Conserving biodiversity in the modernising farmed landscapes of Uganda

Final Report

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BTO

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Darwin project information

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Project Title	Conserving biodiversity in the modernising farmed landscapes of Uganda
Host country(ies)	Uganda
UK Contract Holder Institution	British Trust for Ornithology
UK Partner Institution(s)	Royal Society for the Protection of Birds (RSPB), Bournemouth University, University of Reading (Centre for Agri-Environmental Research)
Host Country Partner Institution(s)	Nature Uganda (NU); Makerere University Institute of Environment & Natural Resources (MUIENR); Makerere University Department of Forest Biology and Ecosystems Management; Danish Institute for International Studies (DIIS); Ugandan Wildlife Society (UWS); Plan for Modernisation of Agriculture (PMA); National Agricultural Advisory Development Service (NAADS); National Environment Management Authority (NEMA);
Darwin Grant Value	£233,987
Start/End dates of Project	Start June 2005; End June 2009
Project Leader Name	Dr Juliet Vickery / Dr Philip Atkinson
Project Website	www.uganda-agrobiodiversity.org
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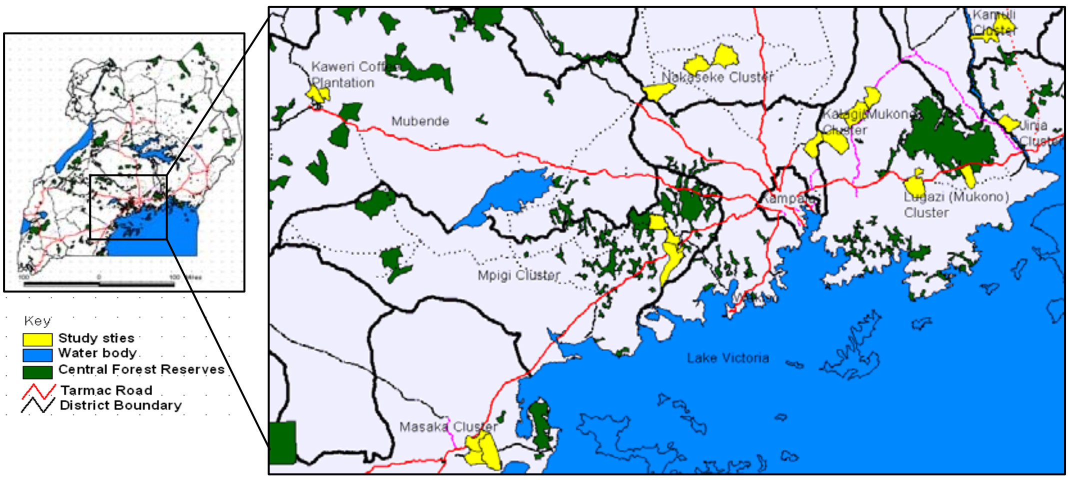
1 Project Background

Traditionally the wider countryside has been relatively under valued for its biodiversity and attention has focussed on biodiversity hot spots and protected areas. This project addressed this knowledge gap by providing quantitative information on patterns and trends in biodiversity (birds, bees, butterflies, trees) and other ecosystem services (pollination and carbon storage) in relation to policy-driven landuse changes in smallholder and large-scale farming systems in the central Ugandan banana / coffee arc.



Map 1. Map of study areas. Areas shaded yellow indicate parishes in which study sites were located. 26 sites (each a 1x1km square), in 8 clusters were used in this study.

2 Project support to the Convention on Biological Diversity (CBD)

The project has kept the CBD focal point up to date at all times during the project. Dr Bob Ogwang (the CBD focal point from the National Environment Management Authority -NEMA) was invited to the project conception meeting during the scoping visit and NEMA representatives were invited to all major project meetings, including the final dissemination meeting.

If applied, the results and recommendations from this project have the capacity to contribute directly to the 2010 Biodiversity target, namely *'to achieve by 2010 a significant reduction of the* *current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth'.* The outputs from this project recommend methods of farming that aim to maximise agricultural outputs without major losses to biodiversity in the wider countryside. For example, this project demonstrated that leaving patches of semi-natural vegetation can not only increases pollination rates and yields but also increases the diversity of birds, bees and plants on agricultural land.

This project not only directly addresses the CBD Articles but also all four of the elements of the Programme of Work for the CBD Thematic Programme on Agricultural Biodiversity. Namely:

• <u>Assessment</u>: by providing a country-driven assessment of the status and trends of agricultural biodiversity (primarily birds and insects) in Uganda, gaining an understanding of the underlying causes of those trends, being able to develop indicators and assessment methodologies and identifying biodiversity-friendly agricultural practices.

• <u>Adaptive Management:</u> by identifying and promoting adaptive management practices, technologies and related policy and incentive measures that promote the positive and mitigate the negative impacts of agriculture on biodiversity (particularly birds and insects) including enhancing knowledge, understanding and awareness of the goods and services provided by the different levels and functions of agricultural biodiversity, eg pollination and carbon storage

• <u>Capacity building:</u> by promoting the participation and strengthening capacities of the National Agricultural Advisory Service (NAADS) service providers (and hence farmers) in the sustainable management of agricultural biodiversity, through enhancing partnerships with researchers and extension service providers and providing opportunities for farmers (through farmer fora) to participate in the development and implementation of national strategies for agricultural biodiversity.

• <u>Mainstreaming:</u> by supporting coordinated and integrated national policies, strategies, programmes and action plans, through the provision of training materials and capacity building at policy, technical and local levels, in relation to the conservation and sustainable use of agricultural biodiversity.

This study was also relevant to the cross-cutting issue of the International Initiative for the Conservation and Sustainable Use of Pollinators by assessing the status of pollinators, identifying potential causes of declines and impacts on agricultural systems and promoting the conservation and sustainable use of pollinator diversity in agricultural systems.

Three key areas of the project will assist the Ugandan Government to implement a range of Articles within the CBD, namely: (i) training and capacity building of researchers, government and non government personnel and users; (ii) development of approaches to integrate biodiversity and agriculture, and (iii) establishment of baseline data and identification of indicators with which to measure future trends in agricultural biodiversity. These addressed CBD Articles:

Article 6 General measures for Conservation and Sustainable Use (10%) through the identification of both biodiversity-friendly and economically viable cropping systems

Article 7 Identification and Monitoring (15%) through the identification of key indicator species within agricultural landscapes, setting up of monitoring plots, surveying of existing monitoring plots and contribution to the National Biodiversity Data Bank (NBDB)

Article 8 In-situ Conservation (5%) by having worked with farming organisations (e.g. farmer fora and extension service providers) to promote biodiversity friendly practices within the Ugandan farming systems.

Article 10 Sustainable use of components of Biological Diversity (5%) through the sustainable use of non-crop products and bushmeat in habitats outside the immediate cropping area (e.g. promotion of community wood lots, fruiting trees, tree corridors along water courses for water conservation).

Article 11 Incentive measures (5%). We identified farming practices that do not further degrade the farmed environment and the results could be used to encourage a change in policy to promote farming systems that enhance biodiversity (e.g. 'lifestyle' crops such as pollinator (bee) -friendly coffee, organic produce).

Article 12 Research and Training (15%) was a major part of the project and the project will leave a legacy of trained staff able to tackle biodiversity issues in the future.

Article 13 Public education and awareness (10%) by linking the research to agricultural service provision within farming communities as well as national press releases & radio interviews, dissemination of information through partner magazines and newsletters.

Article 14 Impact assessment and minimizing adverse impacts (10%) through the identification of agricultural practices that have major impacts on biodiversity and identification of practical measures to mitigate these.

Article 16 Access to and transfer of technology (15%) through the training of agricultural extension service providers in biodiversity friendly farming practices who will, in turn, make the advice available to a much larger number of individual farmers. These practices were made available in manual form for service providers and others and broadcast in media that was accessible to farmers (e.g. posters, radio broadcasts)

Article 17 Exchange of information (5%) All project staff benefited from being involved in a major international project. Making research information available to others was a key component of this project and the research findings were communicated to policy advisors in the Plan for the Modernisation of Agriculture (PMA), a major Government initiative. Information was also exchanged further down the chain to individual farmers through direct contact and also by training of agricultural service providers.

Article 18 Technical and scientific co-operation (5%) This project involved researchers from a number of highly-regarded research-based organisations from the UK, Uganda and Denmark who worked with both policy-based and technical advice-based organisations within Uganda.

3 Project Partnerships

This project has built on and strengthened existing partnerships, particularly between BTO and RSPB and Nature Uganda and DIIS and Makerere University as well as developing invaluable new ones. The essence of the project was to gather detailed field data on a range of taxonomic groups, as well as land use and socio-economic data, in order to make evidence based recommendations for policy and practice in relation to the integration of biodiversity needs within agricultural land management in Uganda. The diversity of disciplines required a diversity of partners with different skills and expertise

The project design was developed in Uganda during a scoping visit that included a multi-stakeholder workshop and numerous one-to-one discussions with academics, NGOs and Government departments. As such, much of the work was driven by host country and Ugandan partners worked closely with the lead partner, the BTO, to develop the log frame, work programme and budgets.

Primary project partners in Uganda

As the lead organisation, the BTO was responsible for the overall design and implementation of the work, central to which were two PhD students and their field assistants based at the Makerere University Institute of Environment and Natural Resources (MUIENR) and the Department of Forest Biology and Ecosystems Management. Two research associates were also part of the field research team, one based at NatureUganda (NU) and one at the Uganda Wildlife Society (UWS). NU is the BirdLife partner in Uganda and has a strong conservation and environmental agenda. UWS also undertakes a range of field projects but has increasing expertise in policy research, dissemination of information and education.

MOUs were produced between the BTO and MUIENR, NU and UWS. These detailed work programs and initial budgets. The relationship with NU and UWS has been good in the past but working closely on this project has strengthened it greatly at a personal and institutional level with field teams and CEOs working 'side by side'. NU are well established in conservation and development through numerous field-based projects and some political campaigns. To date, however, much of this has focussed on sites and species. This project has extended the work to ‘wider countryside issues’. NU and BTO are now in discussions about further projects concerning avian influenza and training to develop the capacity for waterbird monitoring in Uganda (database design and statistical analysis).

Other project partners

From the outset, the aspiration of this project was to use the results from field research to inform practices at a regional and even national level in Uganda and thus establish strong links with government departments. Throughout the project, the relationship with the government agricultural departments has been excellent. The project has been fully supported by the National Agricultural Advisory Services (NAADS) and the Plan for the Modernisation for Agriculture (PMA). These two departments are responsible to the development of agricultural policies and practice and their implementation in Uganda and are key policy customers from this project. Their involvement from the outset, via a workshop outlining the project aims and study site selection process, ensured their input in the project design. Two final workshops and the development of a policy brief have made the results accessible and relevant to government departments. Partnership with the wider agriculture and biodiversity community took place through the Agro-biodiversity Working Group, which was set up in the first year of the project, co-ordinated by the research associate at UWS. The group met regularly throughout the lifetime of the project and participated in several field visits to project sites, in order to identify practices suitable for inclusion in the Agro-biodiversity handbook as well as suitable demonstration farms. The working group consists of a number of organisations made up from the government, non-governmental, academic and conservation sectors. See Annex 7 for a list of members.

BTO has a wealth of expertise in the design and implementation of field-based research on biodiversity in general and birds in particular. The need for greater socio-economic expertise was recognised from the outset of the project and was secured through the involvement of Dr Simon Bolwig at the DIIS who had worked extensively in Uganda and elsewhere in Africa. He provided direct input and advice in the field in relation to socio-economic survey questionnaires and assessments of land use and crop production. Recognising the need for greater entomological and botanical expertise we recruited Dr Simon Potts at CAER and David Nkuutu, an expert tree botanist in Uganda to the project. Dr Potts has field and analytical expertise in the study of insect pollinators in a range of habitats worldwide and was able to advise the entomological PhD student in appropriate sampling protocols designed to answer novel questions and be comparable with field studies elsewhere. The pollination work followed guidelines produced by the ALARM project (Assessing LArge-scale Risks to biodiversity with tested Methods). The main aims of the pollination part of this project were to measure the biodiversity and economic risks associated with the loss of pollination services in agricultural and natural systems through the development of standardised tools and protocols and to determine the relative individual and combined importance of drivers of pollinator loss (eg land use, environmental chemicals, invasives and socio-economic factors). David Nkuutu is recognised as an expert in tree identification and survey work, having been part of several previous field-based studies in Uganda (e.g. IFPRI) and assisted the field team in a full inventory of the tree community in the study sites. Dr Adrian Newton at Bournemouth at Bournemouth University is an expert in GIS analysis and ran a GIS and general statistics course for the PhD students.

