Impact of Land use Interventions on Crop production: A case of Payment for Ecosystem Services Scheme in the Uluguru Mountains, Tanzania

Lazaro Kagata

Lecturer

College of Humanities and Business Studies, Mbeya University of Science & Technology,

Corresponding Author: Lazaro Kagata, Email: lazakagata@gmail.com

Abstract

It was not known whether land use interventions promoted by payment for ecosystem services (PES) scheme had an increase in crop production. The study assessed the impact of PES scheme interventions on crop production in Uluguru Mountains, Tanzania. Specifically, the objectives of the paper were to (i) compare crop production before, during, and after PES scheme, and (ii) to examine factors affecting crop production. To achieve these objectives 219 randomly selected households were involved during data collection using a questionnaires survey. In addition to this, focus group discussions (FGDs), and key informant interviews were employed whereby checklists were used. Multiple regression was used to assess factors influencing crop production. A repeated measure ANOVA was used to compare crop production before, during, and after the PES scheme. The results show that, there was an increase of crop production for maize, beans, and rice where bench terraces and grass strip farming were practised, and where enough labour force was available and extension services were accessible. Farmers realise benefits using the proper interventions promoted by PES scheme, which are beyond the incentives that were provided to them. Thus, the study recommends that farmers be encouraged to continue practising bench terraces and the promoted grass strip interventions because they are appropriate for crop production and ecosystem management.

Keywords: Ecosystem services, watershed, land use interventions, crop production, land degradation, bench terraces.

1.0 BACKGROUND INFORMATION

The agricultural sector continues to be one of the major contributors of human livelihoods because it provides employment for 2.6 billion people worldwide and

accounts for 20 to 60 per cent of the gross domestic product of many developing countries (Dickie et al., 2014). Despite that agriculture production depends on land, land degradation including soil erosion is among the fundamental global challenges facing farmers' livelihoods (Dubale, 2001; Eswaran et al., 2001; Damene et al, 2013 and Dickie et al., 2014). These challenges can lead to soil infertility, which in turn reduces the ability of the land to produce more yields.

The challenges of land degradation and low crop production are persistent phenomena in many countries including Tanzania. Crop production is the quantitative measure of crop yield in a given measured area of field (Noor and Singh, 1981). As highlighted by scholars (Bagoora, 1988; Amsalu & de Graaff, 2007), soil erosion is one of the severe challenges of crop production especially in highland areas. This is endemic in some parts of Tanzania such as Uluguru Mountains where degradation of watersheds was reported to be high (CARE and WWF, 2009), leading to a decrease of crop yields (Mahenge, 2014). The trend led to the introduction of payment for ecosystem services (PES) scheme in different countries including Tanzania as an approach aiming at minimizing environmental degradation through sustainable farming practices (Engel et al., 2008; and Waage et al., 2006)

In Tanzania, PES scheme was piloted at Kibungo Juu Ward on the Uluguru Mountains. This scheme was initiated by CARE and WWF in 2006 and the actual implementation started in 2008 and ended in 2012 (John, 2012). PES scheme aimed at improving the welfare of the people through poverty alleviation and at improving watershed management through sustainable farming methods, including bench terraces, construction, and agro-forestry (CARE and WWF, 2009). These farming methods aimed at reducing soil erosion and overall land degradation. Such practices were expected to promote the growth of the agricultural sector and hence an increase in crop production (CARE and WWF, 2008). However, it was not known whether practising the promoted interventions led to increase in crop production. In this respect, the current study investigated the impact of PES scheme on crop production.

As Adhikari and Agrawal (2013) noted, PES schemes are multi-dimensional targeting the improvement of more than one outcome. Thus, a focus on watershed management is likely to lead to continued provision of ecosystem services and improvement of land production and thereafter crop production as well. The first target of promoting adoption of land use interventions was successful as

reported by Kagata et al. (2018). Accordingly, about 60 and 90 percent of farmers adopted various types of land use interventions during and after PES scheme respectively. The findings revealed further that, while the percentage of farmers who adopted agro-forestry, reforestation, and grass strip farming practices increased after PES scheme, it was different for bench terraces. Therefore, this scenario influenced the need of assessing the impact of land use interventions on crop production. Specifically, the study (i) compared crop production before, during, and after the phasing out of the PES scheme and (ii) determined the factors influencing crop production.

