

## Mitigating Impacts of Projects on Biodiversity Conservation in Uganda

Fred R Muwanika\*, Mwaura F, Ogwal F, Masiga M, Akullo M and Okurut TO

National Environmental Management Authority (NEMA) House, P.O Box 22255, Kampala, Uganda

### Abstract

**Introduction:** This study provides light on the impact of implemented projects on biodiversity in Uganda in terms of harmful and enhancing projects. Biodiversity harmful projects are defined as the types of projects that destroy or led to biodiversity loss during their implementation. While biodiversity enhancing are projects that lead to biological diversity during their implementation.

**Objective:** The objective of the study was to assess the impact of implemented projects in the communities on biodiversity conservation and management in Uganda.

**Methods:** The data used in this analysis was obtained from Uganda Bureau of statistics (UBOS) previously collected during the National Service Delivery Survey. Multiple correspondence analysis (MCA) was used to derive the different impact dimensions of projects on biodiversity among the communities in Uganda.

**Results:** Implemented projects in the communities impact on biodiversity both positively and negatively. Findings revealed that livestock improvement/restocking/breeding contribute about 30% on the biodiversity positive impacts while introduction of improved crop variety at about 20% and agricultural technology at about 11.4%. Furthermore, construction of new road/bridges are the leading projects in destroying biodiversity accounting for about 13.5% of the variation in negative impacts while construction of toilet/latrines and health units accounts for 11.8% and 9.4%, respectively of the variation in biodiversity loss.

**Conclusions and recommendations:** Construction related projects impact negatively on biodiversity in their implementation while agricultural related projects are the leading agro-biodiversity enhancing projects in Uganda. This implies that works sector must play an important role in biodiversity conservation in Uganda. Secondly, construction and agriculture related projects should endeavour to allocate a percentage of the project budget equivalent to expected impact on biodiversity towards its management and restoration.

**Keywords:** Biodiversity; Harmful; Enhancing; Projects

### Introduction

The objective of the analysis was to assess impact of projects implemented in the communities on Uganda's biodiversity expenditures. This analysis provides light on the impacts of biodiversity expenditures using biodiversity harmful and enhancing projects. We define biodiversity harmful projects as types of projects that destroy or led to biodiversity loss during their implementation. While biodiversity enhancing are projects which lead to biological diversity during their implementation.

Infrastructure development through construction carried out by either public and private institutions are more likely to harm environment and its species [1]. These constructions could be carried out at a commercial level like construction of schools, health facilities, roads and bridges that harm the forestry biodiversity by utilizing the timber as well as clearing trees and vegetation. Similarly, constructions of residential structures are likely to have a higher impact resulting from increasing population. This implies that the Ministry of Works and Transport (MWT) which deals construction of roads and related infrastructures have a significant role in protection and restoration of biodiversity in Uganda.

Currently the sector has limited understanding and knowledge about biodiversity conservation in Uganda. As a result of the limited knowledge and involvement of the MWT sector in the conservation of the environment, there is need to have a criteria for assessing the impact of infrastructure development on biodiversity.

Land use and its management play a significant role in the conservation of biodiversity in any country. For example, in Uganda,

agriculture accounts for about 38% of the total area [2]. This implies that management of agricultural systems have significant shocks both positive and negative on the environment and more specifically biodiversity. Agriculture technology has largely established agricultural diversity of the environment and landscape. Furthermore, according to UBOS [3], about 66% of the working population are employed in the agricultural sector. This implies that the agricultural sector is the main channel for the delivery of biodiversity and ecosystem services to the population for socio-economic development. Therefore, in the attainment of sustainable socio-economic development, there is need to assess the impact of agricultural related projects on biodiversity in Uganda.