Additional project partnerships

The Darwin-funded project looked solely at agricultural sites over a range of intensification. We did not therefore have any sites where there was zero (or very little) agricultural impact. A Leverhulme Trust-funded project, obtained on the back of this DI-funded project, was awarded to allow us to visit forest sites in the study area and collect bird data. This involved one of the research assistants who was formerly employed on the Darwin project, as well as an additional professional bird guide who was an expert on forest bird identification.

As the number of bee species recorded from Uganda was <50 species our entomological student required help in identifying the c500 species that he collected. Help was sought from Dr Connal Eardley at the Agricultural Research Council (ARC) Plant Protection Research Institute in South Africa. This association has led to benefits such as providing reliably-identified insect material to collections at the ARC and the Zoology Department at Makerere University as well as the Consortium for the Barcode of Life (CBOL), an international initiative devoted to developing DNA barcoding as a global standard for the identification of biological species. It also linked in our entomological PhD student into the African Pollinator Initiative (API). Collaboration between BTO and Dr Eardley has continued with another grant proposal.

Achievements lessons, strengths or challenges with the partnerships

One of the key achievements of this project has been the collection of an almost unique, year round, spatially referenced database relating to the biodiversity, land use and livelihoods of famers in a large number of agricultural sites in east Africa. This would not have been possible without the strong partnership between biologists and socio-economists in Europe and academics, field staff and students in Uganda. The two greatest challenges have been the effective co-ordination of such a complex team and the much greater than expected investment of time by European scientists in the analysis and reporting of findings.

Working with so many partners has been extremely rewarding and has resulted in invaluable sharing of skills and approaches but this has come with considerable management challenges. Indeed, the issue of a lack of a clear local hierarchy in terms of project management was raised at the first annual review. The particular issue was that, in the absence of a UK project manager based in Uganda throughout the project and in the presence of three well established Uganda partner organisations, there was no clear individual/organisation with ultimate responsibility for co-ordination and reporting in country. This was addressed by assigning the research associate at NU responsibility for co-ordinating the field team and the research associate at UWS for co-ordinating wider project activities e.g. calling management meetings regularly. Coordination worked well during the main period of fieldwork (approx 14 months) when the organisations were in daily personal contact & staff were working as one team. It was more difficult when staff were split and based in three organisations (MUIENR, NU and UWS). It was further complicated by several changes of leadership at MUIENR and UWS (three CEOs during the project lifetime) and extended periods of absence for two members of the team on maternity leave. In retrospect, the original budget should have included more UK staff time in country perhaps at the expense of a local post, to ensure smoother operation of the project.

The analysis and reporting of results as PhD thesis and papers in peer reviewed journals is an essential output of the project if this work is to be built upon in the future and used to conserve biodiversity in agricultural systems. This task was largely the responsibility of the two PhD students and has been hampered in many respects. We had great difficulty securing desk space at MUIENR with one student having ultimately to work from home or 'hot desk'. In addition, during the main period of the writing up phase, the entomological student had less contact with the local supervisor compared with the ornithological PhD. Given the expertise of the lead organisation (BTO) and the nature of the student, strong supervision was crucial to ensure ‘delivery’ of results and hence submission was seriously delayed (final deadline: 31 October 2009). Supervision would have been more effective (and considerably more expensive) if students had been required from the outset to spend much of their writing up period at a UK institution or a European post doc level scientist had been based in Uganda as project manager and scientific supervisor. In retrospect, this would have ensured submission of theses on time.

4 Project Achievements

4.1 Impact: achievement of positive impact on biodiversity, sustainable use or equitable sharing of biodiversity benefits

Although too early to draw any firm conclusions it is anticipated that the project will impact positively on all three of the DI generic goals of *a) a change in state of an element in biodiversity; species, population or habitat loss reduced, etc; b) a transition from unsustainable use to sustainable use; c) the relevant human community living with biodiversity had its costs reduced or benefits increased stemming from the conservation of that biodiversity*. This will be dependent on the adoption of the project recommendations and successful implementation of these by the agricultural sector in Uganda.

If many of the best practices identified are adopted at a reasonable scale then farming systems will, undoubtedly, move to being more sustainable in the long term. In particular the retention of trees and fallows will enhance soil and water protection, supporting yields and provide nesting and foraging habitat for a range of species of birds and insects. The latter will, in turn, contribute significantly to crop yields through pollination services provided, thus benefitting the human communities living with the biodiversity. By placing an economic figure on the value of bees as pollinators of coffee crops, the project has demonstrated a clear and easily understood way in which biodiversity conservation directly benefits local farmers.

Coffee is an important cash crop in this area. The amount of agricultural land under cultivation (as opposed to fallow) was used as a measure of farming intensity and termed the *cultivation intensity*. On the small-scale farming sites this varied between approximately 0.5 and 0.85. The yields of coffee in areas with a low cultivation intensity (ie more fallow) were approximately 65% higher compared with high cultivation intensity areas. The actual income per hectare of coffee achieved by farmers in areas with the lowest cultivation intensity was 93% higher than areas at the highest. If the sole use for agricultural land was either fallow land or growing coffee, the optimum solution to maximise income would be not be to have 100% coffee, but a mix of approximately 60% coffee and 40% fallow. Although simplistic, this does demonstrate the economic value of fallow land on farmland and also the biodiversity benefits in terms of the increased abundance and diversity of bees. A similar argument could be made for a range of other bee-pollinated crops such as tomatoes.

We also demonstrated that increased levels of biodiversity on agricultural sites also have the potential for providing another ecosystem service (carbon sequestration). The standing stock of carbon on the sites ranged from between 4.9 - 41.2 t C ha^{-1}. This vegetation is also improves soil quality and aids water conservation.

In terms of impacts on biodiversity the project was successful in establishing baseline data for key species and habitats in agricultural systems and setting up protocols to monitor the impact on land use change on these species in the future. It has also greatly increased the awareness of the nature, extent and value of biodiversity outside protected areas at the local and national level. These two aspects provide a good foundation for the conservation of biodiversity in these farmed habitats.

Capacity building and dissemination were key elements of this project. By setting up the Agro-biodiversity Working Group, the project brought together individuals from the conservation, agricultural and development communities to discuss ways of improving farmers' livelihoods as well as minimising or improving the status of biodiversity on farmland. Although, not unique, this was the highest profile project of its type in Uganda to engage these communities that we are aware of. The organisations involved (in particular NU and UWS) are now in a strong position to move away from their traditional focus of species and/or site conservation and tackle issues related to the wider countryside.

4.2 Outcomes: achievement of the project purpose and outcomes

The project purpose was to identify best practice for the long-term conservation of biodiversity in selected farmed landscapes in Uganda and establish a framework for sustainable agricultural development and monitoring and we have been largely successful at achieving this. This project has had close contact with the key agricultural policy body, the Plan for the Modernisation for Agriculture (PMA), and regular meetings between project managers and the PMA were held to keep them informed of progress. PMA also had a representative on the Agro-biodiversity Working Group. They requested a policy brief about biodiversity in agricultural landscapes and this was produced by UWS. It remains to be seen whether the results of this project will be taken up by policymakers but the best practice has been identified and the framework is available for them to do so. We will develop a follow-on application to DI to push the outcomes of this project and to trial a rollout of the recommendations in one area in Uganda.

Changes in human behaviours towards biodiversity

In the 26 sites in which the project operated, farmers were heavily involved in the project and were exposed to ecologists and socio-economists working on their farms for 2 years. During the project a number of farmer fora were held and the importance of biodiversity to pollination, soil and water conservation was stressed. During the course of the research, the number and diversity of trees was found to be important in influencing both bird communities and pollination and farmers were encouraged to keep trees on their land. There was considerable enthusiasm for this and the project offered a number of native and fruit trees for sale at one of the farmer fora. These were quickly sold and farmers were keen to increase the cover of woody vegetation on their farms.

Access to different types of assets

Considerable knowledge has been gained during the course of the project and data on birds, plants, land use, insects, and socio-economics are available for use. The training of field assistants and PhD students has increased the capacity for individuals to collect data in a rigorous way, analyse, critically interpret & apply the results. This project has been as much about making information accessible to stakeholders as the research and UWS, through convening the Agro-biodiversity Working Group has considerably increased its ability to translate scientific results into on the ground solutions and communicate effectively with government departments, aid, development and conservation communities. Within the structure of this project it has been extremely successful because members of these different communities visited study sites and were able to discuss practical solutions on site with farmers.

The training provided by the project has raised the ability of project staff to successfully apply for funds for future work. Raymond Katebaka was awarded a Rufford Small Grant and Maurice Mutabezi was awarded a scholarship for a Masters course at Makerere University.

In terms of physical assets the project vehicle was handed over to local partners, together with the remainder of the project equipment. The posters, handbook and policy briefs were distributed to stakeholders.

The other main outcome of the project has been the body of work on which other studies can be based. The baseline data has been used by two other projects. One, funded by the Leverhulme Trust measured bird abundance and species richness in forest areas and the second, a joint project between the University of Bergen and Makerere University is looking at bat abundance and diversity in the farmland sites used by this project.

4.3 Outputs (and activities)

Output 2. Relationships between biodiversity and farming practices are understood and best practices (including novel approaches) identified.

Relationships between biodiversity and farming are complex and often difficult to establish even in relatively well studied and well understood temperate systems. The data gathered on both invertebrates and birds has enabled us to identify relationships between features of the farmed landscapes and enhanced abundance and/or diversity of taxa (eg see Table 1 for birds and Figure 1 for bees). For birds there was not necessarily a general decline in diversity and abundance with agricultural intensity, except at extremely high levels of intensification (ie plantations) but there was a turnover in the assemblage such that species that were classed as forest specialists or forest-generalists (often these were species of conservation concern) declined rapidly as intensity increased. Some relationships were scale-dependent, eg species richness showed a significant decline with the proportion of the landscape covered by agricultural land at a landscape scale ($1km^2$) but not at the local scale (around the survey points) showing the importance of not only the cover of

Table 1.
Significant relationships between the number of bird species and the proportion of agricultural land in each study site

Group	Relationship
Forest specialists	Negative***
Forest visitors	Negative**
Grassland species	
Wetland species	
C Species	
Migrant species	
Frugivores	Negative**
Insectivores	Negative***
Nectarivores	Negative*
Granivores	
Omnivores	
Fish eaters	
Predators	

different habitats but also where they are located in the landscape. Other relationships such as the strongly positive relationship with crop diversity were not.

Bee species richness, diversity and abundance were all higher in sites with a higher cultivation intensity (proportion of agricultural land being actively cropped rather than be left fallow) and from other environmental data it was shown that non-agricultural habitat such as riparian forest patches and wetlands but also habitats that were part of the agricultural matrix such as forest fallows, tree lines and hedges around fields were important. The diversity of nesting sites and floral resources were therefore the main factors determining bee abundance/diversity. Similar results were obtained for butterflies such that species richness increased with increasing crop diversity and more fallow land.

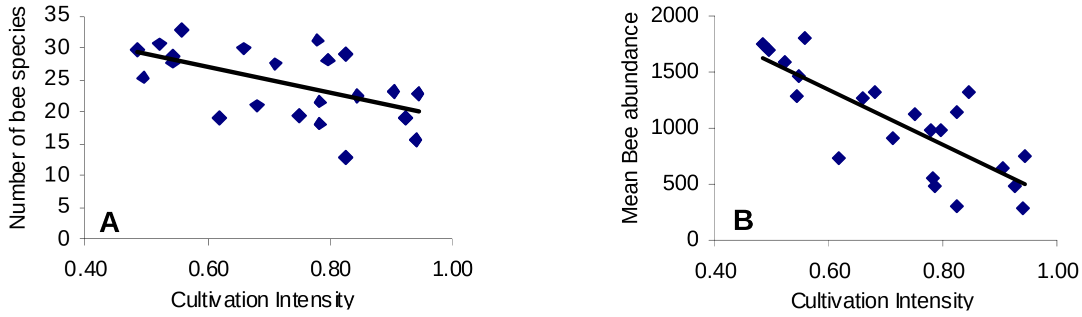


Figure 1. The relationship between (A) the number of bee species and (B) bee abundance and cultivation intensity.

Best practices were identified based on the results of field research and review of existing literature. These were compiled in an Agro-biodiversity Handbook (see Annex 8). Comprising three sections, the handbook first outlines Uganda's farming systems, the status of biodiversity and its importance to agriculture worldwide and then presents a selection of different practices that promote productivity and enhance biodiversity emphasizing benefits for agricultural production. The section that describes practices that are beneficial in terms of agricultural yield also details how these are important for maintaining levels of biodiversity in the landscape. Several of the practices have been illustrated in simple posters distributed to farming communities. These were produced in both English and Luganda (see Annexes 9 & 11 for examples).