The theoretical foundations of PES lies in the major principal of theory of change which tries to describe the process of social change by making explicit the perceived current situation, its underlying causes, the long term change desired, and the things that need adjustment for the change to happen. Weiss (1995) describes the theory of change as a theory of how and why an initiative works. Building on this definition, we have defined the theory of change approach to show the impact of land use interventions on crop production as a study of the links between the adoption of interventions and outcomes. The experienced low agricultural production in many developing countries is a result of different factors associated with farming practices and ecosystem management. This has resulted into the rise of different pressures from researchers, policy makers, and development agencies into focusing attention on what is really causing the current low production of African agriculture (Adekunle and Fatunbi, 2014).

This critical attention of key stakeholders in agricultural development has necessitated the promotion of conservation of natural resources and ecosystems leading to the development of Payment for Ecosystem Services (PES) schemes (Grima, 2016). Therefore, the theoretical framework of this study builds on the overarching principle of PES, which ensures that those who benefit from a particular ecosystem service compensate those who provide it, thus giving them an incentive of continuing doing so. The incentives attached to the PES are a driver for behaviour change among farmers. This is because according to researchers, environmental degradation leading to soil erosion is caused by poor farming practices carried out by farmers (CARE and WWF, 2009; Dickie et al., 2014).

Thus, long-term sustainable environmental management, which is directly linked to good soil fertility resulting into crop production, cannot be achieved

unless farmers adopt new land use interventions promoted by PES. The theory of change helps to not only understand and foster collective thinking regarding the process needed to achieve the desired change but also it helps to engage in a better learning that brings together theory and action. These changes include changes within agricultural production systems and changes in land-use practices, which help to maintain long-term production of ecosystem functions and increase production of agricultural goods, and environmental services, which is the heart of PES scheme.

2.0 METHODOLOGY

The study was carried out in Kibungo Juu ward, in Morogoro Rural District, Morogoro Region, Tanzania where a PES scheme was piloted. The area was selected because of the existence of land use interventions promoted by PES scheme namely bench terraces, agro-forestry farming, grass strip farming, forestation, and low crop production because of land degradation (CARE and WWF, 2008). A cross-sectional research design was employed because the design allows many variables to be incorporated at one specific time (Walliman, 2006**).** Three villages namely, Lanzi, Nyingwa, and Lukenge were randomly selected for this study. about 219 households were selected randomly for questionnaire administration while two focus group discussions (FGDs) of about 7 to 8 participants per village and 7 key informant interviews were conducted using checklists. The composition of participants in FGD based on gender issues in order to allow freedom of expression during discussion whereby in each village two FGDs were composed one for women and another for men separately.. The selection of key informants considered experience and leadership of a particular person in question at an area.

The data collection among others, included production (output per unit land per year) of cassava, maize, beans, rice, and bananas crops basing on three major periods that is before, during, and after the end of the scheme on the same piece of land. Cassava and bananas were measured in boxes commonly known as 'matenga' while maize, beans, and rice were measured in bags of 100 kg each. Furthermore, the type and number of interventions practised per each crop were also collected. Data collected on harvest quantities relied largely on farmers' memory and available records for those who kept records whereby respondents were required to provide data basing on the periods before, during, and after PES scheme implementation.

During data analysis, only those farmers who were not practising the promoted interventions but had adopted them during the scheme implementation were subjected to analysis to find out if there was any change in crop production before, during, and after PES scheme as indicated in Table 4.1. Quantitative data were summarized, coded, and analysed using Statistical Package for Social Sciences (SPSS) computer software version 16.0 to obtain descriptive statistics including means and standard deviations of the selected crops before, during, and after PES scheme. Multiple regression was used to assess factors influencing crop production after PES scheme implementation. Since this study satisfied the requirement for multiple regressions, it was used for the analysis to assess factors that influence crop production.

