Integrating Farm Forestry and Biodiversity Conservation around Lake Victoria, Sango-bay region, Rakai district, Uganda

A Final Report submitted to the Rufford Small Grants Foundation

By

Uganda project team

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ABBREVIATIONS

CBEWs: Community Based Extension Workers

FF: Farm Forestry

IRUCODI: Integrated Rural Community Development Initiative

MOA: Ministry of Agriculture

NFA: National Forestry Authority

RSGF: Rufford Small Grants Foundation

DEFINITION OF KEY TERMS

Biodiversity: Biodiversity describes the diversity of all living organisms, their genetic makeup (between species and within species) and the variety of natural ecosystems in which they exist.

Conservation: The management of human use of the biosphere so that it may yield the greatest sustainable benefits to present generations, while maintaining its potential to meet the need and aspirations of future generation.

Farm Forestry: Land management practice in which farmers cultivate trees in addition to their other productive activities or the intensive use of trees for regional development in particular focusing on wood or plant products.

Participatory Rural Appraisal: Participatory rural appraisal (PRA) is a label given to a growing family of participatory approaches and methods that emphasize local knowledge and enable local people to make their own appraisal, analysis, and plans.

Sustainable development: Defined, as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development which conserves land, water, plant and animal genetic resources, is considered environmentally friendly and non-degrading, technically appropriate, economically viable and socially acceptable.

Ecosystem: An ecosystem is a system whose members benefit from each other's participation via symbiotic relationships (positive sum relationships). It is a term that originated from biology, and refers to self-sustaining systems.

SUMMARY

The conservation of biodiversity is an issue of public concern. Although biodiversity conservation and timber production are sometimes seen as mutually exclusive goals of Farm Forestry (FF), there are examples of where they have proved complementary. This second project (i.e. Integrating FF and biodiversity conservation around Lake Victoria, Sango-bay region) was meant to build on the first one (i.e. The conservation of aquatic and terrestrial biodiversity around Lake Victoria, Sango-bay region) inorder to creat sustainability that is deeply rooted among the stakeholders and the environment. This report contains objectives, activities and achievements of the Rufford Small Grants Foundation (RSGF) funded FF project in Rakai district Uganda, as well as a combined evaluation of the first and second projects, and the way forward. This project was meant to cary out special schools training and set up of a demonstration units, to provide more knowledge dissemination, to inititate innovative FF designs and management regimes, and to research the role of planted farm forests. The project has imparted knowledge onto the young generation about the role of trees in ecosystems; set up demostration forest units comprising of Pine (*Pinus* spp) and Eucalyptus (*Eucalyptus cinerea*); provided more extensive knowledge to the local stakeholders and community leaders; initiated some FF designs and magement regimes, leading to increased patchness of the trees that were grown during the first project as fast growing tree seedlings were planted within and around the the borders of the the other trees (citrus trees , Pine, coffee, etc). Research concluded multiple roles of planted farm forests in the region. The Oranges seedlings that that were supplied to the rural communities in the first project have now grown and the first harvest is due. The stakeholders have expressed utmost appreciation to the RSGF for initiating such a program in their area.

INTRODUCTION

It is important to note that forests are the world's air conditioners and the earth's blanket; without them the world would be a bleak and inhospitable place. Forests are a renewable resource and nature's gift to mankind. The forest eco-system of Uganda consisting of a variety of flora and fauna representing remarkable bio-diversity is essential for environmental stability and food security. As a life supporting system forests play a vital role in the ecological stability and rural development of Uganda, and support of this sector should not be overlooked. Any efforts to improve and increase forests in Uganda through technologies like FF are increasingly necessary.

In September 2006, Sango-bay wetlands in Rakai district, on the shores of Lake Victoria, was designated as a Ramsar Conservation site, bringing the total of Ramsar sites in Uganda to 11

(Kasozi, 2008). The objective of this ordinance was to make Rakai district a tourist destination. The ordinance/bylaws was also to regulate unfavorable human activities in the region for better environmental sustainability. The region is considered an Important Bird Area (IBA) with an exceptional biodiversity supporting among others internationally significant numbers of four congregations of breeding bird species. The region is known to have the largest breeding colony for the Grey-headed Gulls in Africa and 75% of the total global population of the Blue Swallow, Egyptian Goose, Little Egret, Long Tailed Cormorant and Greater comorant. Unique reptiles like snakes and lizards are also found on this area which is covered with forest mosaic containing 30 endemic floras, restricted subspecies of primates, Elephants and Sitatungas (Kasozi, 2008). Sango Bay wetland is endowed with diverse and unique natural and cultural resources that are suitable for ecotourism development and promotion (Nyakaana, 2008). It ranks 3rd and 4th in mammal and bird species respectively when compared with Uganda's ten National Parks (Bakamwesiga, 1999; ITE, 1995). This makes it an important biodiversity area worth conserving. However, this conservation area and most of its outskirts are being eroded away by agricultural advancement (Crop farming), firewood, land fragmentation, charcoal production and above all ignorance of the importance of natural resources. According to the State of Environment Report for Uganda 2002, both the National Environment Statute 1995 and the Local Governments Act 1997 provide for the devolution of environmental management activities at the districts and the lower level local governments. The vast majority of Rakai people live in scattered small farmsteads (Kasozi, 2008; Nyakaana, 2008), hence the reason FF should be more emphasized and promoted among them.

Farm Forestry has the potential to address many ills in the agricultural landscape: rising watertables, declining biodiversity, soil acidity, diminishing farm income, and also the added benefit of providing additional habitat for native animals and plants (O'Loughline, E and Nambiar, E.K.S. 2001, Wildlife notes, 2005). FF plantations may enhance re-establishment of diverse natural vegetation and maintain soil biodiversity: some studies have demonstrated a greater level of microbial and micro-arthropod activity in the soil under trees and FF plantings than in soil on cleared or unplanted land; the plantations can also maintain stream biodiversity as trees planted on stream banks or in recharge areas can assist in controlling rising saline groundwater, limiting erosion and capturing nutrients and bacterial pollutants (O'Loughline, E and Nambiar; E.K.S. 2001; Wangaratta, 2007). FF can as well provide income from land managed for habitat: carefully designed FF can integrate the periodic harvest of selected and specially managed trees with the provision of habitat along riparian zones, in wildlife corridors or in remnant native vegetation, thereby helping to fund on-farm nature conservation efforts (Wildlife notes, 2005). These plantations provide more diverse habitats – both above and below ground – than do other agricultural land uses such as annual crops and pastures. The vertical structural component, for example, may assist the return of certain tree- dependent birds and mammals.