Consequently, conservation, management and policy efforts aimed at sustainable improvement of agriculture in central Uganda should preferably, (i) first preserve and prevent degradation of remaining forest fragments, fallows and wetlands; (ii) secondly, strongly encourage small-scale farmers to maintain higher cover of trees and fallow and linear and non-linear features of semi-natural habitats (eg tree lines) and (iii) mimic natural vegetation or natural ecosystems through promoting habitats such as community forests/woodlots in the rural landscapes

We did not specifically identify biodiversity indicators although several bird or bee species could be used as they were sensitive to agricultural intensification. However the baseline data will provide the means to consider change in species with change in land use in the future and allow indicators to be developed.

Output 3. Economic importance of on-farm biodiversity and its loss, and economic implications of novel land management approaches are identified and quantified.

The financial implications of changes in farmland biodiversity (particularly loss of pollinators) can be assessed and predicted by year 4. Best practices identified are related to income (from existing IFPRI data) and costs and benefits of novel approaches can be assessed by year 4.

Three key ecosystem values of biodiversity were quantified: pollination services, carbon storage and agricultural yield.

The pollination study focussed on the relationship between farming practices and pollinators of coffee, the main cash crop in the study area. This was quantified through a field experiment involving the bagging (to prevent pollination) and pollen saturation (to mimic maximum pollination) of coffee flowers on different branches of trees in farmed areas that differed in extent of fallow. Cultivation Intensity was a key driver in determining the proportion of potential coffee yield (yield for saturated flower/yield for open flowers – Graph A). As cultivation intensity increased, the proportion of the yield due to pollination by insects also decreased (Graph B) and yields (in terms of income) of coffee were 40-50% lower in areas with little fallow vegetation compared with areas with more extensive fallow (Graph C). Although simplistic, if the agricultural landscape was made up of fallow and coffee fields, the farmer's total income would not be highest when the land was all coffee, but peak at a cultivation intensity of 0.63 (Graph D). More detailed interrogation of the data showed that there was a direct positive relationship between the foraging rate (visitation rates by bees to a flower) and the proportion of potential yield and that both abundance and the number of bee species were positively related to yield. The number of bee species and abundance were positively related to the area of young fallows, the number of flowering plants in the vicinity, the distance to the nearest refugia (ie fallow, tree lot, forest, and wetland) and the area of crops that provide floral resources. The make up of the landscape was therefore important both in terms of larger-scale features (such as wetlands, distance to forest etc) as well as smaller-scale features (such as numbers of flowering weeds, crop diversity surrounding the coffee field etc).

These results, some of the most striking found by the project, clearly show the importance of bees for pollination and give a strong economic argument for keeping fallows and high crop diversity at a moderate cultivation intensity.

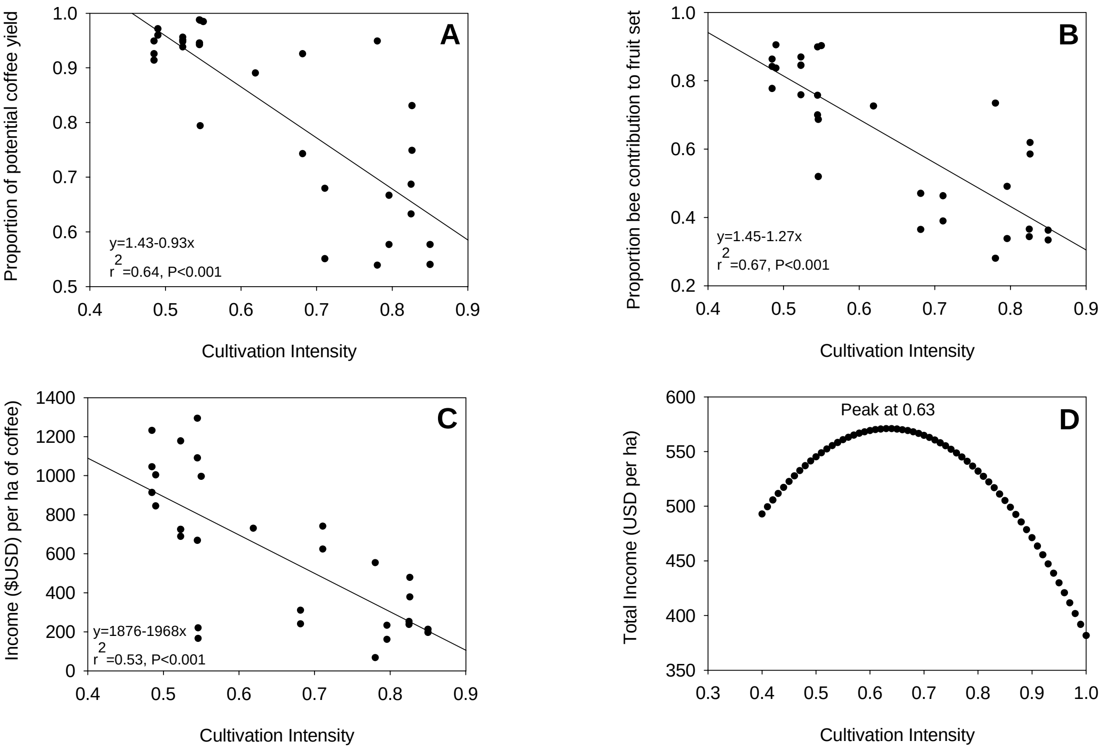


Figure 2 (A-D) Summary of the results of the pollination experiments in relation to cultivation intensity. A – Proportion of yield; B - Bee contribution to pollination; C – Income per hectare of coffee; D – Total Income.

The complete tree inventory for all the study sites also enabled us to quantify the carbon value of the ‘standing crop’. On the smallholder plots, this ranged between 4.9-41.2 t C ha^{-1}. There was a strong negative relationship between cultivation intensity and Carbon for smaller trees (<30 cm dbh). For larger trees (>30 cm dbh) there was no significant relationship indicating that the number of large trees retained on farmland was independent of how intensively the area was farmed. These larger trees tended to be species that provided food, medicines, shade etc. The smaller trees would have been part of the fallows and these made up an average of 53.9% (range 25.7%-90.0%) of the total Carbon on the land.

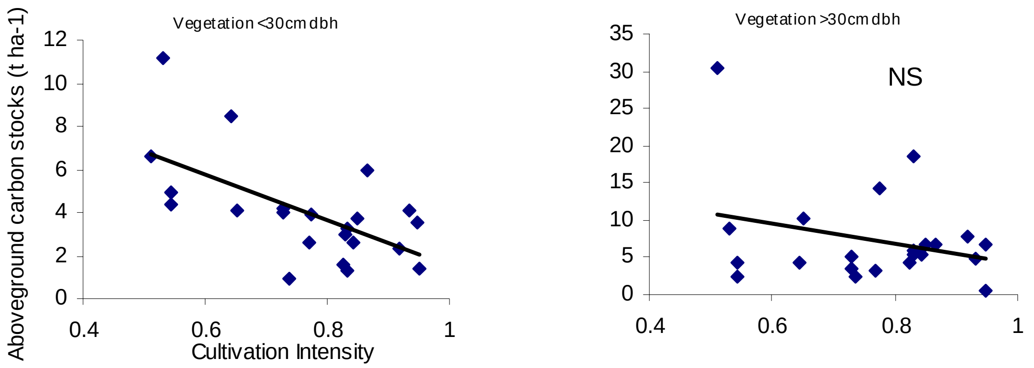


Figure 3. The total standing Carbon stocks (above ground) in relation to cultivation intensity for vegetation <30 cm diameter at breast height (dbh) and > 30 cm dbh.

The socio economic data (household survey and land use) allowed a calculation of yield from each of the 26 sites to be estimated. In monetary terms, six crops (beans, maize, sweet potato, coffee, cassava and banana) dominated. Of these, coffee was the main cash crop with a proportion of the others being sold, the remainder being consumed by the household. The monetary value of the crops (total sold and consumed) averaged USD 206 per ha (range 138-263). This monetary value of crops increased with the proportion of land under cultivation in the site but levelled off so that in sites that have more than >71% of the area cultivated, monetary value did not increase further.

We are currently seeking funding to allow us to explore these data further and integrate the ecosystem service and biodiversity datasets.

Output 4. Capacity enhanced in agricultural biodiversity science, policy and practice

At least two African students trained to PhD level and up to 6 research assistants trained in biodiversity survey and census techniques. At least 50 NAADS agricultural service providers attend two training workshops in biodiversity assessment. Two NU/UWS staff trained in biodiversity assessment, participatory development proposal writing and raising of public awareness. Agricultural working group established

The legacy left as a result of this project, in terms of trained staff, is considerable. The two PhD students have either submitted (Dianah Nalwanga – birds September 2009) or are due to submit their theses (Theodore Munyuli - invertebrates and pollination – due to submit 31 October 2009) and have gained extensive expertise in the design and implementation of field surveys and census work, analysis (statistical and GIS) and writing up and reporting of results in written and oral form. The two field assistants also gained considerable expertise in biodiversity assessment. Raymond Katebaka is now an ecological consultant in Uganda working on both commercial impact studies and other conservation projects for which he has sought funding with BTO support (he is currently working on a project funded under the Rufford Small Grants Scheme). Maurice Mutabezi received a scholarship for an MSc in Environment and Natural Resources at Makerere University. David Mushabe is now permanently employed at NatureUganda and is registered for an MSc, the research project of which is based on the woody vegetation and land use data gathered under this project. The second research associate based at UWS remains employed there and as a result of this project has established a good reputation and network within Government agricultural sectors (PMA & NAADS). The trained NAADs staff remain and the Agro-biodiversity Handbook has been distributed to over 40 organisations (Annex 9).

The legacy in terms of policy and practice is also considerable and takes the form of data, publications and equipment. The spatially referenced data collected in fieldwork will provide a detailed and extensive baseline data for future surveys and the assessment of the impact of changes in land use practice on biodiversity. These data will be archived in the National Biodiversity Databank (NBDB) and copies held by the BTO and other stakeholders. Policy and practice has been enhanced through the publication of the Agro-biodiversity handbook, posters for farmers, visits to demonstration farms and a policy brief and the ongoing Agro-biodiversity Working Group. In the future scientific publications based on these field data will also add to this knowledge and will, we hope, also inform policy and practice.

Output 5. Best practices, including novel approaches translated into practical advice for farmers

Increased awareness of and hands on experience with biodiversity issues and increased recognition of the value of biodiversity among farmers within the study area by year 2 and from nearby communities by year 4. Ability and willingness by these farmers to adopt and trial novel land management approaches by year 4. At least 50 NAADS agricultural extension service providers trained

Practical advice has been afforded through a handbook, posters and radio interviews and visits to demonstration farms. Best practices have been simply documented and outlined in the Agro-biodiversity Handbook and posters in English and Lugandan. The handbook was published in 2008 and launched at a meeting in Kampala in November 2008. A total of 500 copies have been distributed free to a range of audiences (Annex 9). Two one hour long radio shows were broadcast members of the Agro-biodiversity Working Group and project partners. Finally, farmers and advisors made two visits to the demonstration farms in Mukono and Masaka districts to view and discuss farming approaches that would maintain or promote yields and benefit biodiversity.

Output 6. Policy and relevant advice developed within the project is available to all relevant parties and stakeholders

Information and materials on best practices packaged and distributed to policy makers and agricultural extension service providers by year 4. Biodiversity and agricultural manual produced for extension service providers and distributed by year 4. Two demonstration plots. Two supplementary funding applications submitted to potential donors by year 4.

Policy and relevant advice developed within the project has been made available to the wide range of stakeholders. Different ways have been used to disseminate the information. For farmers, the project produced a series of posters and held meetings ('farmer fora') where groups of farmers gathered together to discuss the pros and cons of methods the project team considered to be biodiversity friendly. This was extended to a wider audience through the use of radio programs in local language and press articles. The radio programs followed a phone-in format and this generated lively discussions about the positive and negative impacts of various aspects of biodiversity on farmland. For a wider audience, we produced a pull-out insert in NatureUganda's magazine (Annex 11). We produced a number of extra copies of this and these were distributed to government and other NGOs.

Links to policy were made in written and oral form through a policy brief (Annex 12), regular meetings and presentations with PMA and farm visits with the Agro-biodiversity Working Group.

Two successful applications for funding were made to extend this work. These were to the Leverhulme Trust (http://www.leverhulme.ac.uk/news/archive/PAG/2007) and the Rufford Small Grants Scheme (http://www.ruffordsmallgrants.org/rsg/projects/raymond_katebaka) and were designed to extend this work.

Output 7. System for long term monitoring of agricultural sustainability is established.

Readily repeatable, spatially referenced multi-taxa data collected and entered into National Biodiversity Database (NBDB) by year 4. Monitoring methodology/ protocol established and study sites geo referenced by year 4.