### Methods

#### Data sources

The data used in this analysis were obtained from Uganda Bureau of statistics (UBOS) previously collected during the National Service Delivery Survey [4]. The purpose of the surveys was to obtain information on the availability, accessibility, utilisation and satisfaction

\*Corresponding author: Fred R. Muwanika, National Environmental Management Authority, Kampala, Uganda, Tel: +256 779 604 453; E-mail: [frmuwanika@yahoo.co.uk](mailto:frmuwanika@yahoo.co.uk)

Received May 31, 2017; Accepted June 13, 2017; Published June 20, 2017

**Citation:** Muwanika FR, Mwaura F, Ogwal F, Masiga M, Akullo M, et al. (2017) Mitigating Impacts of Projects on Biodiversity Conservation in Uganda. J Ecosyst Ecography 7: 232. doi:10.4172/2157-7625.1000232

**Copyright:** © 2017 Muwanika FR, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

of the service recipients with regard to services that were being provided in those sectors. In particular our analysis utilized section 8 of the household questionnaire which collected information on the types of projects implemented in the community in the last three years prior to the survey. Furthermore, information on whether the household members had benefited in the projects were also collected.

### Data analysis

The impact of implemented projects on the people in the communities was first visualized and then analysed using correspondence analysis method. Correspondence analysis is a descriptive, exploratory technique designed to analyse simple two-way and multi-way contingency tables containing some measure of correspondence between the rows and columns.

### Visualization of impacts

To explore the impact of projects that were implemented in the communities on the people in the households, bi-plots were used. The bi-plots are graphical representation of the correlation between the implemented projects (variables) and their impacts on the people in the households. The graphs were used to identify projects that are correlated and forming distinct groups in terms of biodiversity loss or gain.

### Multiple Correspondence Analyses (MCA)

MCA is an exploratory tool for the analysis of association(s) between many categorical variables [5]. According to Jolliffe [6], correspondence analysis is equivalent to principal component analysis of categorical variables in our case whether the project is implemented in the community or not. Furthermore, MCA is an exploratory methodology that does not require prior distributional assumptions about the projects implemented in the communities. MCA is an extension of correspondence analysis (CA) which decomposes the chi-square statistic into the contribution of the rows and columns. The MCA is a simple correspondence analysis carried out on an indicator matrix with individuals as rows and projects as columns. The indicator matrix is commonly known as Burt matrix in MCA [7]. The total inertia of the rows and columns were computed and decomposed into lower dimensions. Inertia is defined as the total Pearson chi-square for the two-way table divided by the total sum. The total inertia of all the projects implemented in the communities was computed and then decomposed to establish lowest number of dimensions to explain the impacts of the projects. Correlations and percentage contribution of each project and the impact dimensions were computed. The results were presented using bar graphs explaining the proportion of each project contribution on the impacts to the population.

### Results

Table 1 shows the distribution of projects implemented in the communities three years prior to 2008 NSDS.

Results shows that road/bridge constructions and water provision were the most frequently implemented projects while environmental conservations and fish related were the least implemented projects in the communities. To explore the dimensions of the impacts from all the projects implemented in the communities, bi-plots were performed. The results are shown in Figure 1.

Results from the bi-plots show that the impacts from all projects implemented in the communities manifest in two dimensions. For example biodiversity harmful projects seem to define one dimension

Projects	Frequency (n=6329)	Per cent
Road or bridge rehabilitation	2401	37.9
Water provision	2387	37.7
Introduction of new crop or improved variety	1543	24.4
Livestock improvement / restocking /breeding	1318	20.8
Health unit construction	933	14.7
Sensitization / extension services/ information	822	13.0
New school construction	812	12.8
Introduction of improved agriculture technology	605	9.6
Classroom construction	571	9.0
Toilet / Latrine construction	382	6.0
Poultry / birds related	314	5.0
New roads or bridges	274	4.3
Other school improvement	258	4.1
Construction of teachers houses	256	4.0
Electrification	225	3.6
Demonstration Garden	150	2.4
Forestry related	139	2.3
New markets construction	99	1.6
Markets rehabilitation	86	1.4
Environmental conservation	57	0.9
Fish related	38	0.6

Table 1: Distribution of implemented projects in communities in Uganda, 2008.

Dimensions	Principal inertia	Per cent
Dimension one	0.00238	58.9
Dimension two	0.00083	20.5
<b>Total</b>	<b>0.004045</b>	<b>79.4</b>

Table 2: Distribution of mass across impact dimensions.

of the impacts while biodiversity enhancing projects another impact dimension (Figure 1).

### Biodiversity enhancing and harmful impacts

Table 1 shows the summary of the multiple correspondence analyses of projects that were implemented among the communities in Uganda. The total mass (inertia) attributed to each of the extracted dimensions and the proportions explained were computed. The results are presented in Table 2.

