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Livelihood Impact of Carbon Sequestration on Local Communities: A Case of Ethiopia Nature Regeneration Project in Wolaita, Ethiopia

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LIST OF ABBREVIATIONS AND ACRONYMS

CDM	Clean Development Mechanism
ETB	Ethiopia Birr
JFM	Joint Forest Management
KAs	*Kebele*s Administration
NTFP	Non Timber Forest Products
SNNPRS	Southern Nations Nationalities and Peoples Regional State
THPs	Traditional Health Practitioners
TLU	Tropical Livestock Unit
UNFCC	United Nations Framework Convention on Climate Change

Abstract
A number of carbon sequestration projects were being implemented worldwide to address environmental and economic issues simultaneously. This research paper describes research concerning a carbon sequestration project in Humbo district in Ethiopia. The central research question is: Do the project activities result in improved socio economic aspects of small holder farmers in the area? Questionnaire-based household surveys were the main source of data. Data was collected from 130 randomly selected households by using probability proportional to household size. The key results are as follows.1) Participant households used fodder, fuel wood, medicinal plants, honey and wax forest resources and financial benefit from the project for their livelihood and forgone charcoal, fuel wood, grazing land and poles. 2) Project participation is among determinants of household income. 3) Participant households were different in household head age, family size, per capita expenditures for clothing and footwear as a proxy of per capita income and the numbers of main meals including animal protein (i.e. poultry and beef) during the last seven days taken by participant households were higher than non participant households.

INTRODUCTION

Background

Dry tropical forest is the most widely distributed habitat type in the tropics covering 42% of all tropical vegetation (Jaramillo *et al*, 2003). Dry forests typically have lower biomass densities than moist or wet forests, but store a significant amount of biomass carbon because they cover large areas. These ecosystems have become increasingly threatened by human intervention: a greater proportion of dry forests have been degraded or cleared than moist forests (Robertson *et al.*, 2004; Jaramillo *et al.*, 2003).

The driving forces to this are poverty, hunger and increasing demand for agricultural land that leads local communities to over - exploit the forest resources. Forests surrounding Humbo, located 430 kilometers south - west of the Ethiopian capital, Addis, were largely destroyed by the late 1960s and across Ethiopia less than four percent of native forests remained recently (Secretariat of the Convention on Biological Diversity, 2008).

It is widely accepted that smallholder, community - based projects can help to alleviate rural poverty (Tipper, 2002). Based on this understanding, a program of community agroforestry employing a process of community managed natural regeneration project was established in Humbo with a focus on Carbon Sequestration to contribute to global climate change reduction activities through concerns on local community livelihood options. This study examined the case of Humbo project to discuss the contention that forest carbon sequestration related project can significantly improved the economic and social aspects of local communities and direct linkages between the carbon protection and development activities.

LITERATURE REVIEW

Land use change and the greenhouse effect

Concerns about human driven global warming and deforestation trends have motivated scientific efforts to quantify the role of forests in the global carbon cycle and political efforts to make forest preservation more socio-economically attractive (Brown, 1997; Houghton, 1997; Watson *et al*., 2000).

Human activities that produce atmospheric carbon include fossil fuel burning, biomass burning and land cover changes. Because CO_2 gas traps heat in the earth's atmosphere like a blanket, significant increases in atmospheric carbon are believed to impact the earth's climate.

The majority of the recent increase in atmospheric carbon can be attributed to fossil fuel burning, it was estimated that land-use change, primarily the loss of forest cover, was responsible for 20-30% of the net increase over the last 20 years (Houghton, 1997).

Plants remove carbon dioxide from the atmosphere and use this carbon to build their biomass during photosynresearch paper. As a result, 50% of a plant's dry biomass is comprised of carbon. Forests, with their high density of woody vegetation, have much greater biomass than other vegetation cover types and hence store more carbon. Forests also maintain large stocks of carbon rich organic matter in their soils due to constant litter and deadwood production and relatively slow decomposition. Therefore, forests store large amounts of terrestrial carbon per unit area. In addition to storing carbon, forests may also act as **carbon 'sinks'** if the rate of carbon sequestration from plant growth exceeds the rate by which biomass carbon is returned to the atmosphere through natural decomposition and/or biomass burning.

As forests are converted to less carbon rich land cover types, such as agricultural fields or urban areas, much of the carbon stored in forest biomass and soil is released into the atmosphere and a potential carbon sink is lost. Globally, an estimated 13 million hectares of tropical forest was lost each year to deforestation (FAO, 1999) emitting between 5.6 and 8.6Gt[1] of carbon (Houghton *et al*., 1995). Preventing further deforestation and encouraging forest regeneration not only preserves biodiversity and other local ecosystem services, but also mitigate global climate change by preventing the carbon stored in trees and soils from being released into the atmosphere. In addition, **reforestation** and **afforestation** activities could attract funds for sustainable development from emerging international carbon markets.