Greater biodiversity can contribute to farm productivity: there is increasing evidence that biodiversity performs ecological functions that contribute to overall farm productivity. For example, siracid wasps, which feed and breed on acacia and often eucalyptus windbreaks

planted around paddocks, have been shown to reduce the population of scarab larvae in pastures. Mixed plantations can produce high quality saw logs: understorey and nurse crop species can help ensure that commercially important species such as Eucalyptus maculate achieve the required height, straightness and diameter needed to optimize the production of high-value timber from FF.

1.2 Objectives

I. To raise tree seedlings, particulary eucalyptus and pine.

II. To provide more information on tree production and biodiversity conservation.

III. To inititate Innovative Farm Forestry designs and management regimes.

IV. To carry out special schools training and set up a demonstration units in at least two schools in the region.

V. To establish the role of planted farm forests in rakai.

1.3 Problem analysis

Currently, there is increasing level of poverty, underdevelopment and unemployment in Sango-bay region despite the increasing consumptive use of the natural resources. With the rapid increase of human population in recent years, increasing numbers of marginalized people, especially women and the youth, are moving and settling in the wetlands in search of new means of earning a living and in so doing, are clearing forests without replacement. Within this broad socio-economic and environmental context, the development and promotion of FF, and recreational non-consumptive uses of the wetland such as ecotourism, is crucial for long-term conservation of resources and poverty reduction. FF increases plant diversity in anyone eco-system which in return is important for supporting diverse fauna especially herbivores and birds, and this is important for biodiversity development, which can be used to positively change the livelihoods of a community (Nyakaana, 2008). FF as an option to diversify farm income has not been given much attention in Uganda, but has been a success in many developed countries, for instance steady development has been observed in the south-west of Western Australia over the last fifteen years and plantations of all shapes, sizes and compositions are springing up across the rural landscape (Wildlife Notes, 2005). Species such as eucalyptus for sawlogs, citrus, medicinal plants (Moringa and Neem), and pine are good examples of trees that have been used successfully in FF.

MATERIALS AND METHODS

2.1 Study area

Rakai district (31°35' East 0°55' South) has three counties, namely Kooki, Kakuuto and Kyotera. Sango bay covers parts of Kooki, Kakuuto and Kyotera. The scope was two counties (Kooki and Kakuuto), two Sub-counties (Kabira and Kyebe) and nine parishes.

2.2 Raising of seedlings

Tree nursery construction and planting of seeds was slowly started in December 2007. Tree nurseries were begun in Kakuuto and Kooki counties and looked after until the seedlings were ready for planting into the fields, between July and September 2008. Enormous labor including site clearance; fertilisation, seed collection, planting, and irrigation were done to keep the nursery beds healthy. From the nurseries, the seedlings were transported to different selected stakeholders for planting. Most of the stakeholders were those who were already involved with the first phase of the project (The conservation of aquatic and terrestrial biodiversity around Lake Victoria, Sango-bay region- Rakai district, Uganda). All this work was done alongside other activities since seeds take a while before developing into seedlings.

2.3 Meeting with local leaders and provision of more extension services

Meeting with Local council chairpersons and school administrators: at the begining of the year we sought permision from the local council to carry out our second project (Integrating FF and biodiversity conservation around Lake Victoria, Sango-bay Rakai Uganda) and a continuation of our previous project (The conservation of aquatic and terrestrial biodiversity around Lake Victoria, Sango-bay region- Rakai district, Uganda). After two weeks of several beauracratic procedures, permission was granted.

Provision of more extension servivces: This activity took 75 days to complete (April – June 2008). More information highlighting the potential role of trees in both production and biodiversity conservation was availed through the provision of more extension services and easy to read booklets to the stakeholders (Community leaders, farmers, students, politicians, and other interested classes of people). Large numbers of stakeholders, particularly those that were involved in the first project attended the dissemination classes (Figure 1)

Figure 1: Mr. Byaruhanga Dickson presenting at a knowledge dissemination workshop

(*Photo by Tusiime Loyce*)

2.3.1 Training of technical and support staff

The workers (CBEWs) were trained in forest plantation establishment and management. The project technical and support staff were given training on a regular basis to keep them acquainted with plantation forest management. Routine training in plantation work was sought from the National Forestry Authority (NFA) for better performance.

2.4 Initiating Innovative FF designs and management regimes

Innovative FF designs to increase habitat patchiness, takes a while and so we only initiated the practice in a few areas (some parishes in Kakuuto county), and we intend to continue mixing different plants to increase patchiness, thereby facilitating an increase biodiversity. This should continue in the next phase of the project. In a few plantations, more seedlings of different type were planted; e.g. Neem and Moringa seedlings were planted among Orange trees from the previous project.

2.5 Special schools training and set up a demonstration units in schools in the region

In august and September we spend 30 days training schools and setting up demonstration units. The exercise was done in Nabigasa Primary school in Kabonela parish and Kakuuto High school in Kakuuto parish. Senhte C, Byaruhanga D, Ekapolon G and Tusiime L carried out out a search for the most favorable schools within which demonstarations units would be set. To do this we had to start by meetings Local council chairpersons, and the parish administator who gave us a letter of introduction to the various schools. We then went randomly to five primary schools and five high schools. For every school we visited, we took a transect walk through the premises and graded its surrounding land area accordingly: 1- completely bare (without trees or any form of crops), 2- large chunk of land, mostly bare with few trees, 3 – small piece of land, mostly bare, and 4- land with many of trees and other plant life. A school was selected for consideration if it had a large piece of open land with very few or no trees growing in the area. Nabigasa Primary school had the largest piece of land that had no trees, followed by Kakuto high school. We later divided our team into two. One team was sent to implement activities at Kakuto high school and another at the Nabigasa primary school. Due to limited resources we had only one camera, therefore we never managed to capture the photos at the high school, however the activities and procedures were the same. Firstly, all students were given lessons and briefed in small groups on the importance and purpose of trees in the context of nature; they were engaged to participate in giving reasons why they thought it was important to plant trees (Figure 2). They were equiped with practical skills of establishing a tree nursery, how to care for seedling until they are ready for planting, and were taught the techniques of lining out and pitting, and also how to carry out various silvicultural practices such as pruning, weeding and thinning of trees in a plantation. The procedures of planting trees and how they can be managed was also disseminated to the teachers.