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_{11} x_{11} + \varepsilon_i$$

Where:

y = crop production in bags/boxes measured in kg

β_0 = constant

$\beta_1 - \beta_{11}$ = coefficients

ε_i = Error term

$x_1 - x_{11}$ = Independent variables

x_1 = Marital status of the household head (1= Married, 0 = Unmarried)

x_2 = Sex of the household head (1 = Male, 0 = Female)

x_3 = Age of the household head in years

x_4 = Education level (years of schooling of the household head)

x_5 = Number of interventions adopted by the farmers

x_6 = Adopt bench terraces (1 = Yes, 0 = No)

x_7 = Adopt agro-forestry (1= Yes, 0 = No)

x_8 = Adopt grass strip farming (1= Yes, 0 = No)

x_9 = Access to extension services (1= Yes, 0 = No)

x_{10} = Household labour force size

x_{11} = Years living in the same village by the household head

A one-way repeated measure ANOVA was employed to compare the mean of crop production before, during, and after PES scheme where pairwise comparison was conducted to find out if there was an increase in production. Pairwise comparison

was conducted for crops that showed significant difference in Table 4.1. One-way repeated measure ANOVA is used where the same group of participants is tested in all experimental conditions (Field, 2004). As Field (2004) suggests, repeated measures design make efficient use of participants and thus saving time and money. In this study, one-way repeated measure ANOVA was used because the same respondents were interviewed to give data basing on before, during, and after PES scheme. Qualitative information was analysed using content analysis whereby themes and sub-themes were summarized for interpretation.

As Cohen and Cohen (1983) argue, when choosing to analyse data using a repeated measures ANOVA, part of the process involves checking to make sure that the data can actually be analysed using a repeated measures ANOVA. Firstly, the dependent variable should be measured at the continuous level. In this study, the dependent variable was crop production measured in bags (100 kg per bag per acre) or boxes (50 kg per box per acre) depending on the nature of the crop. Secondly, the independent variable should consist of at least two categorical, "related groups," or "matched pairs." "Related groups" indicates that the same subjects are present in both groups. The same respondents were assessed basing on before, during, and after PES scheme. Thirdly, there should be no significant outliers in the related groups. Fourthly, the distribution of the dependent variable in the two or more related groups should be approximately normally distributed. Fifthly, the variances of the differences between all combinations of related groups must be equal. In this study, these assumptions were checked and found that the method was appropriate for data analysis.

3.0 RESULTS AND DISCUSSION

3.1 Comparison of crop production before, during, and after the PES scheme

The results in Table 1 revealed that production for cassava, maize, beans, rice, and bananas increased during PES scheme. The results indicated that there was an increase in maize production during and after PES scheme. Furthermore, there was a dramatic increase in beans production after PES scheme. However, the results revealed also that rice production decreased after the PES scheme in the study area**.** In addition, there was a small increase in both cassava and bananas production.

Table 1: Results of crop production before, during, and after PES scheme and number of interventions adopted

Crop	Period of PES scheme	n (sample size)	Mean (in bags/ boxes)	Std Deviation	Wilks' lambda value	F	P- value
Cassava	Before PES scheme	126	51.94	5.21	0.98	1.21	0.30
	During PES scheme	126	52.07	14.72			
	After PES scheme	126	53.33	9.15			
Maize	Before PES scheme	132	1.42	0.59	0.29	160.67	0.000**
	During PES scheme	132	2.65	1.36			
	After PES scheme	132	4.65	2.43			
Beans	Before PES scheme	132	1.39	0.56	0.24	202.07	0.000**
	During PES scheme	132	2.70	1.35			
	After PES scheme	132	4.67	2.41			
Rice	Before PES scheme	126	1.22	0.49	0.89	7.74	0.001**
	During PES scheme	126	1.56	0.80			
	After PES scheme	126	1.36	0.57			
Banana	Before PES scheme	124	52.22	5.19	0.96	2.65	0.075
	During PES scheme	124	53.73	13.24			
	After PES scheme	124	54.43	10.19			