The total mass to be explained by the twenty categories of the projects was about 0.004. Out of the total inertia, dimension one explains about 59% while dimension two explains about 21%. Overall, the two dimensions extracted explain about 79% of the variation in biodiversity associated with all the above categories of projects.

Further analyses were carried to gain understanding in the different dimensions of the projects in measuring the positive and negative impacts on biodiversity. The mass contributed, correlation and proportion of the inertia were computed for each of the project under consideration.

Introduction of improved agriculture technology, forestry related projects, introduction of new crop or improved variety, construction of new roads or bridges and livestock improvement/restocking/breeding are highly represented by the two biodiversity measures(correlation>0.8). On the other hand, demonstration garden, electrification, health unit construction, new market construction, poultry/birds related, road or bridge rehabilitation, other school improvement, sensitization/extension services/information, construction of teachers houses, toilet/latrine construction and water

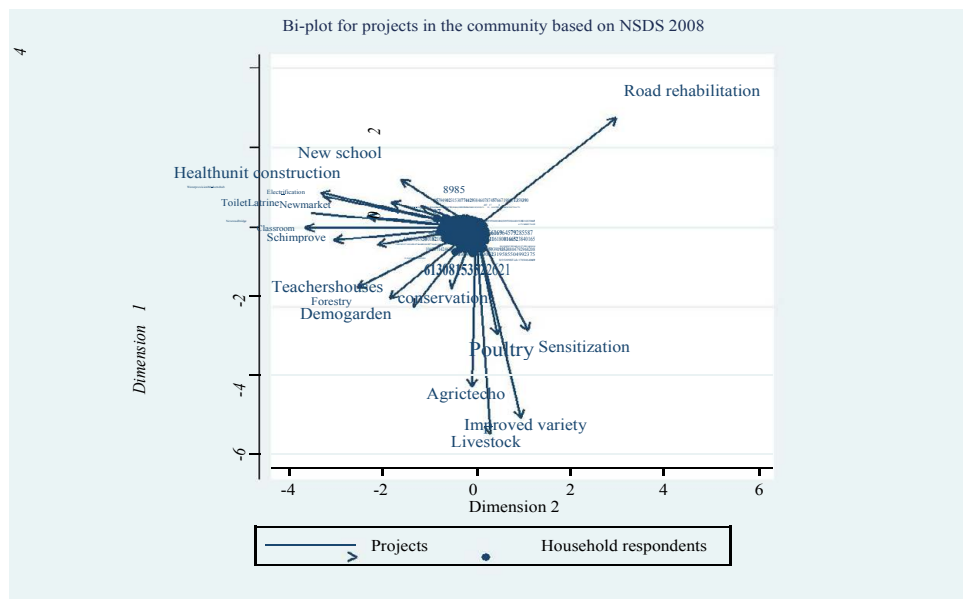


Figure 1: Bi-plots of impacts of biodiversity enhancing and harmful projects.