Livelihood impacts of carbon projects

Under the CDM, industrialized countries can invest in the carbon sequestering activities in developing countries in return for carbon offsets that count against emission reduction targets specified by the Kyoto Protocol (UNEP, 2002). Investments in the form of carbon sequestration projects thus represent valuable financial inflows for developing countries. Experience also suggests that, if undertaken with small land holders, carbon sequestration projects can help alleviate rural poverty and improve local livelihoods in developing countries (Tipper, 2002). Carbon sequestration projects may thus provide a win–win situation between environmental conservation and increased opportunities for economic development in poor countries (UNEP, 2002).There are few studies on Africa on livelihood impact of carbon projects on local communities.

Jindal (2004) found that the carbon Project proved to be beneficial to the local community by providing regular source of income in the form of carbon payments, raise the productivity through agroforestry and generate alternate means of livelihoods such as selling of non-timber forestry products. However, he forecasted the project may also introduce economic disparities amongst the households, which could create resentment and local unrest.

Other study in Uganda by Sarah (2009) the Plan Vivo project was found to be accessible to poor small scale landholders, and that barriers to entry would only affect a very small proportion of potential participants. In addition to the payments for carbon sequestration, the project was found to have multiple benefits which it brings to participants, which contribute to food and fuel security at the household level and the project provides social and human capacity building.

Humbo carbon project is providing the direct and indirect economic and social benefits to local communities (Douglas *et.al,* 2010). This study aims to look the impact of benefits on livelihood of local communities.

Significance of the study

In recent years, carbon sequestration in the form of forestry projects has evolved into a viable alternative to tackle global warming and climate change. As per the Third Assessment Report of the Intergovernmental Panel on Climate Change forests, agricultural lands, and other terrestrial ecosystems offer significant carbon mitigation potential (IPCC, 2001). The report states that in addition to reduction in atmospheric carbon dioxide, such projects may also provide other social, economic and environmental benefits such as sustainable land management and rural employment. However, if implemented inappropriately, they may pose risk of adverse impact like community disruption. Further, such projects could only become sustainable if

[1] Giga tone

the socio-economic drivers for deforestation and other losses of carbon pools are addressed. Therefore, an understanding of socio-economic processes, particularly the potential benefits and impacts of carbon sequestration projects, is essential before they are recommended for wider replication.

Statement of the Problem

The Wolaita zone represents one of the major food deficit and famine-prone parts of Ethiopia. Food insecurity, poverty and vulnerability to livelihood crises have increased in the zone since the drought years of the middle 1980s and early 1990s (Rahmato, 1992 cited in Ayele, 2008). As part of Wolaita zone Humbo district is one of food insecurity areas where the people are dependent on food aid mainly during crop failure and among the most populated areas in the country (CSA, 2005).

With aim of alleviating rural poverty community - based project was implemented in Humbo. There is a need to conduct quantitative and qualitative analysis of the socio-economic impact of projects. Specific to Humbo project, Douglas *et al*. (2010) stated that the project is providing direct benefits such as fodder, firewood, wild fruits and other non-timber forest products and also farmers are using agroforestry for both environmental restoration and income generation to local communities. But there is no study in the area that analyzed quantitative and qualitative socio economic impact of the project in local communities. Thus there is an urgent need to evolve a framework that could be used to measure the actual quantitative and qualitative impact of carbon sequestration project on local communities.

Objectives

- To estimate households' average annual tangible benefits received from the project and forgone due to the presence of the project.
- To analyze the impact of project participation in households income.
- To compare of socio-economic situations of the two communities based on welfare indicators.

Hypothesis.

- Participation of household in the project is a significant factor of income for communities in the research area.
- There is a significant socio economic situation difference between target communities and control communities.

METHODOLOGY

Study Site Description

The study was carried out in Humbo District, Wolayita zone, South Western Ethiopia which is located 430 kilometres southwest of Addis Ababa, Ethiopia. The district is one of the 12 districts in Wolaita zones of SNNPR. Geographically, it is located at $6^0$43'44 N latitude and $37^0$45'51''E longitude with an altitudinal ranges between 1500-2500ma.s.l (SNNPRBoARD, 2007).

Sampling Procedures

Humbo *district* was selected purposively by considering the existence of carbon sequestration project (World Vision Ethiopia) in the *district*.