**denote significance at 5% level

The results for maize production, as indicated in Table 4.1, revealed that there was a significant difference before, during, and after the PES scheme (Wilks' Lambda = 0.288, F (2, 130) = 160.673, p = 0.000). These results suggest that maize production increased significantly over time as indicated in Table 4.2 which shows a remarkable increase in maize production whereby the change

was significant for all pairs. The increase in maize production was contributed by introduction of PES scheme in the area, which left some benefits to farmers. In this case, poor agronomic practices were the major source of low crop production as compared to high production after the introduction of PES in the study area. This assumption is also supported by one of the key informants from Lanzi village who said, "Farmers are experiencing an increase of maize production in this area as a result of the adoption of interventions promoted by PES." This means that before using the interventions, maize production was low. Similar results are reported by Stanton et al. (2010) and John (2012) who revealed that crop production in some parts of Uluguru Mountains, particularly at Kibungo Juu ward, was low before the implementation of PES scheme. As Kisaka and Obi (2013) observe, if farmers use PES opportunities, they are likely to meet their goals of increasing crop production.

Similarly, results for beans production revealed a significant increase of production (Wilks' Lambda = 0.243, F (2, 130) = 202.067, p =0.000) before, during, and after phasing out of the scheme. As Table 4.2 indicates, the difference was positive implying that beans production increased, which was probably due to the use of bench terraces farming during and after the PES scheme, leaving other factors constant. In this respect, in one of the FGDs held at Lukenge village the following was revealed:

> *"When we started to practise bench terraces in our farms, beans harvest has increased than before" (FGD with farmers at Lukenge, 21st May 2016)*

This means that proper land use interventions have an impact on crop production. Similar observation is made by a key informant at Lukenge Village, who said,

> *"There was an increase of beans production as a result of using bench terrace farming because the steep slope is reduced by the bench terraces thus soil erosion decreases".* FGDs in Lukenge Village *26st June 2016.*

Before PES, many farmers used to grow such crops on steep slopes, which were more vulnerable to erosion (CARE and WWF, 2008). The results on rice production revealed further that there was a significant increase during PES scheme (Wilks' Lambda = 0.889, F (2,124) = 7.736, p = 0.001). Pairwise comparison in Table 2 shows a decrease in rice production after PES, because some farmers abandoned the appropriate practices such as bench terrace farming because of being labour

intensive (Kagata et al., 2018). One of the key informants from Nyingwa village revealed further,

> "*Some farmers continued to grow rice on steep slopes, a situation which led to decrease of production*." KIIs in Nyingwa Village *24st June 2016*

However, for banana crop, there was no significant difference in production (Wilks' Lambda = 0.938, F (2,122) = 2.647, p = 0.075). In the FGDs held at Nyingwa village one of the participants reported,

> "*Many of us did not change our farming practices for some crops such as bananas that is why there is no change in production" (FGD with farmers at Nyingwa, 11st April 2016)*
>
> *This observation is in line with the observation by one of the key informants from Lukenge village, who said, "Farmers who are practising bench terrace farming for crops such as maize and beans had increased production*." FGD's in Nyingwa Village *23st June 2016.*

This means that if farmers could practise these interventions, particularly the bench terraces in the study area, they were likely to increase banana production, other factors remaining constant. Similar observation is made by Obalum et al. (2012) who say that sustainable agricultural practices can increase crop production. The terraces reduce erosion and conserve moisture, which in turn improves soil fertility (Damene et al., 2013). An increase in soil fertility may lead to an increase in crop production.

Cassava production results showed no significant difference in production across the three periods before, during, and after PES (Wilks' Lambda = 0.981, F (2,124) = 1.214, p =0.301). This was because few cassava farmers used the appropriate agricultural practices promoted by the PES scheme as one of the key informants from Lanzi village revealed,

> *"Few farmers implemented the appropriate interventions for cassava crop."* KII in Lanzi Village. *26st June 2016.*

This was also supported by one of the key informants from Nyingwa village who said, if many farmers could use bench terraces on steep slopes cassava

production could increase and thus encourage other farmers into using the promoted interventions.