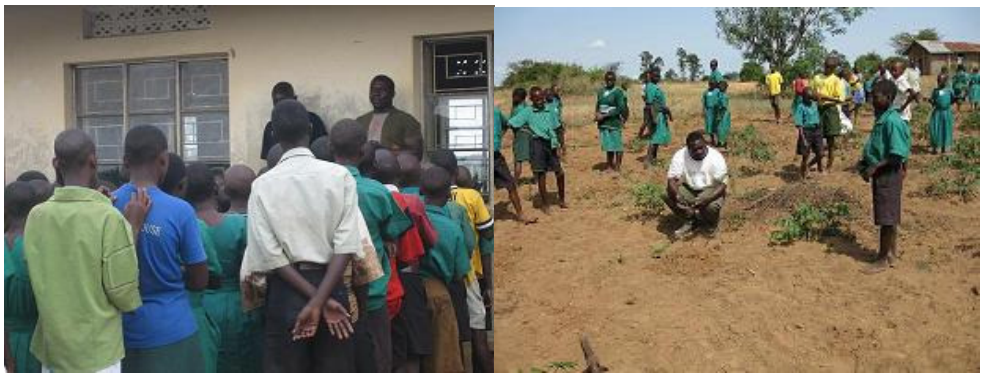


Figure 2: Dr. Celsus Senhte delivering a briefing to Students about the program (*Photo by Tusiime Loyce*)

2.5.1 Loading and transportation of seedlings

The seedlings were delivered to the planting sites and great care was taken to avoid damages. A truck was used to transport the seedlings to the planting sites (Figure 3). During movement, care was ensured to avoid damages. On the plantation sites, plastic basins were utilized to carry seedlings to the required planting spots. Loading was done with utmost care to avoid damages especially to the roots, and keeping the soil and roots intact. The off-loading of seedlings at the planting site was also done with care to prevent exposure of the roots to the sun.

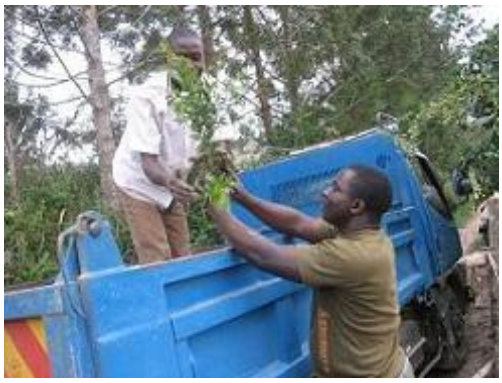


Figure 3: Seedlings transport (*Photo by Timothy Mbazira*)

2.5.2 Actual planting Exercise

Planting was carried out with healthy seedlings of 15-30 cm tall. The seedlings were planted between August and October during the on-set of the second rainfall season. On a well cleared area, pitting was done using a hoe. Each hole was 25 by 30 cm. The polyethylene tubes were gently torn with care to keep the soil and roots intact. The seedling were then handled carefully to avoid damaging the roots, and vertically placed in the pit. The soil was replaced to the root collar and pressed around it using the thumb and the index fingers. The polyethylene tubes were was gathered and taken back for re-use.

2.6 Research: the role of planted farm forests in biodiversity conservation

This research mainly ivolved the use of interviews to the FF practising farmers, as well as observations through transect walks through the FF premises. We also carried out literature survey about what has been done so far in Uganda. Research was also performed to Identify factors that may influence the effectiveness of designs and management regimes. Existing farm forests were utilized to identify these biodiversity effects. This was done alongside the other activities, throughout the project period.

ACHIEVEMENTS/OUTCOMES

3.1 Kooki and Kakuuto Tree Nurseries

Two nursery beds containing a mixture of eucalyptus, Pine, and a few Neem and Moringa seedlings were established in Kakuuto and Kooki counties (Figure 3- 5). Depending on the availability of funds, we intend to keep these two sites with replacements of the seedlings each rainy season, and keep distributing to other stakeholders in future. This should in turn create employment to the local people as well as provide the stakeholders/farmers with trees for future sustainable income.

Figure 3: A tree nursery in Kakuuto (*Photo by Celsus Senhte*)

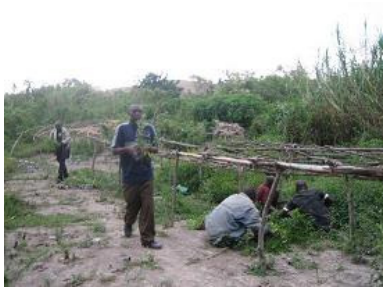


Figure 4: A tree nursery in Kooki county County (*Photo by Celsus Senhte*)

Figure 5: A tree nursery in Kooki County (*Photo by Celsus Senhte*)

Kakuuto and Kooki community has learned to make reforestation and FF profitable. After selected number of CBEWs taking a course in tree nursery reforestation and FF, the group saw the potential in continuing tree production as a vital part of reforestation efforts in Uganda. While the community had already planted 4,000 trees to reforest their surroundings in Sango-bay, it is expanding its tree production to keep up with future demand for good tropical hardwoods like eucalyptus, pine. The Kooki group still has close to 5,000 seeds germinating (Figure 5), and all of them are already destined to be planted on local farms in this important FF effort. Forestry authorities are taking notice of the efficient tree nursery, offering them a great economic opportunity. Clients outside the project area have agreed to buy trees from the Kakuuto and Kooki groups, hence compelling them to expand their annual production capacity twenty-fold to 100,000 trees come the 2009 wet season. Since FF is currently an important ongoing effort all over Sango-bay, the tree nurseries will likely enjoy a healthy market for decades to come, offering employment to both men and women in the community.

3.2 Involvement of local leaders and the community

Following talking to the various local leaders individually and at meetings, a few accepted our invitation and participated at the special schools training and set up of demonstration units (Figure 6). This was aimed at using local leaders, the community (the silent majority), and students in the participatory approaches in farm forests and conservation management. In so doing the following benefits have been realised:

- **Cooperation**

  In practice, one of the most compelling reasons for seeking the participation of FF users, students and community leaders in managing FF resources has been the inability of governments to police forest areas effectively and enforce their own rules of access and use without local public support. When local communities and private companies share in the design, benefits, costs, and management responsibility of FF projects, they have incentives to cooperate in enforcing rules on which they have themselves agreed.

- **Poverty Alleviation**

  The products from the FF practice will help the beneficiaries in terms of increased income, through timber/wood, seedlings, and fruit sales. Majority of the people who occupy wetland areas or the agricultural fringes that surround them are poor and vulnerable populations; many, often being indigenous or landless people who have migrated from other areas. In this context FF will enable them to share the benefits as well as the management of farm forest development and future commercialization to alleviate poverty and diversify their sources of income.

- **Farm Forest Productivity**

  With the benefit of local knowledge and participation, the value of non-timber farm forest products to different users for food, fiber, medicines, oils, and gums are more fully exploited.