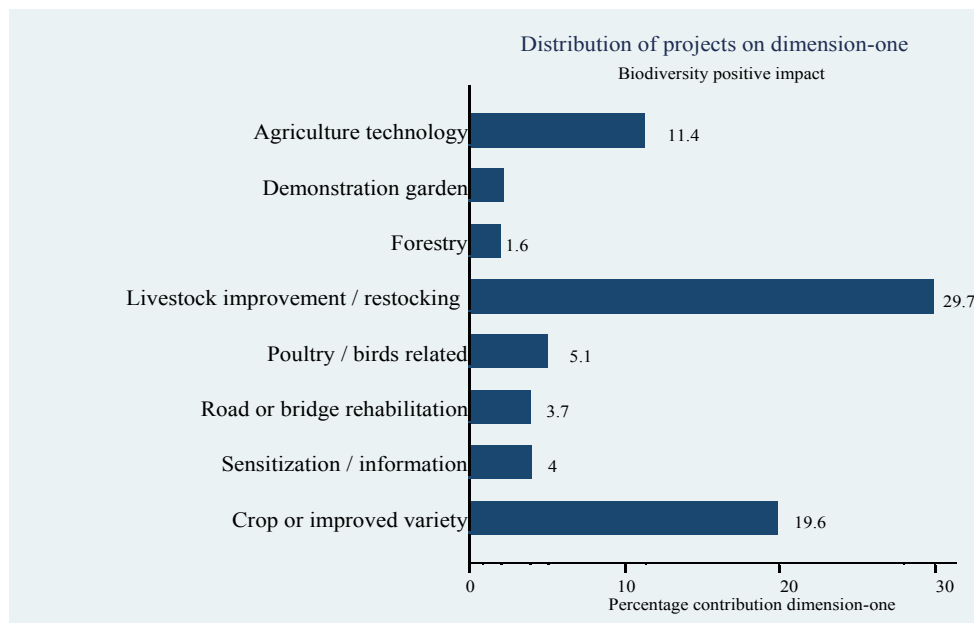


Figure 2: Biodiversity enhancement projects in Uganda.

provision projects were moderately explained by the two dimensions correlation (0.5-0.79).

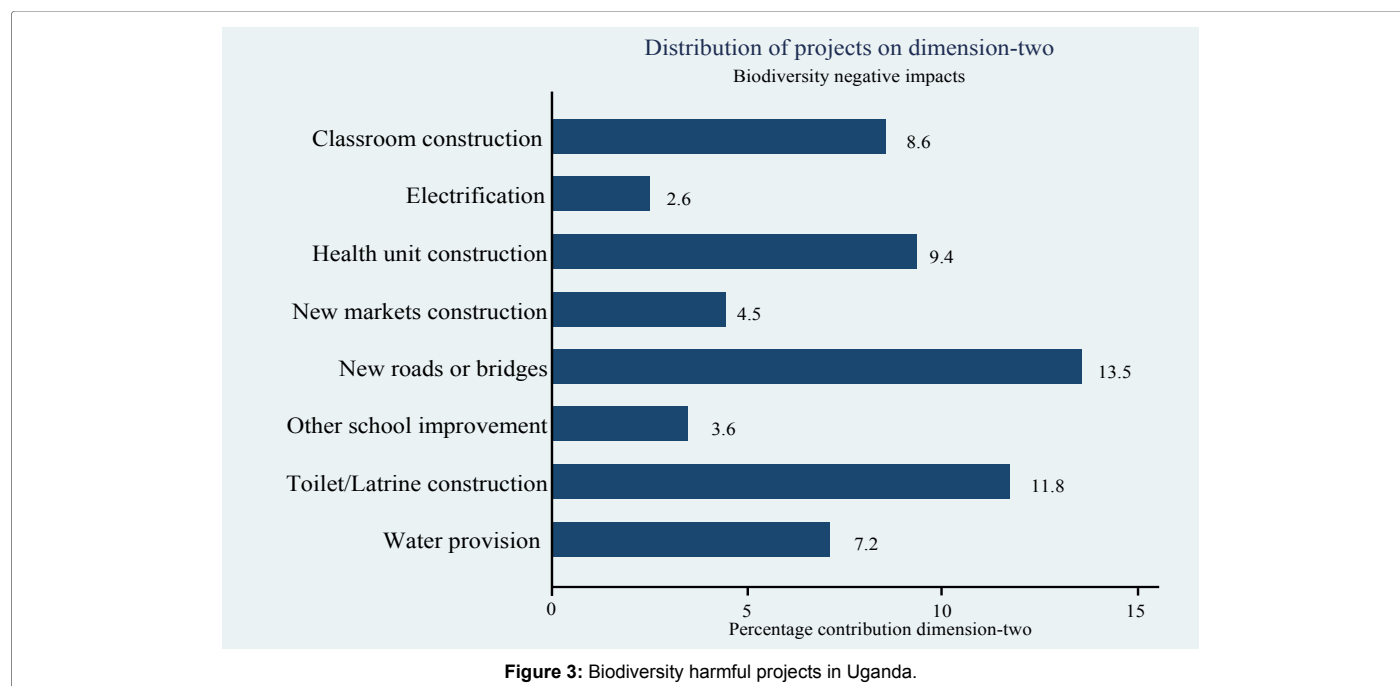
Lastly projects under classroom construction, market rehabilitation and new school construction were poorly represented by the two dimensions of biodiversity (correlation < 0.5).