Table 2: Pairwise Comparisons results for crop production before, during, and after PES scheme

Measure	(I) factor1	(J) factor1	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
Maize	2007	2010	-1.235	0.143	0.000**	-1.581	-0.888
		2015	-3.250	0.233	0.000**	-3.816	-2.684
	2010	2007	1.235	0.143	0.000**	0.889	1.581
		2015	-2.015	0.114	0.000**	-2.292	-1.738
	2015	2007	3.250	0.233	0.000**	2.684	3.816
		2010	2.015	0.114	0.000**	1.738	2.292
Beans	2007	2010	-1.318*	0.120	0.000**	-1.609	-1.027
		2015	-3.280*	0.223	0.000**	-3.820	-2.741
	2010	2007	1.318*	0.120	0.000**	1.027	1.609
		2015	-1.962*	0.271	0.000**	-2.619	-1.306
	2015	2007	3.280*	0.223	0.000**	2.874	3.820
		2010	1.962*	0.271	0.000**	2.741	2.619
Rice	2007	2010	-0.330*	0.086	0.000**	-0.542	-0.125
		2015	-0.135	0.670	0.139	-0.298	0.028
	2010	2007	0.333	0.860	0.000**	0.125	0.542
		2015	0.198	0.890	0.081	-0.017	0.414
	2015	2007	0.135	0.670	0.139	-0.028	0.298
		2010	-0.198	0.890	0.810	-0.414	0.017

Based on estimated marginal means

**. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Note: 2007 = Before PES scheme, 2010 = During PES scheme, 2015 = After PES scheme

3.2 Factors Influencing Crop production in the study area

The multiple regression results in Table 4.3 show that grass strip farming, bench terraces farming, years of living in the same area, extension services, and the size of household work force were statistically significant in influencing crop production in the study area. The type of interventions, particularly bench terraces and grass strip farming practises increased maize production. The number of interventions alone did not have statistical significance in influencing crop production. The evidence that the type of land use intervention rather than the number of implemented intervention influence crop production was supported by participants during FGDs, which showed that bench terraces construction and the use of grass strip farming increased production for beans and maize.

This observation was supported by one of the key informants from Lanzi Village, who said,

> "*Some farmers in the village who decided to grow crops such as beans and maize on bench terraces increased production." KII 26st June 2016*

The findings imply that the adoption of appropriate interventions for a certain crop is what matters**.** Access to extension services was also found to influence crop production because farmers were advised by Agricultural Extension Officers to use proper land use interventions. That is, as farmers get more extension services, there is a possibility to have farmers adopting appropriate interventions and thereby implementing them appropriately, as. One of the key informants said,

> *"PES scheme implementation requires access to extension services for close technical support." KIIst June 2016*

In another FGD at Lukenge Village, one participant had this to say,

> *"Extension officers always assist us to adopt the right interventions in order to increase crop production" (FGD with farmers at Lukenge, 26st June 2016)*

This means that farmers need information about proper farming practices. This is in line with Lambrecht's et al. (2014) observation that access to information through extension agents and programmes not only increases farmers' awareness

about improved technologies but also facilitates access to quality information that is more appropriate and adaptable to their local conditions.

Table 3: Factors that Influence Crop production

Input variable	Coefficient (β)	Standard error	t	Sig.
(Constant)	0.252	0.154	1.641	0.104
Agro-forestry	-0.026	0.039	-0.670	0.504
Grass strip farming	0.339	0.058	5.860	0.000**
Sex	-0.073	0.044	-1.660	0.099
Age	0.000	0.001	-0.679	0.499
Education level	0.004	0.005	0.801	0.425
Marital status of the household head	-0.012	0.041	-0.304	0.761
Extension services	0.090	0.041	2.206	0.029
Household labour force size	0.229	0.058	3.941	0.000**
Years living in the same area	-0.011	0.002	-5.652	0.000**
Bench terraces farming	0.565	0.054	10.488	0.000**
Number of interventions adopted	-0.001	0.031	-0.041	0.968