- **Sustainability**

  Twenty CBEWs were trained in nursery and plantation establishment, and management, and these will continue to relay/disseminate this knowledge to the stakeholders that require it in the region. While still seeking to generate economic benefits from forest resources, policymakers are increasingly aware

of the important role played by farm forests in preserving biodiversity and protecting critical watersheds, especially in regions with large and growing populations, like Rakai district and most areas in western Uganda, where participation is often the only viable way to conserve forest areas for sustainable use or for their environmental values as intact ecosystems.

Figure 6: From the left are: Mr. Nsambu (Local Council chairperson), Mr. Nanseru (Parish Administartive assistant), Mr. Kagaro emmy (School Head teacher), Mr. Byaruhanga Dickson (RSGF Uganda Project Researcher), Mrs. Nakayima Kintu (Mobiliser), Dr. Celsus Senhte (RSGF Uganda project Team leader), and Mr. Deus Rugomora (School teacher and Student organiser) - (*Photo by Timothy Mbazira*)

3.3 Special schools training and set up of demonstration units

In total, 200 students in Sango-bay, Rakai district have been trained in:

- tree nursery establishments (see appendix I),
- planting seedlings into the fields,
- Silvicultural practices,
- Watersheds and forest management,
- Impact of trees on environmental sustainablity, and
- Impact of trees on income generation.

In addition, a total of 3000 eucalyptus and 500 pine trees have been planted in two schools (Nabigasa Primary school and kakuuto High school Premises). The school staff and local leaders

have expressed gratitude to the activity and commended RSGF for their contribution (Appendix II) .

3.4 Innovative Farm Forestry designs and management regimes

In this particular activity, we initiated a regime that will help increased patchiness, by interplanting Eucalyptus and pine with Neem/Moringa trees which on the other hand will serve as sources of local medicine. Habitat 'patchiness 'was promoted by mixing species and planting at time-intervals that provided a mix of age classes in close proximity. This was done based on varying site quality: for example, habitat plantings were integrated into property management plans so that commercial species are planted and managed on sites of high quality and biodiversity plantings are located on sensitive or low productivity sites. In future, when it is necessary, in regions where thinnings have low economic returns, we might use nurse trees that can be felled or killed and left standing, thereby providing an extra habitat component. The dead trees will provide habitat for a range of arthropods, which in turn feed birds and reptiles.

The planting of species mixtures is also an important strategy to minimise the risks to plantations from pests, diseases and climatic extremes. The mixed plantations provide a potential diversity of timber products to help reduce economic risks. The accurate description of wood properties helps to inform processors and potential end-users so that markets can be developed to use sustainably produced forest timber.

3.5 Research: role of planted farm forests in biodiversity conservation

3.5.1 Research findings

We conducted a literature review of scientific studies related to biodiversity in FF. We found that research relevant to this topic is sparse and generally inconclusive. For example, few studies compare the biodiversity value of FF on cleared agricultural land with that of land used for traditional agricultural enterprises. This largely reflects the fact that FF is only a relatively recent phenomenon in Uganda and points out a major need for further research. From the few farmers that were found already practising FF, it was observed that they had small scale FF with mixed species of plantations (many fruit trees) varying in shapes and sizes and with less intensive silvicultural practices, and often extensive harvesting (Table 1).

Planted farm forests were found to have the following roles (Table 1):

- fuelwood for the households: The MOA (1999) estimated supply of fuelwood country wide from farm homesteads at about 60,000 tons per year based on an

assumed number of five mature trees per rural household. The same source indicated that there are some 120,000 hectares of woody vegetation in patches less than 200 hectares in size that are contributing nearly 100,000 tons per year. There has however been a very significant decrease in on-farm planting of trees, related to the change of government policy on individual tree tenure,

- timber for construction: 18.5% of the repondents use their farm forests for timber production, which is sold to timber dealers (often middlemen) to get income to sustain them,
- food, through harvesting of fruits planted amongst other trees: 30 % said that usually within their forests, they mix fruit trees like Oranges, avocado, guavas, and sometimes edible crops such as beans, maize and ground nuts for home consumption and sale,
- herbal medicines: 3% of the respondents utilise certain trees on their farms for provisiomn of herbal medicines, among which are, Moringa (*Moringa oleifera)* and Neem (*Azadirachta indica*),
- **Biodiversity conservation:** 10% believe farm forests can contribute towards biodiversity conservation. The flora of Uganda consists of between 6,000 and 8,000 species of which 12 % are considered endemic. The forests host the major portion of the flora, including about 25 % of families or close relatives of cultivated crops.
- **Soil and water protection:** They were also certain that farm forests can lead to the conservation and protection of soil and water resources (8%). Land degradation through soil erosion remains the greatest threat to sustainable land management in the country. Erosion by water alone is estimated to cause an annual loss of 1.9 billion tons of soil. The soil conservation research project results show that the maximum soil loss on cultivated land is in the order of 300-400 tons per ha per year. In response:
    - trees and shrubs in agricultural and grazing land can increase both crop and livestock productions by reducing wind speeds and water loss,
    - it has been estimated that one hectare of eroded land with 35 % slope looses as much as 140 m^3 of top soil each year. Conversely, if forestry is chosen to be the best alternative form of land use, not only is the loss of such an amount of soil prevented but, also that it is not deposited in river bottoms, lakes and dams, and
    - forests and trees lessen the impact of rainfall thus allowing water to percolate instead of being lost through run off. In areas receiving an annual rainfall of 600 mm per year, the afforestation of one hectare of steep slope and eroded land (35%), allows an estimated 5,000 m^3 of water to seep into the ground thus preventing the filling up of waterways and the incidence of floods.

Table 1: Utilisation of Farm Forestry versus % respondents in Sango bay (n=100)

Utilisation	% Respondents
Firewood	30
Food	30
Medicine	3
Timber	18.5
Ecotourism	0.5
Soil/water protection	8
Biodiversity conservation	10

Factors that may influence the effectiveness of designs and management regimes

While FF in the countryside has been controversial in some aspects of nature conservation, there can be little doubt that the expansion of forests and woodland has many potential benefits for wildlife. Establishing a forest on farmland can be a very positive move, from an environmental point of view. The environmental benefits obtained depend largely on how and where the FF is carried out – and this ultimately depends to a large extent on decisions made by the landowner. There is much that landowners can do, at all stages of the process of forest planning and management, to enhance the value of their plantation for the benefit of plant and animal species, i.e. to improve the "habitat value" of their forests.

It is important to start out with a good assessment of the FF site. This assessment tells us that areas we should aim to retain unplanted and incorporate into our overall forest design as "open space", and what "biodiversity features" should be retained and protected during forestry operations.