For sampling, a rule-of-thumb that $N \geq 50 + 8$ m, where N is minimum number of households and m is explanatory variables, was used (Green, 1991). Thus, a total of 130 farm households were selected randomly using proportional to sample size sampling techniques. Using primary and secondary data sources data collected from sampled households.

Data analysis

Descriptive statistic analyses like means, frequencies, percentages and standard deviation were used. And also to compare the two survey group t-tests for independent samples was implemented with the respective variables. Additionally to assess the effect of project participation on household's income econometric model, multiple linear regression model, was constructed and tested. Significance level chosen was α=0.01, 0.05 and 0.1. Where dependent variable was farmers' annual income (Yi) and the independent variables were factors affecting household annual income (Xi) with special consideration of household participation on project. The model took the following form (Gujarati, 2004);

$$Yi = \beta Xi + \varepsilon i$$

Where

Let Yi = i^{th} respondent's size of annual income.

X_i= observable attributes of the respondent income factors.

β = a coefficient for independent variables.

εi = unobservable random component distributed N (0, ε)

A method of Variance Inflation Factor (VIF) was employed to detect the problem of multicollinearity. Additionally, the presence of heteroskedasticity was checked by using the Breusch-Pagan (BP) test.

Variable and justifications

Table 3: Justifications of variables included in the econometric model.

Variable code	Description	Types of variable	Unit of measurements	Expected sign
TOTALANUALCASHIN	Total household annual income	Continuous	Measured in Birr	
PART	Household participation on project	Discrete	1=participant,2=nonparticipant	+
SEX	Sex of household head	Discrete	1=Male,2=Female	+/-
AGE	Age of household head	Continuous	Measured in years	-
FAMSIZ	Family size	Continuous	Number	+/-
EDUC	Household head education level	Discrete	1=primary, 0=illiterate,2=secondary,3=tertiary	+
LANDHSIZ	Total land holding of household head	Continuous	Measured in hectare	+
TLU	Livestock holding of a household head	Continuous	Measured in tropical livestock unit (TLU)	+
LANDSEC	Land tenure security	Discrete	1=secured,0=not secured	+
MTKACC	Access to market service of household head	Discrete	1=very good,2=good,3=fair,4-bad,5=no access	-

Result and Discussion

Households tangible benefits received and lost by carbon project

Households residing around the project area obtained and forgone different forest products and other benefits from participating in the project. They received fodder, fuel wood, financial, medicinal plants and edible things like honey and forgone fuel wood, charcoal and poles for different activities. Households used these products as sources of income and for household consumption. Before the implementation of carbon project Charcoal was the major sources of income for the sampled respondents. Generally in the area fuel wood, fodder, poles, medicinal plants and honey were used for household consumption. Douglas *et al*. (2010) indicated communities were able to harvest fodder and firewood within a year of project initiation and wild fruits and other non-timber forest products. The forest is the major source of their livelihoods and subsistence by providing them with a variety of NTFPs. Many rural dwellers in tropical regions depend on NTFPs for their livelihoods and their cash needs (Ndoye *et al.*, 1998).

The degree of involvement of households in the production and use of different NTFPs varied. 61.84%, 47.37%, 46% and 1.4% of the households obtained fodder, fuel wood, medicinal plants and honey products, respectively. Ermias (2011) reported that 72%, 100%, 18%, and 52% of the respondent households in southwest Ethiopia were engaged in fodder, fuel wood, honey and medicinal plant. In this study, higher percentage (61.84%) of sampled respondents reported that they received fodder from the forest.

Sampled households harvested on average 222 man load of fodder, 236 man/women load of fire wood, 70 kg of honey and visited 5 times THPs for medicinal plant per household per year. The present finding is not consistence with Ermias (2011) who revealed that on average the user households in Bonga forest area, South West Ethiopia extract considerable amount of different NTFPs such as, 7 man/women load fodder, 28 load fuel woods, 6kg honey per year and visited 4 times THPs for medicinal plants, respectively. The average values obtained by sampled households were Birr 5559.57, 4716.67,1350 and 840 from fodder, fuel wood, honey and medicinal plants, respectively. The findings from this study on the estimated monetary values of these NTFPs were quite different from those of Ermias' who reported income of Birr 91.00, 5840.00, 2421.60 and 824.80 from the production of fodder, fuel wood, honey and medicinal plants, respectively in Bonga forest, Southwest Ethiopia. Additionally, studies from various parts of India show that income from non timber forest products (NTFP) averaged $280(about 4928 Birr) per household per year (World Bank Task Team, 2001) which is also different from current study.