The multi taxa datasets produced in this project were spatially referenced and are available from project partners and will be lodged at the National Biodiversity Databank in Kampala. Nature Uganda, together with RSPB, started a common bird monitoring program in 2008. This covers c.35 plots including 5 of the plots used in this study. This work is being done by both professional staff and volunteers and there is a commitment to continue monitoring birds on these plots for many years to come. As the data are georeferenced it will be possible to revisit these plots in future and we plan to seek funds to repeat aspects of this project 5-10 years after the original data collection. Measuring landuse change and changes in biodiversity will provide a powerful way of linking changes in agricultural practice with changes in biodiversity.

Output 8. Integration of biodiversity issues into national policy is created.

Project proposals produced. Sustainability mechanism established through establishment of an agricultural biodiversity working group to promote biodiversity issues into future agriculture policy by year 4.

The Agro-biodiversity Working Group was established much earlier in the project than was expected and the group had a key role in the production of the handbook for extension advisers. This was distributed to NAADS offices, the PMA Secretariat and during training courses held with NAADS staff. At a policy level, the PMA requested a policy brief with information on biodiversity that could be included in the development of the next major agricultural policy initiative. Agricultural policy has developed during the lifetime of the project with the focus shifting from raising people out of poverty (‘Poverty Eradication Action Plan’ PEAP) to promoting and sustaining economic growth (the ‘Prosperity for All’ policy). The focus is now on improving market access, improving varieties, promoting cash crops and processing of crops by farmers individually or collectively. This has the potential to dramatically change the agricultural landscape. For example, increased production will lead to shorter rotations and increased clearing of fallow resulting in less semi-natural vegetation as well as reducing crop diversity, both of which impacted on birds and bees. The results of this Darwin project have demonstrated the clear value of fallow land for biodiversity as well as ecosystem services such as carbon storage and pollination. The policy brief recommends keeping semi-natural vegetation on the farms in a way that will have little impact on the farming system and, importantly, yield levels.

Problems in achieving outputs

At the beginning of the project, there was a clear issue with a lack of a clear local management structure. This was addressed at the end of year 1 by giving clear roles to the research associates at NU/UWS to manage aspects of the project locally. This did not impede the data collection and the fieldwork went extremely smoothly. In the original implementation plan there were to be a number of field seasons followed by periods of writing up. As it became clear that a year-round set of data would enable us to look at seasonal differences, the fieldwork protocol changed and data collection was compressed into one year. The field team worked extremely well but struggled in analysis & writing as there was insufficient in country support as no UK member of staff was present to encourage and mentor the students. One student's supervisor also had a sabbatical in the UK during the write-up phase which meant he was without support for a long period.

The amount of time taken to support the students and research associates was underestimated and UK staff put in much more time than was originally budgeted and in future we would alter the ratio of UK / overseas partner time. Even though underestimation of UK time was an issue there were serious management issues with the entomological student who would not take advice and consistently ignored deadlines agreed between himself and his supervisors. The project invested more resources in him than any other member by asking Dr Simon Potts (Reading University) and Dr Connal Eardley (ARC Pretoria) to help supervise the project. We provided funding for him to visit Dr Eardley in South Africa to identify his bee collection, and recruited Dr Stuart Roberts (Reading University) to organise and clean up his data files and advise on suitable analyses.

Turnover in project staff also caused an issue at the beginning of the project (3 CEOs at UWS during the course of the project) and half the project staff took maternity leave during the project, which resulted in happy but challenging management issues!

4.4 Project standard measures and publications

See Annex 4/5 for details

4.5 Technical and Scientific achievements and co-operation

As already highlighted, one of the key achievements of this project has been the collection of an almost unique, year round, spatially referenced data base relating to the biodiversity and land use of a large number of agricultural sites in east Africa. This would not have been possible without the strong technical and scientific partnership between biologists and socio-economists in the Europe and biologists, field staff and students in Uganda. This work has resulted in the promotion of cooperation in the field of conservation and sustainable use, the development of relevant policies and of joint research programmes all of which are specifically included under Article 18.

The study was based around 26 1km squares, termed sites. These sites varied in management intensity from areas of smallholder farming with much fallow to intensively managed plantations (monocultures of tea, sugarcane and coffee). Within these sites, data on birds, bees (pan traps), butterflies, landuse, plants (woody vegetation), yields/incomes and other socio-economic data were collected according to the scheme described in Annex 13.

The **ornithological research,** had the following main aims (i) to assess the diversity and abundance of birds in agricultural landscapes using Point Counts and Ten Minute Counts along a management intensity gradient, (ii) to relate temporal and seasonal patterns in the diversity and abundance to habitat characteristics (iii) to use this information to identify best management practices that would allow yield to be sustained or enhanced whilst also conserving birds. This research was undertaken by MUIENR (1 PhD student and 1 Research Assistant) under supervision of BTO.

In total, 218 bird species were recorded during the counts. The numbers of species recorded in a single site ranged from 72 to 123 species. Using the classification of Bennun et al.[1], a total of 40 forest species (FD species), 75 forest visitors (FV species), 46 wetland species (W species) and 21 grassland species (G species) were recorded. The mean number of species for small mixed agricultural sites was 103.3±2.2 (mean±SE n= 22) while for the large monoculture sites was 82.8±5.5 (n=4). The key findings were that diversity and abundance was not necessarily related to cultivation intensity but that particular groups were impacted more than others and the results differed at different spatial scales. For example, the number of species recorded at the point scale was not related to the proportion of land under agriculture but at the landscape (1km square) scale it was significant (Figure 4). Three main factors were found to drive the diversity and abundance of birds. The number of trees was strongly positively related to the number of forest species at both scales and in terms of functional groups frugivores and nectarivores were positively associated at the point scale, but only frugivores at the landscape scale. Frugivores tend to rely on a resource that varies over a wide area and would be expected to respond to landscape scale factors. The amount of fallow land was important in determining forest species and frugivores at the landscape scale. Trees and fallow will be inter-correlated and it is difficult to disentangle the two effects. The third factor was crop diversity. Nectarivores, insectivores, and forest species were all significantly positively correlated with increased levels of crop diversity.

[1] Bennun, L, Dranzoa, C and Pomeroy, D E. 1996. The forest birds of Kenya and Uganda. *Journal of East African Natural History* 85: 23-48.

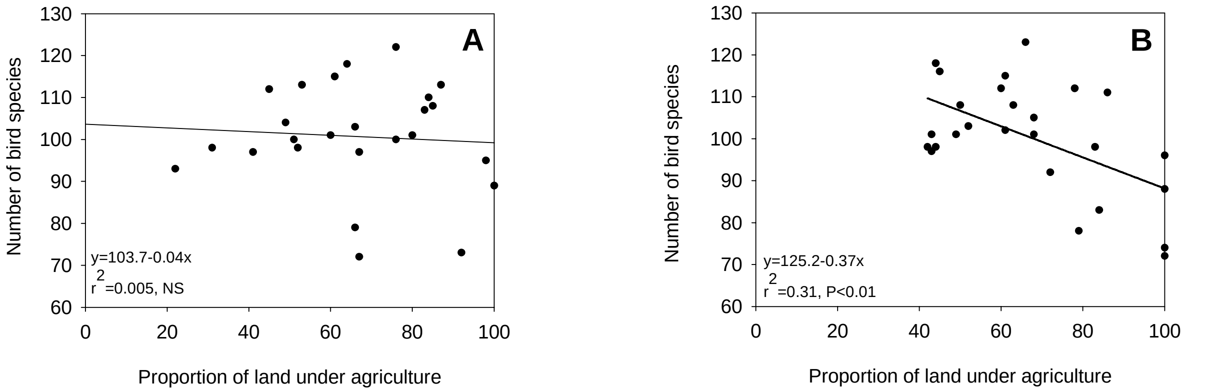


Figure 4 A-B. The number of bird species recorded in relation to the proportion of land under agriculture at A - the local scale (within 50m of the census point) and B - the landscape (1 km square) scale.

The **entomological research** had the following main aims (i) to assess the diversity and abundance of butterflies and bees (insect pollinators) in agricultural landscapes along a management intensity gradient, (ii) to relate temporal and seasonal patterns in the diversity and abundance to habitat characteristics (iii) to use this information to identify best management practices that would allow yield to be sustained or enhanced whilst also conserving pollinators and (iv) to quantify the economic value of pollination services provided by bees for one key cash crop (coffee). This research was undertaken by MUIENR (1 PhD student and 1 Research Assistant) under supervision of BTO and CAER.

The results of this study are some of the most striking that have come out of this project. Prior to this study, only c. 50 species of bee were known to occur in Uganda. This study recorded over 500 species, including some most likely new to science. Many of the results have been presented in Section 4.3 and the key results are as follows. There was a strong negative relationship between bee abundance/diversity with cultivation intensity (Figure 1) and this had knock on effects on pollination services. For coffee, insect pollination was crucial and contributed up to 90% of the fruit set (Figure 2B). There was a strong negative relationship between cultivation intensity and the yield per hectare of coffee (Figure 2C) such that at high cultivation intensities pollination limitation was so high, due to lack of suitable refugia for bees, that berry set was very poor. In economic terms, it would be more profitable for the farmer to leave approximately a third of the land fallow (Figure 2D). This would provide refugia for pollinators and maximise the income from coffee. Although the ratio of cropped to fallow land was important, other factors were strongly correlated with the proportion of potential pollination achieved, these being distance to the nearest forest or wetland (negative relationship), crop and other floral resources (positive). These factors were probably intercorrelated with cultivation intensity to some degree and it is difficult to disentangle these effects. Not only were landuse categories important, but pollination services increased with the abundance and diversity of bees, providing direct links between landuse, bees and pollination services. Keeping fallow land will also deliver other services such as soil and water conservation and provision of other products such as charcoal, medicinal plants etc.

The **land use and socio-economic research** had the following main aims (i) to map the cropped and uncropped habitats at a number of sites (26 x 1km squares) within agricultural landscapes along a management intensity gradient, (ii) to quantify (through a household survey) the total annual yield from different crops and income from these sites and (iii) to relate this information to biodiversity data to identify best management practices that would allow yield to be sustained or enhanced whilst also conserving birds. This research was undertaken by NU under supervision of BTO and DIIS. One of the key results was that the original stratification of the sites, based around human population density from census data, was closely correlated with cultivation intensity. At the outset, without knowing how intensively the land was cropped, we used this as a surrogate and there was a strong relationship between this and the cultivation intensity (Figure 5A). Landuse in terms of cropped and non-cropped land was measured. The total monetary value of crops in the sites harvested varied between 139-263

USD ha^{-1}. Although coffee was a major cash crop, it made up relatively a small amount of the total monetary value of the crops (c. 16%) and the majority of the other crops were consumed by the households (Figure 5B). There was a strong relationship between monetary value and the cultivation index such that monetary value increased to a cultivation index of 0.71 and then remained level (Figure 5C). Further analysis of the yields themselves (rather than the 'common currency' of monetary value) needs to be performed but the shape of this relationship was largely driven by the crops other than coffee. The majority of these are not insect pollinated or are root crops (eg maize, cassava, sweet potato) and likely indicates that lack of fallow land leads to poor soil quality. If so then high intensity cropping systems will lead to severe pollination limitation as well as reduced yields of other non-insect pollinated crops.

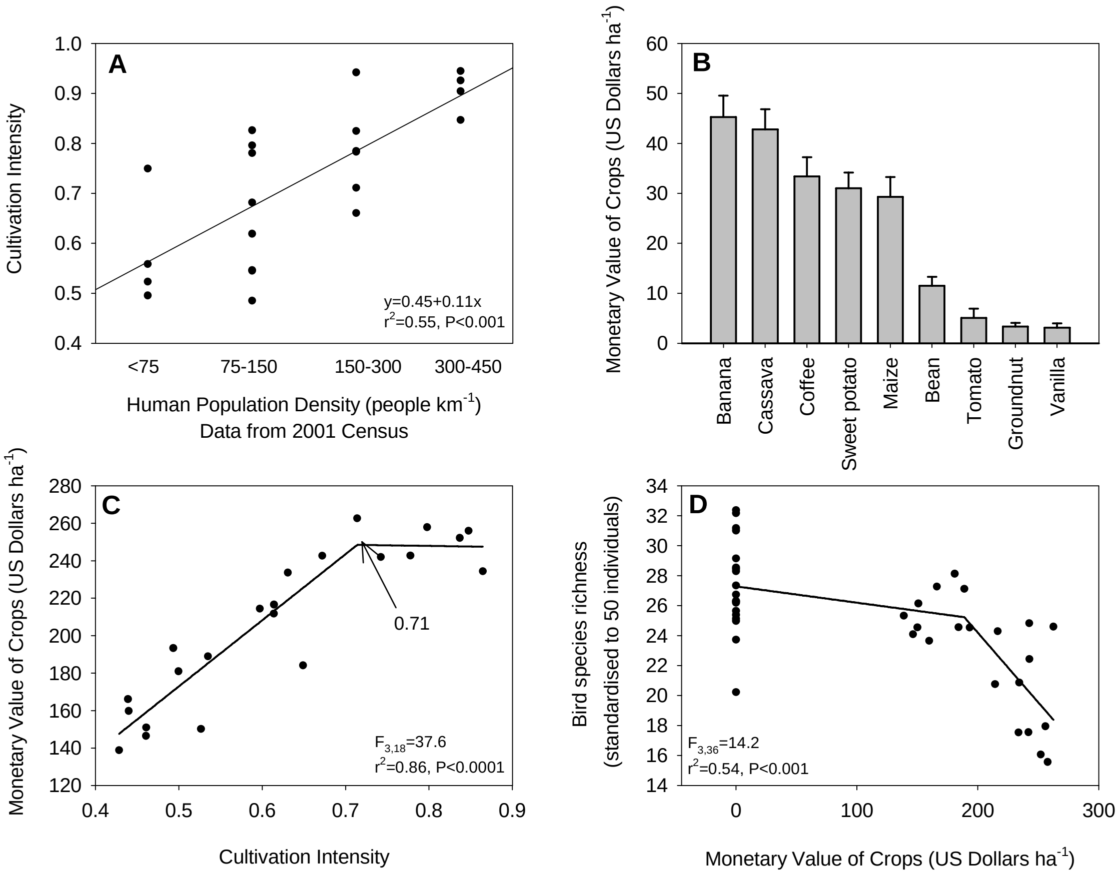


Figure 5 A-D. A – The relationship between human population density and the cultivation index; B – The mean monetary value of the crops (USD ha^{-1}) that contributed more than 1% to the mean total monetary value; C – monetary value of crops in relation to cultivation intensity with 2 segment linear piece-wise regression line fitted; D – the relationship between yield and bird species richness standardised to 50 individuals.