Start by asking: What habitats are currently present on the site? Is there semi-natural habitat or is it all improved agricultural grassland? Examples of semi-natural habitats include: wet intact raised or blanket bog, partially cutover bog, any kind of wetland (e.g. swamp and marsh), unimproved grassland, native woodland or scrub.

If then the site consists mostly of semi-natural habitats, then planting is generally not a good idea – it may result in an overall decrease in biodiversity, which is an unwanted result. There may be potential conflict here because of the strong tendency to locate forest plantations on land that is marginal for agriculture. However, of all areas on the farm, it is this marginal land that often has the best habitat value, and this can be lost by establishing a commercial crop of trees. It may seem controversial to locate the plantation on good agricultural grassland, but by doing so, it does not increase the potential productivity of the forest tree species, but also often moves from a situation where it may cause loss of biodiversity to one in which it is enhancing biodiversity overall.

Unplanted Areas

If, on the other hand, the site has only small pockets of semi-natural habitat present, aim to retain these as unplanted areas (retained habitats) in the overall forest design. Give them good, unplanted buffer zones, to limit the effects of shading by mature trees in future. Map out for retention and protection of any features of nature conservation value on the site (referred to as biodiversity features). Examples of biodiversity features include: over-mature trees – any old trees present in or around the site should be retained and allowed to die off and decay naturally, to provide important habitat for plants and insects; large, old hedgerows – these frequently support a range of native woodland plants; streams/rivers or swamps – these should be given a non-intervention buffer zone on either side, in which it should aim to have a patchwork of open space and native broadleaves, as the site permits. It may also have features that are important for particular species (e.g. important plant sites) which should be retained and managed with protection of that species in mind.

Species and Biodiversity

Selection of which species to plant is a decision that is as important to nature conservation as it is to commercial aspects of forest planning. There is a rule-of-thumb in forestry which says you should plant the "right trees in the right place". This rule also applies when you are trying to improve the ecological value of the forest. The problem is that the species which have the most to offer nature conservation may not always give the best economic return, and so species selection is a question of achieving a balance between commercial and ecological considerations. Broadleaved tree species tend to have better habitat value than conifers, and native broadleaf species yield the best habitat value of all. There are several potential compromise solutions. For maximum ecological benefit, incorporate as many species into the forest design as possible, balancing this with commercial considerations. Where there is no realistic prospect of a commercial return from minor species (e.g. too small an area involved), select non-commercial native broadleaf species as minor species. In any situation when planting for non-commercial reasons, the planting material should always be native species of local or native provenance, and select species that are ecologically suited to the site. Adopt a tolerant approach to natural regeneration of minor species over the lifetime of the crop, where it doesn't hamper the timber production aspects of forest management.

3. 6 Follow up of the first project

3.6.1 Habitat patchiness

Patchiness has been observed in some plantations around some FF designs (Figure 7-9), where oranges were interplanted with Neem and Moringa plants. More biodiversity is being realised

and poultry are often seen frequenting these sites to eat the readily available arthropods and smaller plants/weeds (Figure 7).

Figure 7 : Awuku's FF farm: Some patchiness developing in a an originally bare land two years ago) (*Photos by Celsus Senhte*)

Figure 8 : Some Moringa and Neem trees interplanted (*Photos by Celsus Senhte*)

Figure 9: A Mixture of Oranges, Avocado, and Neem and coffee plants at Mzee Odong's FF farm (*Photos by Celsus Senhte*)

3.6.2 Harvesting of Oranges

In the first project we supplied among others, a number Oranges tree seedlings. Most farmers that received the plants are reporting good progress. We visited some of them and found that

the fruits are about to be ready for harvesting (Figure 10-12). Early, next year all farmers will be harvesting their oranges.

Figure 10: Dr. Celsus and Mzee Obore showing an orange fruit

(*Photo by Ekapolon G*)

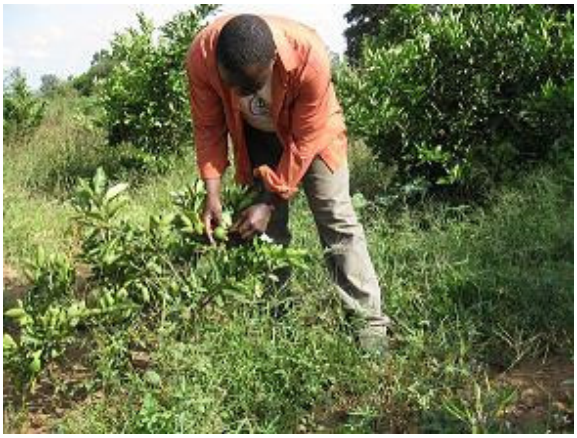


Figure 11: Celsus inspecting the Orange Farm

(*Photo by Ekapolon G*).

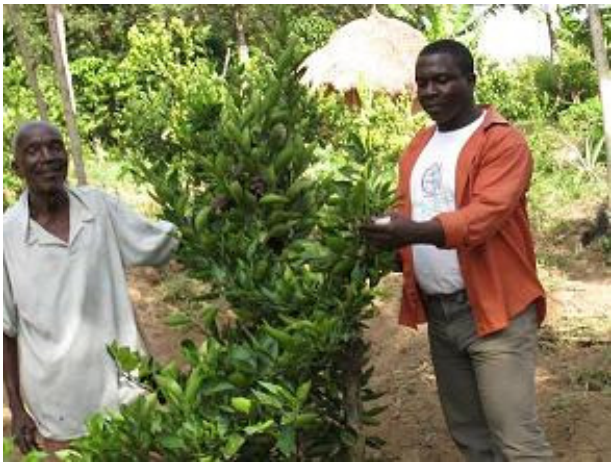


Figure 12: Celsus and Mzee Awuku, one of the FF farmers

(*Photo by Ekapoplon G*)

3.6.3 Food Provision for wildlife and humans

Food is the first essential element that you can help provide for wildlife on ones land. Food requirements vary among wildlife species. The increased patchiness, and secondary outgrowth of smaller plants, and various creeping weeds, has led to development of better microenvironment for a lot of biodiversity (arthropods and other organisms).

The fruit trees that were inter-planted with other trees/shrubs, particularly oranges have already fruited and will be ready for harvest in four months time. The fruits will be a source of vitamins to the local communities especially the malnourished children.

3.6.4 Medicinal purposes

Neem and Moringa seedlings were also supplied during the first project. They have now grown and are proving the FF farmers with medicines used in the treatment of a number of diseases. The medicine is used in animals and man for the treatment of diarhoea, helminthosis, constipation and bacterial infections, among others. In particular, neem leaves are crushed and used in the treatment of malaria, whereas moringa is recommended in the treatment of cancer patients.

