having a much larger research team than I initially thought I would need. I did eliminate the need for land-use mapping workshops which had accounted for half the budget for this section.
Subsistence	£1,117.00	£616.46	£500.54	The cost of living was less than anticipated after I found a house that I could rent for the entire year. The money saved enabled me to pay for the extra cost of soil transportation.

TOTAL	£8,057.00	£**8,320.01**	**£263.01**	I was over my original budget, largely to pay for soil transportation to the US.

1 £ Sterling = Tanzanian Shilling 2,291.58

9. Looking ahead, what do you feel are the important next steps?

The immediate next steps are to:

- Analyse soils and tree cores; and to
- Complete statistical analysis of vegetation data.

With these in hand, it will be possible to combine the vegetation and soil data to develop a carbon sequestration model for the study area.

The data I have collected will allow me to identify the structure of forests as they move from younger to later stages of regeneration, and the species that contribute most to carbon sequestration at each stage. I will be analysing the data to capture the presence and extent of such dynamics, and to identify cultivation practices that enhance aboveground and belowground carbon sequestration.

Remote sensing (RS) techniques can help identify the extent of regeneration across the landscape which can subsequently be used to predict the regeneration value of land that has not been sampled. I will test to see whether RS can be used to generalise the findings of this study to other mountain blocks along the Eastern Arc.

Finally, the missing component to this study is the policy. Once there is better understanding of the biological potential for carbon sequestration in the eastern arcs, an assessment has to be done on whether it can work given current national land tenure laws and land acquisition policies. At an international level, I would like to assess the implications for including regeneration in the forest sector of the Kyoto Protocol.

10. Did you use the RSGF logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

The RSGF logo appeared on all my power point presentations of the project proposal, and in the future on presentations that I will be giving on the findings from the study. I have also talked about RSGF to individual students in Tanzania and in the United States as a source of funding for their own project ideas. I found it very difficult, however, to promote RSGF beyond these channels.

11. Any other comments?

I think that promoting RSGF would be made easier if some of the following things were made available to us: bumper stickers, badges, poster of the tiger, t-shirts, etc.