There was a general decline in bird species richness with increasing yield (Figure 5D). This figure also includes the forest sites surveyed using the Leverhulme Trust grant where agricultural income was assumed to be zero, although strictly speaking this will not necessarily be the case. Although the yield-species richness relationship looks to be level initially and then show a decline, there was an almost complete turnover of species indicating that forest species were intolerant of habitat change. Forest was the natural climax vegetation in central Uganda, leading to the conclusion that, to maximise agricultural production as well as protect forest species, conserving existing forest patches and farming existing agricultural areas intensively is the best way to conserve them. However, within the agricultural matrix, we have shown that systems with very intensive cropping systems (ie little fallow, low crop diversity, little semi-natural vegetation) show reductions in both biodiversity and yield and that, without radical changes to the current types of agriculture, the optimal solution for both farmers and biodiversity is a system that has one third fallow, two thirds cropped land.

To date the project has not delivered research findings in the form of peer reviewed scientific papers. However, the PhD students have either submitted (ornithological PhD - September 2009) or are very close (entomology - 31 October 2009 deadline) to submitting their theses and have been encouraged to write these as a collection of papers for submission. The paper plan is that each student will first author at least two papers from their thesis and BTO will lead on an integrated paper. This integrated paper will link agricultural and landuse practice to ecosystem services, in particular regulating services (pollination), cultural services (biodiversity) and provisioning services (yield and economic data from the household survey). Data that encompass all three main types of service are rare and this will be submitted to a high profile journal. We will also be publishing a paper on the integrated bird data from the DI and Leverhulme Trust funded projects.

4.6 Capacity building

Capacity building has been an extremely important element of the project and has been achieved through formal and experiential training of individuals and organisations

In terms of institutional capacity building, this project has enabled the Ugandan partners, particularly NU and UWS, to move away from their traditional focus on individual species or sites to issues relating to the wider countryside. This has allowed them to develop new partnerships with the wider development and agricultural communities and will enable them to build on this in future. In the past, NU has often focussed on sustainable use projects, working with communities local to a particular site and this project has allowed NU and UWS to work at a national level, evidenced by attending formal meetings of the PMA/NAADS, the key government organisations dealing with agricultural policy and responding to their requests for material such as a policy brief on agriculture and biodiversity. NU has also been strengthened in terms of their ability to design and undertake scientific research as two of the project staff currently employed by them will have completed a PhD and an MSc course.

In terms of individual capacity building, formal training has included: a training course on bird survey techniques and analysis (Annex 14), workshops with NAADS advisers to develop and use the handbook and also a GIS and general statistics course for 3 Ugandan project staff held at Bournemouth University.

Experiential training this relates to the visits made by project staff to the field including those by Dr Philip Atkinson (BTO), Dr Juliet Vickery (BTO), Dr Paul Donald (RSPB), Dr Simon Bolwig (DIIS), Dr Simon Potts (Reading University, student trips to UK and Theodore Munyuli's visits to the British Museum and the Agricultural Research Council in Pretoria (Dr Connal Eardley). Dianah Nalwanga (the ornithological PhD student) also benefitted from working in an established NGO (Nature Uganda) and both students and research associates benefitted from the good working relationship the project had with government departments.

The key capacity building components have been in the training of project staff, production of guidelines for biodiversity-friendly agricultural practices and enabling policy makers to make informed decisions about changes in farming practice. Five of the sites used in the project have been incorporated into the national bird monitoring scheme, the data from which is used in the production of the 'State of Uganda's Biodiversity' report to the CBD. The collection and local storage of the baseline data also increase the capacity for the local partners initiate other projects on the back of these data.

Many lessons have been learned during this project, especially about effective communication between project partners and the importance of ensuring that enough time is spent in country to ensure smooth management of the project. This project was the first Darwin project the BTO had secured although it has been involved as a partner in others. Perhaps inevitably, the project design underestimated the time required to remotely manage the work effectively. The fieldwork proceeded well as there was a clear protocol to follow and daily interaction between organisations as they collected data in the field. The supervision time required for analysis and reporting was much greater than anticipated. This was a combination of underestimating the skills of the students who, despite having MScs, struggled with data analysis and scientific writing and there was less on the ground support from local institutions than was expected. In the future the BTO would establish a much more rigorous and frequent reporting procedure and spend more time in country.

4.7 Sustainability and Legacy

The key legacy most likely to endure is the availability of trained personnel, the establishment of the Agro-biodiversity Working Group, the production of the Agro-biodiversity Handbook and the establishment of a set of geo-referenced sites with biodiversity and socioeconomic information.

The project staff continues to work in the field of biodiversity conservation. Dianah Nalwanga is employed by NatureUganda on an RSPB-funded project monitoring common birds in Uganda. The project sites make up the core of the agricultural components of the national bird monitoring programme (which is included in Uganda's regular reports to the CBD) and will be continue to be used in the long term. The two field assistants continue to work in biodiversity related areas, one being an ecological consultant and the other undergoing a Masters course. David Mushabe now has a full time contract at Nature Uganda and continues to work on his Masters degree which is using project data.

The project partners continue to collaborate. BTO is in discussion with NU about two projects (avian influenza and improving waterbird monitoring) and RSPB have two small projects with NU on vulture conservation and common bird monitoring. The BTO will continue to develop ideas with the Ugandan partners and, in particular, will look for ways of disseminating the results of this project further.

5 Lessons learned, dissemination and communication

Overall the project has been extremely positive. The change in the fieldwork protocol so that one complete years worth of data was collected in five rounds of the sites worked extremely well. With clear planning and protocols the data collection was extremely efficient. After the fieldwork the key tasks were to sort specimens, organise the data and analyse and write up the studies. These processes were less efficient for several reasons including limited local supervision, poor facilities at the university (computing & lab space) and lack of reference material for specimen identification necessitating an unplanned visit to South Africa. In hindsight, we could have tackled this in one of two ways, either by placing a UK post doc level staff member in Uganda for much of the analysis and writing up phase of the project or by running the PhDs out of a British university. The post doc would have had the double role of mentoring students and coordinating the final parts of the project locally. Either, or both, options would have made the whole project much more expensive and would have required a cut back in the amount of work we did but would have delivered the aims of the project quicker.

We underestimated the time needed to complete the PhDs and have therefore not produced the number of papers we originally said we would. Two chapters from the ornithological PhD thesis are being prepared (one for Bird Study, one for the Journal of African Ecology) as is a paper on the relationship between fallow land and the economic value of pollination services. The project organisers will also be applying for funds to employ a post doc to undertake more integrated analyses of the data.

The project has largely been based around research with a dissemination component. We have communicated with stakeholders at various levels which ranged from attending meetings of the PMA, bringing together representatives from agricultural, ecological and development organisations within the Agro-biodiversity Working Group to disseminating information via the Agro-biodiversity Handbook (aimed at agricultural service providers) as well as directly to the farmers themselves. As the results from the research have been so delayed, it is important that dissemination continues and that policy briefs are updated as new information becomes available. The two main Ugandan partners will continue to work in the agro-biodiversity sector and are in discussions with BTO concerning a Darwin Follow Up proposal which will have a large dissemination component.

5.1 Darwin identity

The project staff have been keen to promote the Darwin initiate image in all project outputs, the logo is clear on all outputs and prominently displayed on the vehicle, the website and handbook. In discussions with governmental organisations and NGOs the project was referred to as the 'Darwin project' and the Darwin Initiative is well understood by NU and UWS and government departments in Uganda. Project partners promoted the DI through their newsletters and other material.

6 Monitoring and evaluation

The M&E protocol worked well in the first year during field work. Frequent visits by BTO, RSPB, DIIS and CAER (Reading University) ensured that progress was monitored, that all project partners were kept informed of progress and that milestones were met. From evaluation of the project in its early stages, it became clear that a major change in the fieldwork protocol was required. Instead of having 3 month periods of fieldwork separated by 3 months in the lab, it was more efficient to run 12 months of fieldwork concurrently. We planned 6 rounds of fieldwork (ie a round of 26 sites every 2 months) but this proved ambitious and poor weather meant that five rounds of data collection were achieved. It also became clear (and was identified by the external reviewer) that there was a lack of clear local leadership in management. This was rectified by clarifying roles.

During the analysis and writing up phases, there was the problem that the students did not have the support they needed. We responded by helping where possible, eg by devoting extra time to them, identifying and recruiting suitable experts to help, and sending them to appropriate institutions.

In terms of activities, we collected the baseline data we required and through additional collaborations were able to collect additional data (pollination experiments and carbon values). The indicators were generally helpful and the project met most of them.

6.1 Actions taken in response to annual report reviews

The annual reviews were extremely useful and were very positive. They were performed by someone who was knowledgeable about the subject and the local situation. One of the main points raised by the reviewer in Year 1 was the lack of a clear management structure in Uganda. This was addressed by initiating a local management group and appointing a project manager locally. In subsequent reviews, the reviewer has suggested people and organisations to contact and we followed these up.

Once the reviews were received, they were tabled and discussed at the next Project Steering Group meeting which usually took place within 3 months of the report being received.

7 Finance and administration

7.1 Project expenditure

The breakdown of the budget is below. The two key areas where the expenditure was >10% greater than the budget were in staff costs and overheads (rent, rates, heating etc). This was due to BTO staff putting in more time to the project (approximately £xxxx) than was originally budgeted. There were various reasons for this – first the project was initially undercosted but also there was a high degree of turnover amongst the project staff and several periods of maternity leave which contributed to BTO staff having to spend more time managing the project. The PhD students also took much longer to submit their theses and this required more supervision time than expected.

	TOTALS	
Original Budget Headings	**Budget**	**Expenditure**
Staff Costs		
Rent, rates, heating, lighting, cleaning		
Office costs e.g. postage, telephone, stationary		
Travel and Subsistence		
Printing		
Conference, Seminars etc.		
Capital items / equipment		
Other costs		
Total		

Breakdown of Project Participants Salary Expenditure:

BTO Project Supervisor	Dr Juliet Vickery
BTO Research Manager	Dr Phil Atkinson
Community Agriculture Biodiversity Coordinator	David Mushabe
Agriculture Biodiversity Working Group Coordinator	David Mutekanga
UWS Executive Secretariat	Annet Nakyeyune
UWS Project Officer	Olivia Nantaba
DIIS Research Coordinator	Dr Simon Bolwig
PhD Supervisor	Dr Philip Nyeko
PhD Student	Theodore Munyuli
PhD Student	Dianah Nalwanga Wabire
Field Assistant	Raymond Katebaka
Field Assistant	Maurice Mutabezi

The total here is slightly more than the total in the above table due to the fact that the tabulated expenditure is defined from audited accounts up to the project end (December 2008), whereas these figures incorporate some staff time spent since then, for example on report writing.

Breakdown of Major Capital Expenditure:

4x4 Vehicle
Personal Computer & UPS
Binoculars
GPS Unit
Field Equipment e.g. Luxmeter, Humidity Stick
Desktop Computers and printer
Second Hand Vehicle Parts

Breakdown and Summary Description of "Other" Expenditure:

The budget category "Other" covered a variety of areas, including the establishment of a website, Agro-biodiversity Working Group set-up, NAADS meetings, interactions with the media (e.g. radio interviews, press releases), GIS/statistics training courses and farmer 'fora'.