BEFORE AND AFTER PHOTO GALLERY

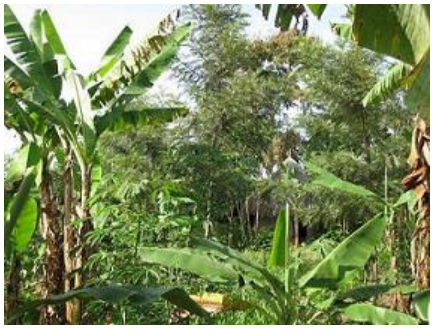
This sections contains a few examples of photos of the land area before and after the start of the first RSGF funded project in in selected areas in Sango-bay, Rakai district.

Before (2006)

After (2008)

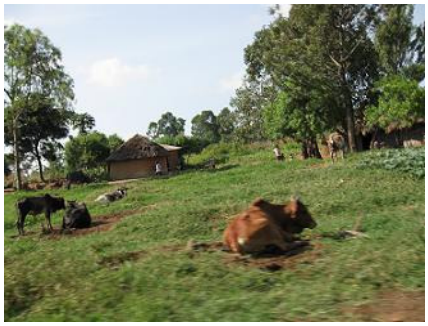
Before – Open land nearby a papyrus swamp (2005)

After – Mixture of neem, Moringa Oranges (2008)



Before – Open space with our tree nursery (2005) After – Grown mixed trees (2008)

Before – Open space (2005) After – Grown Eucalyptus trees (2008)



Before –Free open space (2005) After – Mature trees (Oranges, Neem and Moringa) (2008)

Before – Orange seedlings being planted (2006) After – Mature oranges (2008)

KNOWLEDGE GAPS

There is a body of knowledge available now with which we can improve land management practices by further development of FF. The level of this information varies between catchments and regions, as does the extent to which available information is being used in land planning process. As we progress through the implementation of FF, it is also clear that, despite significant achievement, the knowledge needed to maximize benefits from the previous project plans is not adequate considering the environmental and economic mosaic within which FF is being promoted. New information is needed on the biophysical factors that affect tree growth, their water use, and the diverse and ecosystem-specific hydrogeological effects when trees are established on formerly cleared/barren land. Continuing efforts are required to close the significant knowledge gaps which exist so that the effects of large-scale new tree plantings can be more fully assessed and current controversies and misconceptions addressed. These gaps, not in order of priority, include:

1. marketing information,
2. simple innovative technologies (e.g. honey bee incorporation into FF to encourage pollination of flowering plants, at the same time provide income to the FF farmer),
3. the changes in dry-weather flows from afforested versus cleared catchments,
4. decision support systems for locating, designing and managing trees integrated with overall land use,

THE WAY FORWARD

During this second project we initiated innovative FF design and regimen. For complete sustainability there is need to continue the process, at a greater level. There is need for the promotion of technologies to improve production at FF level. Since inception of promotion of FF in most African countries in the early 1970s, the main perceived beneficiaries have been the small-scale farmers. It is this category of farmers who have limited economic ability to switch to substitutes of wood products. Because of economic constraints, use of yield increasing inputs is limited. Trees and shrubs with scope for improving soil productivity should be promoted. Medicinal plants have become equally important, as health services have grown to attract premium fees and should therefore be more emphasized for incorporation into FF design. Growing a variety of trees on-farm should therefore become an important strategy for sustaining livelihoods as well as protecting and conserving forest resources.

We hope in our next project to increase the number of medicinal trees, use yield increasing imputs i.e. shrubs and trees with the scope for improving soil productivity. Honey bees which

also act as pollinators of flowering plants should be encouraged in the next project. Basically, in the next and final project to completely wrap up and influence greater sustanability, we intend to carry out value addition project.

ACKNOWLEDGEMENTS

We are indebted to the Rufford Small Grants Foundation for their ingenious and continuous support and we hope to continue working with them.

The authors wish to acknowledge the contributions of all the farmers in Rakai district who provided the relevant information, and for effortlessly continuing to work with the project.

We thank Mohamed Bukenya (MSc. Forestry) for his advice in conducting this project.

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APPENDICES

APPENDIX I: TREE NURSERY REFORESTATION DISSEMINATION COURSE

Introduction

This is an overview of the Tree Nursery Reforestation course that the Kooki and Kakuuto community groups took to help launch their tree nursery project. The course was offered to the community at Rakai district head quarters, and was taught by a forestry engineer.

Tree Nursery Reforestation: Topics Covered

1. Why use a tree nursery?
2. The time of year to work in a tree nursery
3. Site selection criteria for a tree nursery
4. Types of tree nursery
5. Equipment, materials, and tools
6. Seeds
7. Land preparation
8. Sections of a tree nursery
9. Germinating beds
10. Disinfecting the soil
11. Filling bags
12. Creating rows to place the bags
13. Creating rows for "false stakes"
14. Transplanting trees
15. Production techniques

What is a tree nursery?

- A tree nursery is the site where trees are cared for in the first stages of life
- A tree nursery is a place where conditions are ideal for the initial production and care of trees that will later be transplanted in the field

Why use a tree nursery?

- A tree nursery protects the trees in the first stages of life (especially important areas with harsh dry seasons)
- A tree nursery facilitates the selection of the best trees in a confined area
- A tree nursery allows you to easily care for tree species that require special treatments
- Seeds are often expensive and scarce, making risky practices without a nursery often very costly
- A tree nursery allows you to care for a large number of trees within a small area

- A tree nursery allows for extra care required by seeds with a very long germination time
- A tree nursery offers a controlled environment in which very small tree seeds can germinate properly

The time of year to work the tree nursery

- In Uganda, production generally starts 2-4 months before planting in the field (when trees are being cultivated in bags)
- If trees are grown to be used as clones, you should start 6 months before planting in the field. This cloning technique consists of planting the seeds directly into the ground and waiting until the trunk of the plant has 1.5-3 centimeters in diameter. You then cut, in a diagonal motion, 10 centimeters off the top and 15 centimeters off the roots. The tree is then ready to be transported to where it will be planted. The tree then regenerates what was cut snipped off. (This only works with species like teak that can regenerate after getting chopped in such a manner)
- In areas where there is a long, harsh dry season, you should time your tree nursery production to plant your trees in the field as soon as the rains commence. So, depending on the species, you will start tree production in bags 2-4 months in anticipation of the rains and you will start your clone production 6 months before. Keep in mind that you may need a reliable irrigation plan in order to sustain your young trees in the nursery during the dry season.