Residual DF =118, R^2 = 0.839, Adjusted R^2 = 0.821, Std error estimate = 0.208, RSS = 5.087

**Significant at 5%

Years of living in the same area was found to influence crop production negatively because number of years of the farmer living in the same area reduces the probability of adopting new agricultural practices. In one of the FGDs, it was reported that,

> *"We were born in this area and we used to cultivate on the slopes without the use of bench terraces, we cannot use them unless there is an additional benefit to convince us (FGD with farmers at Lanzi, 15th April 2016)*

This means that farmers who are still living in the same place of birth, convincing them is difficult. These results are in line with the results in a study by John (2012) revealing that the number of years a farmer lived in the same area is likely to influence the adoption of new agricultural practices negatively. Household labour force influenced the chances of farmers' adoption of new agricultural practices, particularly the bench terraces farming, and this in turn influences crop production. This means that households with more labour force were more likely

to adopt interventions, especially labour-intensive ones such as bench terraces farming. One of the participants of FGDs at Nyingwa village had this to say,

> *"In order to implement land use interventions promoted by PES scheme such as the bench terraces farming, enough labour force is needed because they are labour intensive." (FGD with farmers at Nyingwa, 11st April 2016)*

The majority of households had an average of two people who could work on the farms. This made it difficult to implement some of the proposed interventions such as bench terraces, which are labour intensive as it was revealed by one of the key informants in the study area.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Generally, the study found an increase in crop production for beans and maize during and after PES scheme intervention. The findings revealed further that farmer who practise bench terraces and grass strip farming were likely to report experiencing higher crop production than was the case with their counterparts. Other factors such as access to Agricultural Extension Officers, enough work force in the farming households were among the significant factors for increased crop production. Thus, the study concludes that farmers realise that the PES scheme was beneficial in terms of crop production because of adopting land use interventions promoted. Therefore, basing on this argument, this study recommends that Department of Agriculture at the district level should encourage farmers to adopt proper land use interventions so that they can get short term benefits direct from farming practices.

REFERENCES

Adekunle, A.A. and Fatumbi, A.O. (2014). A New Theory of Change in African Agriculture. Middle-East Journal of Scientific Research 21 (7), pp.1083-1096.

Adhikari, B. and Agrawal, A. (2013). Understanding the Social and Ecological Outcomes of PES Projects: A Review and an Analysis. Conservations 11: pp.359-74

Amsalu, A. and de Graaff, J. (2007), Determinants of adoption and continued use of stone terraces for soil and water conservation in an Ethiopian highland watershed. Ecological Economics 6: pp.294 – 302.

Bagoora, F.D.K. (1988). Soil erosion and mass wasting risk in the highland areas of Uganda. Mountain Research and development 8 (2/3): pp.173 – 182.

Bernoux, M., Bockel, L., Rioux, J., Tinlot, M., and Braimoh, A. (2011). Carbon sequestration as an integral part of watershed management strategies to address climate change issues. Policy brief.19p.

CARE and WWF (2008). Household survey conducted in Kibungo sub-catchments. EPWS Phase II. CARE International in Tanzania and World Wide Fund for Nature in Tanzania. Dar es Salaam. 56p.

CARE and WWF, 2009.Equitable Payments for Watershed Services in the Uluguru Mountains in Tanzania: Making progress on slippery slopes. CARE International in Tanzania and World-Wide Fund for Nature in Tanzania. Dar es Salaam. 122p.

Cohen, J. &Cohen, P. (1 9 8 3). Applied multiple regression correlation analysis for the behavioral sciences (2nd edn). New York: Erlbaum.44p.

Damene, S.,Tamene, L. and Vlek, P. L. G. (2013). Performance of exclosure in restoring soil fertility: A case of Gubalaftodistrictin North Wello Zone, Northern Highlands of Ethiopia.Catena 101: pp.136 –142.