7.2 Additional funds or in-kind contributions secured

Additional funding (£35,793) was secured from the Leverhulme Trust for additional surveys in forest habitats adjacent to the project sites. The DI-funded project sites were along a gradient of agricultural intensification but there were no site with an intensification of ‘zero’, ie areas of natural habitat. The collection of these data allowed an analysis to be made with a control of pristine habitat.

An application was successfully made to Rufford Small Grants Foundation for £5,680 to extend the work in agricultural areas to looking at habitat fragmentation on large frugivorous birds (hornbills).

In kind contributions were secured in the form of staff time. Dr Simon Potts agreed to supervise the entomology PhD student (including a visit to Uganda and subsequently 2 months of time). Mr Munyuli spent 1.5 months at the University of Reading with Dr Potts to identify and catalogue his specimens and clean, store and analyse his data.

Dr Connal Eardley (Agricultural Research Council, Pretoria) hosted Mr Munyuli in Pretoria to allow him identify the bee specimens collected in. Dr Eardley is a leading expert in African bee taxonomy.

BTO spent more time than envisaged on this project (approximately £xxxx)

7.3 Value of DI funding

At the project inception the main focus of agricultural policy in Uganda was about poverty alleviation and biodiversity concerns were low down the agenda and this research was not a major priority for the Ugandan government, despite the fact that a key requirement for any development was that it was ‘sustainable’. As such this research would not have been funded by development agencies or by academic funding sources (& still probably would not), so DI funding was crucial for the research to be undertaken and partnerships to be built between the ecological, development and government communities.

This project has also established the UK partners (particularly BTO) in two new fields, namely biodiversity and tropical agriculture and also in the relationship between biodiversity and the provision of ecosystem services. BTO has followed this up by develop a project on biodiversity and Agriculture in Sao Tome e Principe (funding application to DI) and also (with the Geography Dept., University of Cambridge & RSPB) a project looking at the social and economic drivers of landuse change in the Sahel with respect to the African-Palearctic migrant birds.

Annex 1 Report of progress and achievements against final project logframe for the life of the project

Project summary	Measurable Indicators	Progress and Achievements	Actions required/planned for next period
Goal: To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but constrained in resources to achieve • The conservation of biological diversity, • The sustainable use of its components, and • The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources		(report on any contribution towards positive impact on biodiversity or positive changes in the conditions of human communities associated with biodiversity eg steps towards sustainable use or equitable sharing of costs or benefits)	(do not fill not applicable)
Purpose Identify best practice for the long-term conservation of biodiversity in selected farmed landscapes in Uganda and establish a framework for sustainable agricultural development and monitoring.	Advice on best practice disseminated to policy makers and agricultural extension service providers and integrated into agricultural development strategies by year 4. Baseline data, field and analytical protocols established for monitoring agricultural biodiversity (birds and insects) by year 3.		
Output 1 Project management systems in place and effective communication across project partners established.	Activities on schedule, milestones met throughout the project. All project partners have access to all project outputs. Project partners are fully aware of roles and responsibilities and reporting dates and collaborating on all relevant project activities.	After a management structure change in Year 1, the management system worked well.	
Output 2 Relationships between biodiversity and farming practices are understood and best practices (including novel approaches) identified.	Effects of changing agricultural policies and practices on biodiversity can be predicted by year 4. Biodiversity indicators identified and best practices (including novel approaches) described & documented by year 4.	The indicators were appropriate and it was possible to identify practices that promoted sustainable improvements in farmers' livelihoods. Biodiversity indicators will be explored these in future scientific papers.	

Output 3 Economic importance of on-farm biodiversity and its loss, and economic implications of novel land management approaches are identified and quantified.	The financial implications of changes in farmland biodiversity (particularly loss of pollinators) can be assessed and predicted by year 4. Best practices identified are related to income (from existing IFPRI data) and costs and benefits of novel approaches can be assessed by year 4.	This was one of the most successful parts of the project in terms of obtaining strong statistical relationships. Pollination was limited in areas with less semi-natural vegetation and in a simple coffee/fallow system it is economically beneficial for the farmer to keep fallows. We were able to identify several features that were positively related with pollination (in fact all types of semi-natural vegetation).
Output 4 Capacity enhanced in agricultural biodiversity science, policy and practice	At least two African students trained to PhD level and up to 6 research assistants trained in biodiversity survey and census techniques. At least 50 NAADS agricultural service providers attend two training workshops in biodiversity assessment. Two NU/UWS staff trained in biodiversity assessment, participatory development proposal writing and raising of public awareness. Agricultural working group established	The two PhD students have not yet obtained their PhD due to problems identified elsewhere in this report. The ornithological student submitted her thesis in September 2009 and the entomological student is working towards a 31 October deadline. We trained 2 research assistants and both of these have gone on to either study further (an MSc scholarship) or are working in ecology. The project held three workshops with NAADS staff and although we not have exact figures for the numbers of individuals it is in the order of 40-50 individuals. The remaining indicators were achieved.
Output 5 Best practices, including novel approaches translated into practical advice for farmers	Increased awareness of and hands on experience with biodiversity issues and increased recognition of the value of biodiversity among farmers within the study area by year 2 and from nearby communities by year 4. Ability and willingness by these farmers to adopt and trial novel land management approaches by year 4. At least 50 NAADS agricultural extension service providers trained	Awareness was raised through the farmer fora and two demonstration farms were identified and open days held at each. These farmers were volunteers and were not paid but were happy to demonstrate to their peers how various new practices were benefitting them. Attendance at these was good with approximately 40 farmers attending.
Output 6 Policy and relevant advice developed within the project is	Information and materials on best practices packaged and distributed to policy makers and agricultural	This output has been largely achieved. The handbook and policy brief have been distributed to relevant parties (see distribution list elsewhere in this report) and one funding proposal to the Leverhulme Trust was

available to all relevant parties and stakeholders	extension service providers by year 4. Biodiversity and agricultural manual produced for extension service providers and distributed by year 4. Two demonstration plots. Two supplementary funding applications submitted to potential donors by year 4.	successful. We will be developing a proposal for a follow-up project from Darwin which will concentrate on promoting the results of the project and working with districts to implement findings from this project.
Output 7 System for long term monitoring of agricultural sustainability is established.	Readily repeatable, spatially referenced multi-taxa data collected and entered into National Biodiversity Database (NBDB) by year 4. Monitoring methodology/ protocol established and study sites geo referenced by year 4.	These databases have been created and will be placed in the NBDB's systems in Kampala.
Output 8 Integration of biodiversity issues into national policy is created.	Project proposals produced. Sustainability mechanism established through establishment of an agricultural biodiversity working group to promote biodiversity issues into future agriculture policy by year 4.	The working group has become well established and will be the focus of a follow on project proposal to the Darwin Initiative. A policy brief has been created and disseminated.

Annex 2 Project's final logframe, including criteria and indicators

Project summary	Measurable Indicators	Means of verification	Important Assumptions
To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve • the conservation of biological diversity, • the sustainable use of its components, and • the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources			
Purpose Identify best practice for the long-term conservation of biodiversity in selected farmed landscapes in Uganda and establish a framework for sustainable agricultural development and monitoring.	Advice on best practice disseminated to policy makers and agricultural extension service providers and integrated into agricultural development strategies by year 4. Baseline data, field and analytical protocols established for monitoring agricultural biodiversity (birds and insects) by year 3.	Advisory materials, training workshop reports, policy documents, scientific papers.	
Outputs 1. Project management systems in place and effective communication across project partners established.	Activities on schedule, milestones met throughout the project. All project partners have access to all project outputs. Project partners are fully aware of roles and responsibilities and reporting dates and collaborating on all relevant project activities.	Annual and final Project reports. Bi-annual Steering Committee minutes. Distribution lists of all project partners, stakeholders and donors. Project web site established.	Project area remains safe to work in.
2. Relationships between biodiversity and farming practices are understood	Effects of changing agricultural policies and practices on biodiversity can be predicted by year 4.	At least 4 Scientific papers submitted to peer review journals on project completion. Annual and final project reports. Bi-annual	Project area remains safe to work in. Farmers

and best practices (including novel approaches) identified.	Biodiversity indicators identified and best practices (including novel approaches) described and documented by year 4.	supervisory and training visits to Uganda by UK staff. Two exchange visits to the UK by PhD students.	remain receptive to the project.
3. Economic importance of on-farm biodiversity and its loss, and economic implications of novel land management approaches are identified and quantified.	The financial implications of changes in farmland biodiversity (particularly loss of pollinators) can be assessed and predicted by year 4. Best practices identified are related to income (from existing IFPRI data) and costs and benefits of novel approaches can be assessed by year 4.	At least 2 of the 4 scientific papers submitted to peer review journals will include consideration of economics. Annual and final & project reports. Two training visits by DIIS staff.	Project area remains safe to work in. Farmers remain receptive to the project
4. Capacity enhanced in agricultural biodiversity science, policy and practice	At least two African students trained to PhD level and up to 6 research assistants trained in biodiversity survey and census techniques. At least 50 NAADS agricultural service providers attend two training workshops in biodiversity assessment. Two NU/UWS staff trained in biodiversity assessment, participatory development proposal writing and raising of public awareness. Agricultural working group established	Two PhD theses submitted and at least 4 scientific papers submitted. Training manual produced trialled and distributed to agricultural extension service providers with leaflets and posters for farmers. At least 3 open days held for agricultural policy and extension service providers at demonstration farms, Articles produced for popular press and at least 2 radio broadcasts per year. Biodiversity issues integrated into existing and new Government policies.	Farmers Government and NGOs remain receptive and committed to the project
5. Best practices, including novel approaches translated into practical advice for farmers	Increased awareness of and hands on experience with biodiversity issues and increased recognition of the value of biodiversity among farmers within the study area by year 2 and from nearby communities by year 4. Ability and willingness by these farmers to adopt and trial novel land management approaches	At least 2 demonstration farms established with at least three open days for all stakeholders including local communities. Annual discussion fora between NU/UWS and farmers. Leaflets and posters produced for farmers. Two workshops for NAADS agricultural extension service providers. Increased knowledge and understanding of how to integrate the	Farmers remain receptive to the project

	by year 4. At least 50 NAADS agricultural extension service providers trained	needs of biodiversity with sustainable agricultural practices supported by a manual of best practices.	
6. Policy and relevant advice developed within the project is available to all relevant parties and stakeholders	Information and materials on best practices packaged and distributed to policy makers and agricultural extension service providers by year 4. Biodiversity and agricultural manual produced for extension service providers and distributed by year 4. Two demonstration plots. Two supplementary funding applications submitted to potential donors by year 4.	Annual and final project reports. Bi-annual reports from all Steering Committee meetings and two workshops. One training manual produced and advisory leaflets and posters for farmers. Demonstration plots established. At least 2 grant applications submitted. At least 3 national press releases in Uganda and one in the UK in each project year. At least two radio interviews/broadcasts each project year for national and local radio stations	Relevant government authorities maintain their support for the project.
7. System for long term monitoring of agricultural sustainability is established.	Readily repeatable, spatially referenced multi-taxa data collected and entered into National Biodiversity Database (NBDB) by year 4. Monitoring methodology/ protocol established and study sites geo referenced by year 4.	Data entered into the NBDB and at least one article written for an NBDB report. Field and analytical protocols documented in the final report, relevant scientific publications and on the web site Baseline data is fed into the NBDB, study sites geo referenced and protocols and indicators established for future monitoring.	Relevant government, NGO and other stakeholders maintain their support for the project.
8. Integration of biodiversity issues into national policy is created.	Project proposals produced. Sustainability mechanism established through establishment of an agricultural biodiversity working group to promote biodiversity issues into future agriculture policy by year 4.	At least two project funding documents submitted. Agricultural biodiversity working group in place.	Relevant government, NGO and other stakeholders maintain their support for the project.