Site selection criteria for a tree nursery

- **Topography**: In order to allow proper drainage, the nursery will ideally have a 2-3% inclination. For those of you who are used to dealing with degrees of incline, a 3% incline is roughly equal to a 1.7 degree incline. (Inverse tangent of 3/100—or 3%—is about 1.7) Any more incline than this and your work becomes difficult and you minimize the production capacity in your nursery's lot, as you will have to make flat steps in the terrain for the rows of bags. (The surface area of the flat rows will be less than the original surface of the inclined ground)
- **Fertility**: The nutrients need to be "complete." The major elements, Nitrogen, Phosphorus, and Potassium need to have a 10%, 30%, and 10% concentration respectively. You also need to have the following elements in small quantities:
    - Calcium
    - Copper
    - Zinc
    - Boron
    - Magnesium
    - Iron
    - Sulphur
    - Manganese
    - Aluminum

- **pH**: Acidity or Alkalinity can inhibit tree development. The ideal pH range is between 5.5 and a neutral 7. In Uganda, acidity most often the problem when there is an imbalance in pH. Acidity can prevent the absorption of certain elements present in the soil. It can also provoke the solubility of Iron, Aluminum, and Manganese in lethal amounts to the young trees. To solve the problem of acidity, lime is most often used to bring the pH closer to neutral.
- **Antecedents**: You should look into what your land was used for before becoming an aspiring tree nursery. You should do studies of the soil to check for possible agro-chemical contaminants (when applicable). Also, the nutrients may be depleted if a very demanding crop was cultivated in that spot. Also, the soil may be very compacted if cattle had previously grazed there. As the pressure from a cow, which has a lot of weight and relatively small hooves on which such weight is distributed, is quite immense, pastureland is often very compact. If this is the case, you may need to loosen up the soil.
- **Rockiness**: A lot of rocks can be detrimental to tree production.
    - Rocks can inhibit root growth and/or direct roots to grow with an odd trajectory
    - Rocks take up space and can limit the overall capacity of the lot
    - Rocks can make work harder
    - Rocks can deform your plants
- **Texture**: The soil in your lot shouldn't be too clay-like, nor should it be sand-like. If the soil is pure clay, root formation and water drainage become very difficult. If the soil is very sand-like, the plant cannot firmly establish a solid base in the ground.
- **Water**: The tree nursery needs to have a reliable water source. The water needs to be free of contaminants and problems of pH and salinity.
- **Area**: The size of your lot will determine your production capacity. If you are planting your seeds directly into the soil to create production of clones, you can plant your seeds in a concentration of 20-25 trees per square meter, with an average of 80,000 to 100,000 trees per hectare (10,000 square meters). If you are using your lot exclusively for tree production in bags, you can place your bags in a concentration of 100 per square meter, with an average of 200,000 to 300,000 bags per hectare.
- **Accessibility**: If you are starting your tree nursery for commercial purposes, you need to have it accessible and visible. In rural Uganda sometimes the wet season makes a normally accessible road very muddy and only accessible by 4X4 vehicles. Also, visibility is often a problem, unless the tree nursery has sufficient signs leading customers to the locale.

Types of tree nursery

- Two types of tree nursery, temporary and permanent, are distinguished from one another by their duration of usage and the materials they use.
- A temporary tree nursery is used for a period of less than four years and uses cheap materials. These nurseries usually are for personal and/or local consumption.

- A permanent tree nursery is used for a period of four years or more and uses more expensive construction materials. These nurseries usually are used for commercial purposes, selling to customers both locally and from afar.

Equipment, materials, and tools

Equipment: wheel barrow, sprinklers, hoses, chain saw

Materials: sand, soil, agrochemicals, seeds, fertilizers, lumber, tree bags, nails, perforated sheet thingy

Tools: shovels, hammers, machete, rake, saw

Seeds: Selection of seed-bearing trees

- The trunk should be tall, thick, and straight
- The tree should have healthy foilage and void of diseases
- The tree should be mature, but not too old
- The tree should be located in an accessible spot

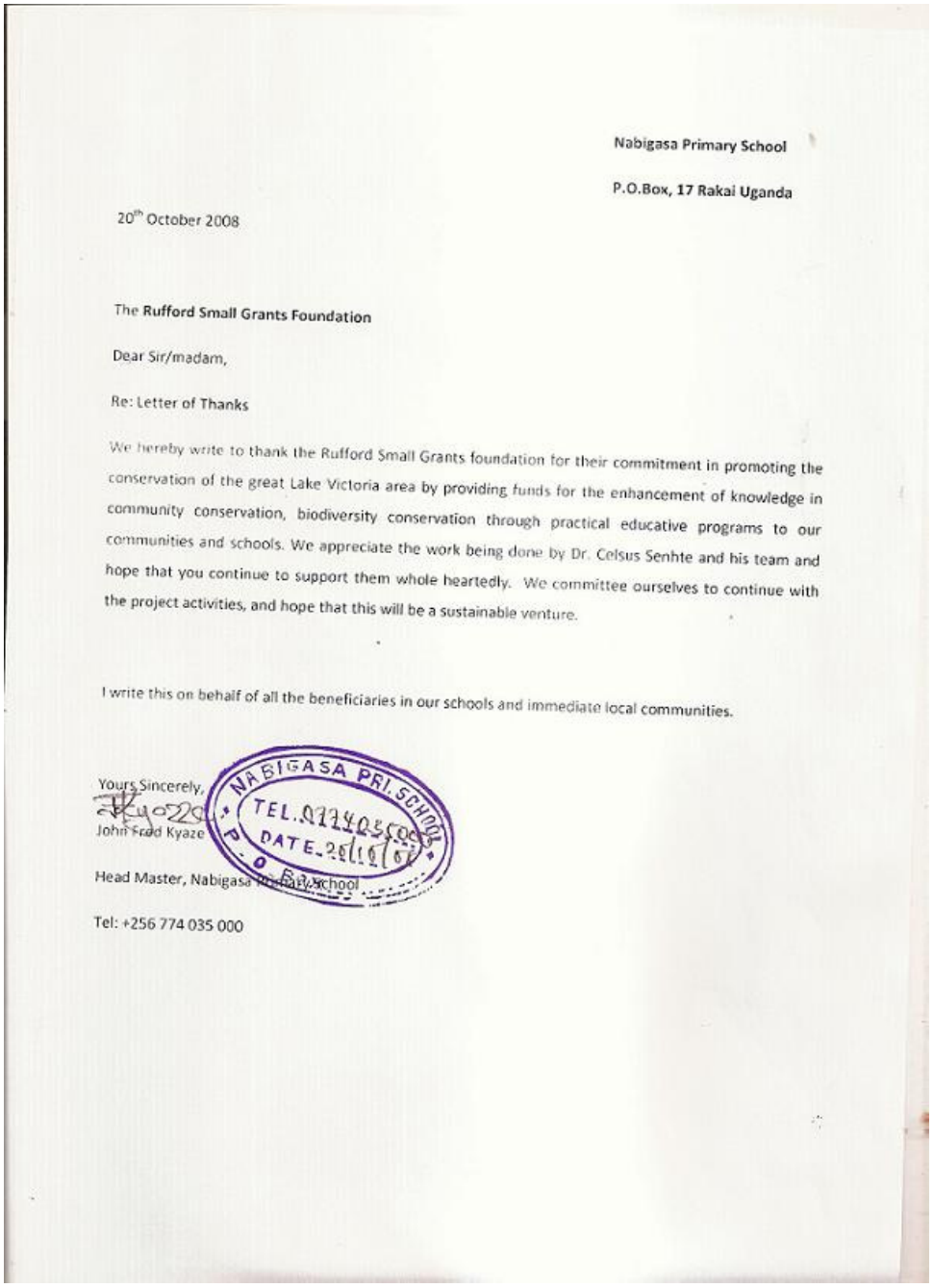
Land Preparation:

Sections of a tree nursery

Germinating Beds

- The germinating bed is where seeds are planted and protected in their initial stages of growth.
- The germinating bed should be a wooden box with a depth of 12-15 centimeters and a width between 80 and 100 centimeters. You can make the bed as long as you need it to be.
- The germinating bed should be propped up to a height of about 80 centimeters.
- The germinating bed should be filled with sand for the following reasons:
  - Sand facilitates draining of water
  - Sand facilitates the extraction of the young trees when moving them to the bags
  - Sand doesn't compact like certain soils can
  - Sand is generally cleaner than soils
  - Sand provides a higher temperature to facilitate germination
  - Sand has a loose consistency, allowing more oxygen to reach the seeds
  - Sand facilitates the initial root growth

APPENDIX II: LETTERS



Nabigasa Primary School

P.O.Box, 17 Rakai Uganda

20th October 2008

The **Rufford Small Grants Foundation**

Dear Sir/madam,

Re: Letter of Thanks

We hereby write to thank the Rufford Small Grants foundation for their commitment in promoting the conservation of the great Lake Victoria area by providing funds for the enhancement of knowledge in community conservation, biodiversity conservation through practical educative programs to our communities and schools. We appreciate the work being done by Dr. Celsus Senhte and his team and hope that you continue to support them whole heartedly. We committee ourselves to continue with the project activities, and hope that this will be a sustainable venture.

I write this on behalf of all the beneficiaries in our schools and immediate local communities.

Yours Sincerely,

John Fred Kyaze

Head Master, Nabigasa Primary School

Tel: +256 774 035 000

NABIGASA PRI. SCHOOL
TEL. 0774035000
DATE 28/10/08
P.O. Box

Kakuuto high school

P.O.Box 330,

Rakai, Uganda.

19th September 2008

The **Rufford Small Grants Foundation**

Dear Sir/madam,

Re: Thank you for your immense support

On behalf of the entire school community, I thank RSGF for supporting and educating our students on the values of trees to the environment. The information and the practical skills that have been provided to our students will indeed foster them towards apprreciating nature. This project is highly welcome in our region and we hope that it will be sustainable, especially with involvement of very active youths. This generational shift will enhance sustainability.

Thank you!

Yours sincerely,

KAKUUTO HIGH SCHOOL TEL:+256 779 154 788 DATE-19/11/08 P.O BOX

Felista Musasizi

Head Teacher, Kakuuto High school

Tel: +256 779 154 788

Email: Musasizifelista@gmail.com

2

THE LOCAL COUNCIL ZONE, SANGO BAY
P.O.BOX 89 RAKAI UGANDA

Moses Manosi

L C 1 Chairman

Sango Bay

20th October 2008

RSGF, UK

Dear Sir/Madam,

RE: Farm Forestry project

The entire Local Council wishes to acknowledge the work that is being carried out in our parish through the help of RSGF. Our communities are thankful. We hope to benefit a lot from this project as well as increase our biodiversity for future tourism activities.

We are pleased and hope to continue receiving your generosity.

Yours cordially,

Moses Manosi, Chairman LC1, Sango Bay Parish

Tel: +256 772 398 485

SANGO BAY LOCAL ZONE COUNCIL
P. O. BOX 89
TEL: 772-398-485

cc

LC II chairman

LCIII Chairman

Rakai Chief Administrative Officer

APPENDIX III: ACCOUNTABILITY

Accountability for the second RSGF funded project in Uganda (Integrating Farm Forestry and biodiversity conservation around Lake Victoria, Sango-bay region)

Item	Quantity	Budgeted amount per unit	Actual expenditure per unit	Budgeted total cost	Actual total expenditure	Balance
1.0 Office Materials and Supplies						
1.1 Communication	6 months	20	35	120	210	-90
1.2 Booklets	500	1	500	500	500	0
1.3 Stationery	6	20	19	120	114	6
1.4 Training manuals	10	4	5	40	50	-10
2.0 Field requirements						
2.1 Improved seeds, seedlings and inputs	1000 packets	2.5	3.5	2500	3500	-1000
3.0 Meetings and Workshops						
3.1 meeting group leaders at sub-counties	3 days	50	50	150	150	0
3.2 Mobilization allowance for community Trainers and back stoppers	10	6	5	60	50	10
3.3 All Trainings (inclusive of special school visits and training)	150 days	8	10	1200	1500	-300
4.0 Monitoring, evaluation and follow up				200	200	0
5.0 Report writing and Publications	2 months	50	50	100	100	0
Grand Total				4990	6374	-1384

Due to the Falling of the GBP, we had a problem with the exchange rate, and therefore with the cost of materials going up, we had cash balance. Instead, we spend 1384 GBP above the estimated budget.

APPENDIX IV: PROJECT TEAM

Composition of Uganda project team

Position	Name	**Role and responsibilities**
Project leader	Dr. Celsus Senhte, BVM, MSc Makerere University	Head of field work activities Coordination of project activities Participatory Research Methods Environment impact assessments Report writing
Theme Leader	Byaruhanga Chris Dickson BDVS, MSc Makerere University	Participatory Research Methods GIS analyst Environment and conservation strategies Report writing Ssustainable development Project Planning and management Information Communication Technology Application
Theme Leader	Tusiime Loyce BSc, PGD Makerere University	Assistant head of field work activities Participatory Research Methods Gender and development consideration Database management and report writing
Researcher	Ms. Annet Nakyeyune BDVS, MSc Makerere	Participatory Research Methods Environment and sustainable development Project Planning and management Information Communication Technology Application
Ekapolon Godfrey	Diploma Education, Makerere University	Field work and mobilisation