### Biodiversity enhancing/positive impacts-dimension one

To gain insight of the extracted dimensions in terms of impact of the projects on biodiversity further analysis were performed. Projects like introduction of agricultural technology, demonstration garden, forestry related, introduction of improved crop varieties, poultry/

birds related, rehabilitation of road or bridge, sensitization / extension services/information and livestock improvement/restocking/breeding contribute highly on dimension one. Based on these projects we can therefore, interpret dimension one as biodiversity positive projects. In other words these classes of projects enhance biodiversity.

Findings show that livestock improvement/restocking/breeding contribute about 30% on the biodiversity positive impacts followed by introduction of improved crop variety at about 20% and agricultural technology at 11.4% (Figure 2). Overall, the implementation of projects accounts for about 77.2% of the variation on biodiversity enhancement.



### Biodiversity harmful/negative impacts dimension-two

Similarly, projects like classroom construction, health unit construction, new markets, new roads or bridges, renovation of schools, toilets and latrines, electrification and well as water provision contribute highly to dimension two. Dimension two seems to deal largely with construction which in most cases negatively impacts on biodiversity. Therefore, we interpret dimension as biodiversity negative projects.

Findings revealed that construction of new road/bridges are the leading projects in destroying biodiversity accounting for about 13.5% of the variation in negative impacts while construction of toilet/latrines and health units accounts for 11.8% and 9.4% respectively of the variation in biodiversity loss (Figure 3). Overall the implementation of the selected projects accounts for about 61.2% of the variation in biodiversity loss associated with construction works.

### Conclusions and Discussions

This study assessed the nature and impacts of implemented projects in Uganda on biodiversity. The purpose of the analysis is to establish the extent of the damage and use it as criteria for resource mobilization in the protection and restoration of biodiversity. The study utilized the national service delivery survey [4] data previously collected by UBOS. Findings revealed that implemented projects in the communities are classified into biodiversity enhancing and biodiversity harmful projects. Biodiversity enhancing are projects that improve, introduce or restore biodiversity during or after implementation. Furthermore, biodiversity enhancing projects explained about 59% of the variation of the impacts while biodiversity harmful projects explained only about 21% of the variation of the impacts. Overall biodiversity enhancing and harmful projects explained about 79% of the variation of positive and negative impacts on biodiversity conservation in Uganda.

Agricultural related projects are the leading biodiversity enhancing projects in Uganda. For example, livestock improvement and breeding was the leading contributors of biodiversity enhancing accounting

for about 30% of the impact on this dimension. Introduction of new improved crop varieties and agricultural technologies accounted for about 20% and 11%, respectively on biodiversity enhancing in Uganda. This implies that biodiversity conservation should be integrated into agricultural projects for visible impacts and sustainable monitoring.

The other dimension of biodiversity impacts was the harmful impacts that lead to biodiversity loss. Findings revealed that construction projects impact on biodiversity negatively in their implementation. For example, construction of road and new bridges were found to be the leading loss of biodiversity accounting for about 13.5% of the loss. Latrine and health facility constructions each accounts for 12% and 9%, respectively of biodiversity loss in Uganda. This implies that works sector must play an important role in biodiversity conservation in Uganda. Secondly, construction projects should endeavour to allocate a percentage of the project budget equivalent to expected impact on biodiversity towards its management and restoration.

### References

1. Raynsford N (2000) Building a Better Quality of Life: A Strategy for More Sustainable Construction. Department of the Environment, Transport and the Regions: London.
2. UBOS (2015) Statistical Abstract. Uganda Bureau of Statistics.
3. UBOS (2011) Statistical Abstract. Uganda Bureau of Statistics.
4. National Service Delivery Survey Report (2008) Uganda Bureau of Statistics.
5. Greenacre MJ (1984) Theory and application of correspondence analysis. New York: Academic Press.
6. Jolliffe IT (1986) Principal component analysis. New York: Springer-Verlag.
7. Benzécri JP, Coll (1973) L'Analyse des Données. Vol. 1: Taxinomie. Vol. 2: Analyse des Correspondances. Paris: Dunod.
8. Uganda Bureau of Statistics (UBOS) (2014) Uganda National Household Survey 2012/2013. Kampala Uganda: UBOS.
9. Uganda Bureau of Statistics (UBOS) (2016) National Service Delivery Survey-2015 Report. Kampala Uganda: UBOS.