Annex 3 Project contribution to Articles under the CBD

Project Contribution to Articles under the Convention on Biological Diversity

Article No./Title	Project %	Article Description
6. General Measures for Conservation & Sustainable Use		Develop national strategies that integrate conservation and sustainable use.
7. Identification and Monitoring	15	Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities that have adverse effects; maintain and organise relevant data.
8. In-situ Conservation		Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources.
9. Ex-situ Conservation		Adopt ex-situ measures to conserve and research components of biological diversity, preferably in country of origin; facilitate recovery of threatened species; regulate and manage collection of biological resources.
10. Sustainable Use of Components of Biological Diversity		Integrate conservation and sustainable use in national decisions; protect sustainable customary uses; support local populations to implement remedial actions; encourage co-operation between governments and the private sector.
11. Incentive Measures		Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.
12. Research and Training	15	Establish programmes for scientific and technical education in identification, conservation and sustainable use of biodiversity components; promote research contributing to the conservation and sustainable use of biological diversity, particularly in developing countries (in accordance with SBSTTA recommendations).
13. Public Education and Awareness		Promote understanding of the importance of measures to conserve biological diversity and propagate these measures through the media; cooperate with other states and organisations in developing awareness programmes.
14. Impact Assessment and Minimizing Adverse Impacts		Introduce EIAs of appropriate projects and allow public participation; take into account environmental consequences of policies; exchange information on impacts beyond State boundaries and work to reduce hazards; promote emergency responses to hazards; examine mechanisms for re-dress of international damage.
15. Access to Genetic Resources		Whilst governments control access to their genetic resources they should also facilitate access of environmentally sound uses on mutually agreed terms; scientific research based on a country's genetic resources should ensure sharing in a fair and equitable way of results and benefits.
16. Access to and Transfer of Technology	15	Countries shall ensure access to technologies relevant to conservation and sustainable use of biodiversity under fair and most favourable terms to the source countries (subject to patents and intellectual property rights) and ensure the private sector facilitates such assess and joint development of technologies.

Article No./Title	Project %	Article Description
17. Exchange of Information		Countries shall facilitate information exchange and repatriation including technical scientific and socio-economic research, information on training and surveying programmes and local knowledge
19. Bio-safety Protocol		Countries shall take legislative, administrative or policy measures to provide for the effective participation in biotechnological research activities and to ensure all practicable measures to promote and advance priority access on a fair and equitable basis, especially where they provide the genetic resources for such research.
Other Contribution	55	Smaller contributions (eg of 5%) or less should be summed and included here.
Total %	100%	Check % = total 100

Annex 4 Standard Measures

Code	Description	Totals (plus additional detail as required)
Training Measures		
1a	Number of people to submit PhD thesis	2
1b	Number of PhD qualifications obtained	1 submitted Sept 2009, 1 to submit November 2009
2	Number of Masters qualifications obtained	1 to be submitted
5	Number of people receiving other forms of long-term (>1yr) training not leading to formal qualification(ie not categories 1-4 above)	2
7	Number of types of training materials produced for use by host country(s)	3
Research Measures		
8	Number of weeks spent by UK project staff on project work in host country(s)	81
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s)	2 (1 handbook, 1 policy brief)
11a	Number of papers published or accepted for publication in peer reviewed journals	2 in preparation – to *Ibis* and the *Journal of African Ecology.*
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	7 (Birds, Butterflies, Bees, Pollination, Woody Vegetation, Landuse, Socioeconomics) held in country. They will be put together as a standalone package at the National Biodiversity Databank
13a	Number of species reference collections established and handed over to host country(s)	2 – Bee and Butterfly collection handed over to Department of Zoology, Makerere University
Dissemination Measures		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	Total 7 which included 1 final project dissemination meeting, 2 farm demonstration days, 4 farmer 'fora'. A poster was presented at the Cambridge Conservation Initiative

Code	Description	Totals (plus additional detail as required)
		Student Conference in 2007 and at a joint conference working group / EPOPA (Export Promotion of Organic Products from Africa) conference in Kampala on 23 May 2007
15a	Number of national press releases or publicity articles in host country(s)	2
16a	Number of issues of newsletters produced in the host country(s)	1
16b	Estimated circulation of each newsletter in the host country(s)	>500
17a	Number of dissemination networks established	1 – the Agro-biodiversity Working Group
19c	Number of local radio interviews/features in host country (s)	2 (in Luganda and English)
Physical Measures		
20	Estimated value (£s) of physical assets handed over to host country(s)	18,000
22	Number of permanent field plots established	26
23	Value of additional resources raised for project	c. 40,000 in staff time (Dr Simon Potts, Dr Conal Eardley, Dr Philip Atkinson) Leverhulme Trust – £37,874

Annex 5 Publications

Type * (eg journals, manual, CDs)	Detail (title, author, year)	Publishers (name, city)	Available from (eg contact address, website)	Cost £
Manual*	Nantaba, O., Juliet Vickery, J.A., Atkinson, P.W., Byaruhanga, A., Mushabe, D., Pomeroy, D., Nakyeyune, A, Nalwanga Wabwire, D. & Munyuli, T. (2009) *Conserving Biodiversity ion Farmland A Guide to Agriculture Extension Work*	Uganda Wildlife Society	www.uganda-agrobiodiversity.org	nil

Annex 6 Darwin Contacts

Ref No	14-032
Project Title	Conserving biodiversity in the modernising farmed landscapes of Uganda
UK Leader Details	
Name	Dr Philip Atkinson
Role within Darwin Project	Project Leader (2009 onwards)
Address	British Trust for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU, UK
Phone	
Fax	
Email	
Other UK Contact (if relevant)	
Name	Dr Juliet Vickery
Role within Darwin Project	Project leader (2005-2009)
Address	Previously BTO, currently at: RSPB, The Lodge Sandy, Beds SG19 2DL
Phone	
Fax	
Email	
Partner 1	
Name	Achilles Byaruhanga
Organisation	NatureUganda
Role within Darwin Project	CEO of NatureUganda
Address	Plot 83 Tufnel Drive, Kamwokya, PO Box 27034, Kampala Uganda
Fax	
Email	
Partner 2 (if relevant)	
Name	Annet Nakyeyune
Organisation	Uganda Wildlife Society
Role within Darwin Project	CEO of UWS
Address	3rd Floor, Plot 1521 Mawanda Road, Kamwokya, P.O. Box 7422, Kampala, Uganda
Fax	
Email	
Partner 3 (if relevant)	

Name	Professor Derek Pomeroy
Organisation	Makerere University Institute of Environment and Natural Resources (MUIENR)
Role within Darwin Project	Local supervisor of ornithology PhD student
Address	MUIENR, PO Box 7298, Kampala, Uganda
Fax	
Email	
Partner 4 (if relevant)	
Name	Dr Philip Nyeko
Organisation	Makerere University
Role within Darwin Project	Associate Professor
Address	Department of Forest Biology and Ecosystems Management, Faculty of Forestry and Nature Conservation, Makerere University, P.O Box 7062, Kampala, Uganda
Fax	
Email	

Annex 7 The Agro-biodiversity Working Group - list of local member organizations

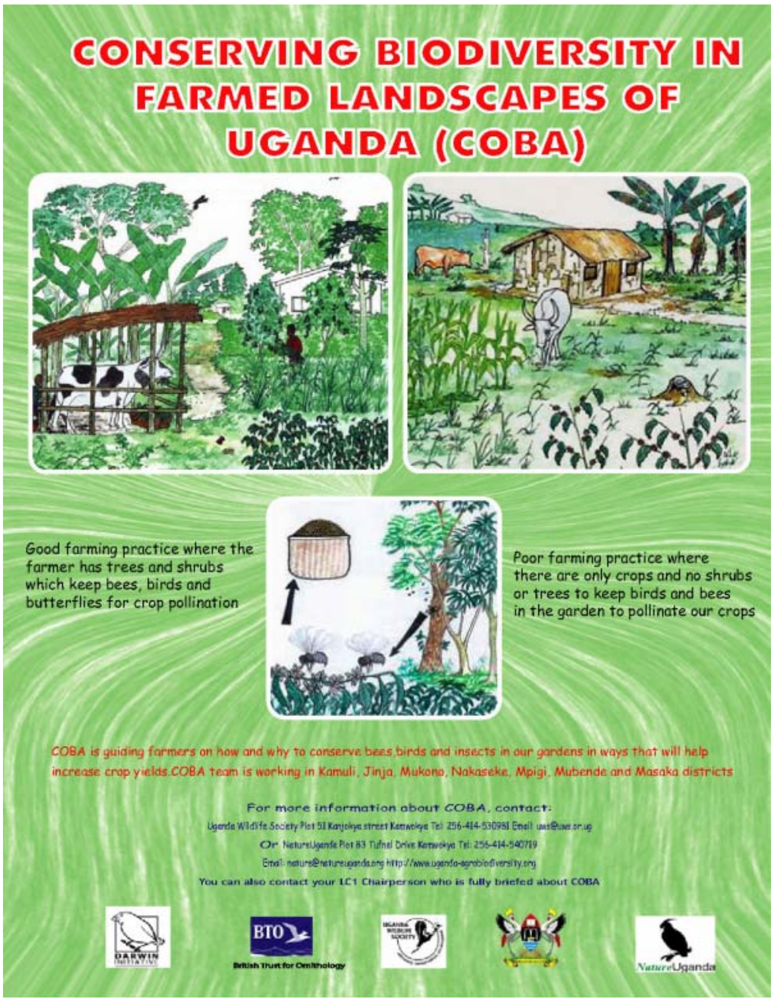
Organization
Plan for Modernization of Agriculture (PMA)
National Advisory Services (NAADS)
Ministry of Water and the Environment
National Environment Management Authority (NEMA)
National Agriculture Research Organization (NARO)
Forest Resources Research Institute (FORRI)
Send a Cow
Kulika Uganda
Faculty of Agriculture, Makerere University
Faculty of Forestry and Nature Conservation, Makerere University
Wildlife Conservation Society (WCS)
Environment Conservation Trust of Uganda (ECOTRUST)
Uganda Export Promotion Board
UNIPA
Earth Care
IUCN
Export Promotion of Organic Products from Africa (EPOPA)
Makerere University Institute of Environment and Natural Resources (MUIENR)
*Nature*Uganda (NU)
Uganda Wildlife Society (UWS)

Annex 8 Agrobiodiversity Handbook (see separate file)

Click link to open

Annex 8 Agrobiodiversity Handbook.pdf

Annex 9 Examples of the posters produced during the course of the project.



Annex 10 The distribution list (with numbers of copies) for the Agro-biodiversity Handbook

UNIPA(10)
FORRI(10)
FAC. AGRICULTURE MUK(10)
FAC. FOREST MUK (10)
IUCN (10)
MUIENR (20)
UEPB(10)
NEPTUNE PETROLEUM (UGANDA) LTD (10)
ECOTRUST(10)
KULIKAUG (10)
VI (10)
ENVIRONMENTAL ALERT secretariat (10)
VEDCO secretariat (10)
EPOPA (10)
NARO Kawanda/Namulonge (20)
NEMA (10)
EARTHCARE (10)
MWE (10)
WCS (10)
SEND a COW (10)
PMA secretariat (5)
NAADS secretariat (5)
- Masaka District (10)
- Kamuli District (10)
- Jinja Bujagali (10)
- Mukono (10)
- Nakaseke (10)
- Mpigi (10)
- Mubende (10)

All organizations suggested by extension advisors
Organizations in Masaka World Vision (5), MADDO (5), Madifa (5), Busoda (5), St Jude (5), NFA (5)
Organizations in Nakaseke World Vision (5), VEDCO (5), Plan International (5), NFA (5)

Annex 11 Project brochure/newsletter, originally published in the Naturalist (NatureUganda's publication to members) as a pull out section. (see separate file)

CONSERVING BIODIVERSITY IN THE FARMED LANDSCAPES OF UGANDA (COBA)

General Introduction

By Olivia Nantaba and Julie Kintu (UWS)

Agricultural development is a major cause of biodiversity loss and continues to result in rapid reduction and degradation of terrestrial habitats. In Uganda, the intensification and expansion of crop and livestock production is the most important influence on land use, land cover and biodiversity. For this cause, the major policy initiatives agree that sustainable and productive land use is the key to economic growth and poverty eradication in rural Uganda. There is therefore an urgent need for an integrated approach to land use that can promote sustainable development by increasing productivity of agricultural land, while at the same time conserving biodiversity. That is the reason for the project "Conserving Biodiversity in the Farmed landscapes of Uganda".

Project research team

This project, the first of its kind in Uganda, is funded by Darwin Initiative through the British Trust for Ornithology (BTO-UK). It is implemented by *Nature***Uganda**, Makerere University Institute of Environment and Natural Resources (MUIENR) and Uganda Wildlife Society (UWS), in collaboration with the Makerere University Department of Forest Biology and Ecosystems Management, Department of Development Research (Danish Institute for International Studies- Copenhagen), Royal Society for the Protection of Birds (RSPB – UK), Plan for Modernization of Agriculture (PMA), National Agricultural Advisory Services (NAADS) and National Environment Management Authority (NEMA).

The project is being implemented in the banana / coffee arc around Lake Victoria. The activities include: (i) collecting baseline data to enlarge the scope for future monitoring of biodiversity (particularly birds and insects) in agricultural systems in Uganda, (ii) identification of best practices regarding sustainable land use options in Uganda, (iii) dissemination of best practices to agricultural development agencies, service providers and selected local communities within Uganda. (iv) policy advice to the Ugandan Government.

The aim of the project is to identify a series of management practices that benefit the farmer and maintain or increases biodiversity on the farm. In order to achieve the project aim, some of the expected project outputs include:

- Relationships between biodiversity and farming practices understood and best practices identified.
- Economic importance of on-farm biodiversity identified and quantified.
- Best practices and approaches translated into practical advice for farmers
- Capacity in agricultural biodiversity relationship for local officials and farmers enhanced
- Policy and relevant technical advice developed and made available to strategic partners and stakeholders.