Dickie, A., Streck, C., Roe, S., Zurek, M., Haupt, F., Dolginow, A. (2014). "Strategies for Mitigating Climate Change in Agriculture: Abridged Report." Climate Focus and California Environmental Associates, prepared with the support of the Climate and Land Use Alliance. 38p.

Dubale, P. (2001). "Soil and water resources and degradation factors affectingproduction in Ethiopian highland agro-ecosystems. Northeast African Studies 8, pp.27–52.

Engel, S., S. Pagiola, and S. Wunder (2008). Designing payments for environmental services in theory and practice: an overview of the issues. Ecological Economics 65: pp.663 – 674.

Eswaran, H. Lal, R and Reich, P. F(2001).Land degradation:anoverview.In Response to Land Degradation (Edited by E.M.Bridges,I.D.Hannam, L. R. Oldeman,

F. W. T. Penning de Vries, J. S. Scherr,and S. Sombatpanit), Science Publisher, Enfield,NH, USA pp. 20 - 35

FAO (2011). Payments for environmental services. What role in sustainable agricultural development? ESA Working paper No. 11-20. 24pp.

Field, A. P. (2004). Discovering Statistics Using SPSS: Advanced Techniques for the Beginner (Second Edition). London: Sage, 77p.

Grima, N., Singh, S., Smetschka, B. and Ringhofer, L. (2016). Payment for Ecosystem Services (PES) in Latin America: Analysing the performance of 40 case studies. Ecosystem Services 17: pp.24–32.

John, I. (2012). How successful has payment for environmental services improved welfare? Dissertation for Award of MA Degree at University of Dar es Salaam, Tanzania. 99pp

Kagata, L., Mombo, F. and Massawe, F.A. (2018). Payments for Ecosystem Services Incentives and Adoption of Land Use Interventions in Uluguru Mountains, Tanzania. Agricultural Sciences 9: pp.299-316.

Kisaka, L. and Obi, A. (2015). Farmers' Preferences for Management Options as Payment for Environmental Services Scheme. International Food and Agribusiness Management Review 18 (3): pp.1-22.

Mahenge, J. (2014). Comparative economic analysis of conventional and conservation agricultural practices in southern Uluguru Mountains, Morogoro, Tanzania. Dissertation for Award of MSc Degree in Agricultural and Applied Economics of Sokoine University of Agriculture, Morogoro, Tanzania,73pp.

Noor Mohammdad and Singh, R. (1981). Measurement of Crop production, perspectives in Agricultural Geography, Concept Publishing Company (4): 159pp.

Obalum, S.E, Mohammed, M. B. John, C. N., Yoshinori, W., Charles A. I.and Toshiyuki, W. (2012). Soil Degradation-Induced Decline in production of Sub-Saharan African Soils: The Prospects of Looking Downwards

the Lowlands with the Sawah Ecotechnology. Journal of Applied and Environmental Soil Science (1) :pp.1-10

Stanton, T., Echavarria, M., Hamilton, K. andOtt, C. (2010). State of watershed payments: an emerging marketplace. Ecosystem Marketplace. 78p.

Waage, S., Scherr,S.,Jenkins, M.andInbar, M (2006).A scoping assessment of current work on payments for ecosystem services in Asia, Latin America, and East and Southern Africa, Forest Trends.80p.

Walliman, N. (2006). Social Research Methods.Sage Publications, London and Thousand Oaks, New Delhi, India. 224p.

World Bank (2008). World Development Report (2008). Agriculture for Development. The International Bank for Reconstruction and Development/The World Bank. Washington, D.C. [http://siteresources.worldbank.org/INTWDR2008/Resources/WDR_00_book.pdf] site visited on 10th July, 2018.

Weiss, C. H. (1995). Nothing as Practical as Good Theory: Exploring Theory-based Evaluation for Comprehensive Community Initiatives for Children and Families. In: New Approaches to Evaluating Community Initiatives: Concepts, Methods, and Contexts, ed. James Connell et al. Washington, DC: Aspen Institute. 87p.