The results of the project will be widely disseminated to political and scientific audiences, including stakeholders and donors. This will be done through discussion forums (meetings or radio programmes) involving the Agro-Biodiversity Working Group and stakeholders.

Pollinators in agriculture

By Dianah N. Wabwire (MUIENR)

A pollinator is the biotic agent that moves pollen from the male anthers of the flower to the female stigma of a flower to accomplish fertilization. The most recognized pollinators are the various species of bees, especially, Honeybees and Bumblebees, which are plainly adapted to pollination. Other pollinators include Beetles, ants & Wasps plus Butterflies & Moths that pollinate wild flowers. Green bottle or carrion flies are especially important for flowers that exude a fetid odor. Some vertebrate pollinators include Bats; important pollinators of tropical flowers, birds; particularly hummingbirds, honeyeaters and sunbirds which mostly pollinate deep-throated flowers. Monkeys, lizards and rodents have also been recorded as pollinators.

Flowers have features that reflect the type of pollinator attracted e.g. size, depth of the corolla, colour and patterns plus the scent, composition and amount of nectar. For instance, birds visit red flowers with long narrow tubes and lots of nectar but are not strongly attracted to wide flowers with little nectar, which are more attractive to beetles.

In agricultural economics, humans have also turned into hand pollinators in vegetable gardens, as they must keep the yields high in the absence of sufficient pollinators. This can involve using a small brush or cotton swab to move pollen or to simply tap or shake blossoms to release the pollen for the self-pollinating flowers. Many kinds of pollinators are cultured and sold for managed pollination. Bees and butterflies are some of the major pollinators cultured in commercial plantings in Uganda. At times hives of honeybees are contracted out as pollinators by beekeepers.

Bees are one of the major crop pollinators in Uganda

Pollination of food crops has become an environmental issue due to the trend of shifting from mixed cropping to monoculture, which means concentration of pollinators at bloom time in an area with little or no habitat for the pollinator population.

The other trend of concern is the decline in pollinator population due to loss of suitable habitat as a result of clear-cut logging, over-use or miss-use of pesticides, new diseases and parasites of pollinators, removal of hedges and other habitat from farms and public paranoia about pollinators among others. The ecological set-up and vicinity of a forest or wild grasslands near agricultural crops such as coffee is said to improve their yield by about 20%. In which case, flower owners may demand payment for their part in the improved results. This is an example of economic value of ecological services.

Since farming is the main source of income for the largest population in Uganda, it is important for farmers to maintain a pollinator-friendly environment. This will keep pollinator populations high and ensure better crop yields for a better standard of living.

1

Consavation of Biodiversity in A

● COBA is an initiative aimed at helping you get the best harvest out of your farm. COBA is working in the intensive coffee-banana arc covering the districts of Masaka, Mpigi, Mubende, Nakaseke, Mukono, Jinja and Kamuli.

Birds, insects and trees are indicators of a healthy envi

It is a win-win situation

For more information about COBA, contact:
NatureUganda, Plot 83 Tufnel Drive, Kamwokya P.O. Box 27034, Kampala – Uganda Tel: 256-41-540719 Email: nature@natureuganda.o

You can also contact your LC I chairperson who is fully briefed about COBA

Darwin Initiative

British Trust for Ornithology

Makere
Environ

\griculture landscapes (COBA)

● So when you see COBA's staff in your village or farm/garden, they may be gathering information on wildlife and farming practices which they will share with you so you can make the best farming decisions and increase your agricultural productivity.

onment and increase productivity in your farm/garden.

· for you and for wildlife!

'g

e University Institute of
ıent & Natural Resources

Uganda Wildlife Society

Nature Uganda

Publicity materials

Publicity material in form of posters, leaflets and a handbook of best practices for the conservation of farmland biodiversity will be developed and distributed. One poster illustrating the importance of conserving biodiversity on farm lands has been produced to create awareness.

NAADS Perspective on the likely Agricultural changes and how they will affect Agro-biodiversity

By Oketcho

The National Agricultural Advisory Services (NAADS) is a body corporate established by an Act of Parliament in June 2001. The NAADS mandate targets empowering the smallholder subsistence farmers organized in common commodity interest groups to select enterprises (that include crops, livestock, fisheries and apiculture) for development and promotion. Based on the constraints that may either require advisory service training and/or adopting improved technologies to increase productivity and profitability, the farmers tender out contracts for technical advisory service to private-based service providers.

The two key guiding principles of NAADS are: farmer empowerment to demand and control the delivery of agricultural advisory services; and natural resource management and sustainability implying managing the agro-ecology in a sustainable manner. Awareness creation on the importance of bio-diversity on farms and guided planning become crucial in this demand approach to advisory service delivery. The prevailing socio-economic situation in rural areas dictate that survival and increased productivity and profitability are at the center of the farmers' goal, regardless of any negative impact of the agricultural activity on bio-diversity. Farmers' indigenous knowledge on the value of useful animals, insects or plants to soil fertility conservation and pollination of plants becomes secondary to the profitability and survival instincts. Sustainable utilization of forests for rainfall catchments compares less against purported gains from encroaching forests for extensive cultivation and source of fuel (mainly charcoal burning) to derive meager additional incomes.

Coffee, a major income generating crop

Fully aware of the likely effect of increased utilization of production enhancement technologies (such as: improved planting and stocking materials, labor-saving technologies e.g herbicides, and insecticides) leading to transforming subsistence farming to farming as a business, the NAADS Natural Resource Strategy emphasizes awareness creation right from the participatory planning/enterprise selection stage. In addition, the strategy targets household levels as focal points for implementing recommended management practices. It similarly encourages the cultivation and promotion of tree crops (farm forestry) such as citrus, mangoes and temperate fruits (apples). Other enterprises such as beekeeping to promote afforestation have become wide spread in many NAADS participating districts. The use of organic manure and mulching are among the technologies promoted under NAADS aimed at conserving the flora and fauna on farms

In conclusion, the conservation of bio-diversity calls for collective effort of all key players who include but not limited to: policy makers, community/Faith-based organizations and NGOs, farmers and technocrats. Single handedly, the task becomes insurmountable. Sustainability as a strategy has to be unpacked to household level and incentive mechanism for good performance should be the engine to propel conservation of bio-diversity.

Outcomes of the project

By Dr. Phil Atkinson (BTO)

We aim to identify a series of management practices that benefit the farmer and maintain or increases biodiversity on the farm, i.e. Win-win situations. An example of this could be growing coffee under shade trees. The shade trees are good for birds and insect pollinators and thus the farmer gets full fertilization of the crop and a better price as shade coffee is often a better quality than that grown in full sun. Other scenarios include protection of water-courses by planting trees and maintaining small patches of forest and fallows for wild bees.

The students and staff at MUIENR, NU and UWS have collected a very large amount of unique baseline data and in future, their sites can be visited again and trends in the health of the agricultural environment can be described. All the data will be stored in the National Biodiversity Databank (NBDB) at MUIENR. This work is breaking new ground in Uganda. Another major aspect of the project has been capacity building both in terms of training people but also increasing the expertise of organizations such as NU and UWS to work in the wider countryside. Their analyses of the data will be published and we envisage this work will make major contributions to the scientific literature.

Data collection in a sugarcane plantation in Lugazi

Of course, projects such as this need to continue to ensure that the findings are put into practice thus the links between project staff and collaborating to ensure a lasting legacy. To make sure the results are made available, we will work closely with these organizations in producing the handbook. Demonstration farms will also be identified and farmers will be encouraged to visit them to show that what is good for biodiversity may also be a good agricultural practice.

We have also established an Agro-biodiversity Working Group with representatives from over 20 organizations. They are actively discussing issues related to this topic, organizing workshops and aiming at becoming a self-sustaining body that continues to take this subject forward after the end of the project. The working group has so far visited two project sites in Masaka and Jinja. They have interacted with the students and farmers in the areas, through organized quorums in which they educate the farms about issues related to agro-biodiversity and also identify areas for further research.

Agro-biodiversity Working Group Members in a meeting with farmers in Namizi East, Jinja

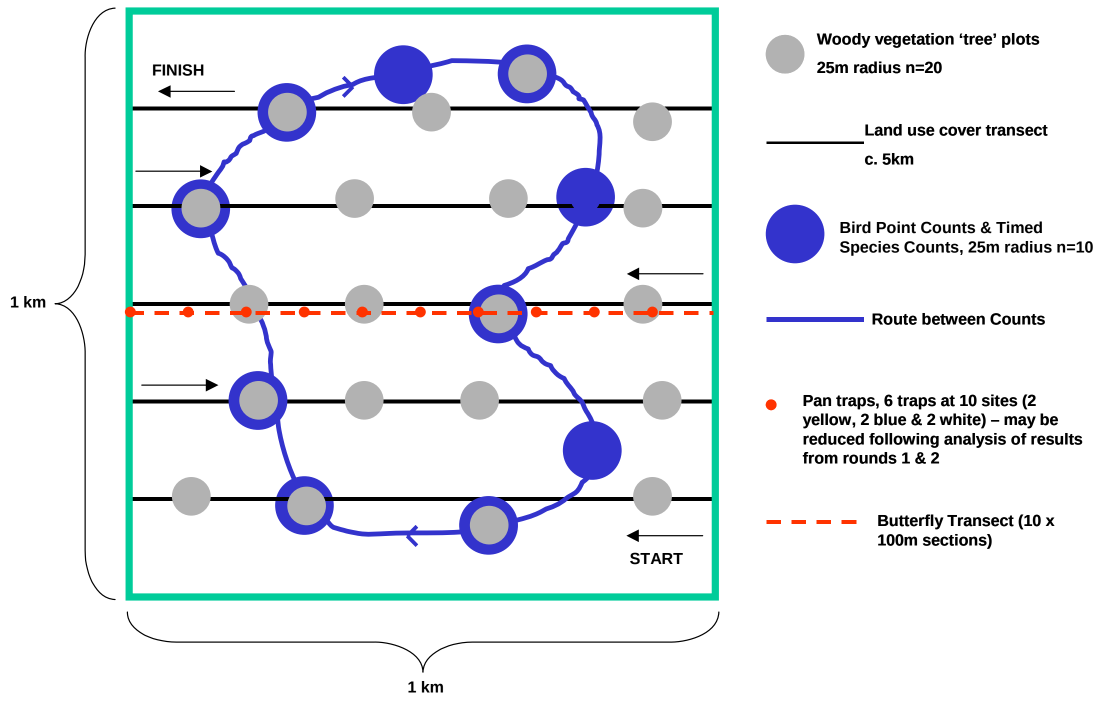
With an increasing trend of intensification of crops, a landscape empty of trees and associated birds and insects is a distinct possibility and this is will not be good for farmers and for biodiversity. This work will identify management practices that result in both profitable farming as well as high levels of biodiversity.

Annex 12 Policy brief (see separate file)

Click link to open

Annex12 Policy Brief.pdf

Annex 13. Summary and layout of the of the survey design. Each of the 26 1x1 km squares was surveyed for birds, bees, butterflies, plants (wood plants), land use, crops, yield and other socioeconomic data.



Annex 14 Details of the course: Estimating numbers of wild animals: an introduction to survey and census methods

Day 1 Tuesday 6 December, 2005

09.00 - 09.30	Introductions and workshop aspirations
09.30 - 10.00	Session 1. An introduction to surveys, censuses and monitoring (PD)
10.00 - 10.30	Coffee
10.30 - 12.00	Session 2. Precision, accuracy, bias and sample sizes (PD)
12.00 - 13.00	Session 3. Sampling strategies (PD)
13.00 - 14.00	Lunch
14.00 - 15.30	Session 4. Survey methods (1): simple assessments, mapping methods and specialist techniques (PD/DP)
15.30 - 16.00	Coffee
16.00 - 18.00	Session 5. Survey methods (2): transects and point counts (PD/DP)

Day 2 Wednesday 7 December, 2005

09.00 - 09.30	Session 6. Counting colonial and flocking species (PD)
09.30 - 10.30	Session 7. Habitat measurements and calculations of habitat use (PD)
10.30 - 11.00	Coffee
11.00 - 12.00	Session 8. Statistical analysis of survey data (PD)
12.00 - 13.00	Lunch
13.00 - 14.00	Session 9. Invertebrate survey methods (PN)
14.00 - 16.00	Session 10. Field exercise: Using GPS and point counts in field surveys (DM)
16.00 - 17.30	Exercise: combining sampling strategy, survey methods, habitat measurement and project management
17.30 - 18.00	Final conclusions and workshop evaluation

PD - Paul Donald
DP - Derek Pomeroy
PN - Philip Nyeko
DM - David Mushabe