In addition to above NTFPs, participant households received direct financial benefit in the form of

participating in training prepared by project. About 47.39% of participant respondents participated in the training and received 275.84 Birr on average. This finding is different from Sarah (2009) of 415,004 USH in average of Uganda and also from Hedge *et.al.* (2009) on performance of an agro-forestry based payments for environmental services project in Mozambique, the total amount of cash payment received by households was not very high (on average about MTS 1,498,933 for participating households, which is equivalent to US$60 per year). However, the finding is in conformity with other Wunder (2008) that PES-like schemes in Bolivia generated an annual income of US$17 to US$640 per household.

Regarding to forgone forest products 22.36%, 100%, 10.5% and 40% of households engaged in charcoal, fuel wood, pole collection and grazing activities in forest previously, respectively. Apart from grazing and pole collection, current finding is in line with Hedge and Bull (2009). The estimated values of these products were Birr1815.63, 7200, 663.75 and 2250, respectively. Rather than its total value, this finding is similar to cases happened in India's JFM program in loss of benefits, which affected most poorer households and women by restricting forest product extraction during the regeneration period (Sundar, 2000).

Additionally, according to Erker (2000) commercial plantations project in Uganda has barred local households from harvesting any timber or other NTFPs that resulting in loss of income for the entire community. Present study has similar effect with Erker (2000) in barring timber and certain NTFPs like charcoal, pole and grazing.

The impact of carbon project participation on household income

There are various socio-economic conditions that affect the household's income in rural community. Variables that showed a significant difference in the current study for household income were being participant in carbon project, education, total land holding, livestock owned and family size.

Table 9: Factors affecting household income

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
(Constant)	40.035	2867.389		.014	.989
PART	1422.046	770.291	.128	1.846	.067*
SEX	370.533	1367.942	.017	.271	.787
AGE	-10.933	35.311	-.022	-.310	.757
FAMSIZ	380.975	219.924	.136	1.732	.086*
EDUC	1550.033	397.265	.265	3.902	.000***
LANDSIZ	3530.357	496.301	.486	7.113	.000***
TLU	837.222	234.055	.260	3.577	.001***
MKTACC	-369.271	444.171	-.056	-.831	.407

N = 130, R^2 = 0.548 Adjusted R^2 = 0.518, F=18.360***

Correctly predicted percent = 54.6, N = 130

* and *** represent statistical significance at 10 ,5 and 1%, respectively

Jindal (2004) and Sarah (2009) stated that household participation on carbon project has positive effect on household income. And also Douglas *et al.* (2010) stated that Farmers in project area are using agroforestry for both environmental restoration and income generation. These findings are in line with the current study. The positive effect of participation in carbon project is may be due to direct and indirect provision of financial incentive for participants.

Educated farmers have been found to have greater likelihood of adopting soil conservation technologies (Ervin and Ervin, 1982) so that it is correlated positively with household income as found in the present study. The finding is also similar with Jehovaness (2010) that states the higher the level of education of rural household head, the higher the household per capita income. This is may be due to education leads to proficient household management and, crucially, improves economic performance of the household as a whole. Additionally in agricultural activities, household heads with relatively higher education are more likely to have skills and opportunities to successfully diversify into other, more lucrative, income generating activities.

According to Omades (2010) farm size has positively correlated with household income, which is in line with current study. Land is a single most important resource in rural farm production. The positive effect was because farmers with large fields operate with better economics of scale with regards to supervision management and capital investments; these in turn lead to higher returns (Olomola, 1988 cited in Omades, 2010).

Mohammed Adilo (2007) revealed that livestock holding positively affected household income, and

this finding confirms with this. The positive effect of livestock asset ownership on household income is may be because livestock's are one means of income source in rural area. Households in the research area use animals and animal products for consumption as well as income source.

Similarly as obtained in current study Hedge (2010) revealed that family size has positive relation with household income. Larger households have larger amount of labor available, which is necessary for different productivity activities like agriculture so that there would have high income.

Welfare difference between nonparticipants and participants in carbon project

In order to look socio-economic and changes in welfare various variables of household characteristics, welfare indicators like land, livestock, assets, agricultural income, per capita expenditures for clothing and footwear and access to services and food security are selected for comparison of two groups.

Thus, there are some statistically significant differences between the participants and the non-participants, in this respect variables that showed a significant difference in the current study were household head age, family size, per capita expenditures for clothing and footwear as a proxy of per capita income and the number of main meals including animal protein (i.e. poultry and beef) during the last seven days from food security.

Household age in participant group is greater than that of nonparticipants. The current finding is not consistence with Hedge (2010) who revealed that house hold head age is not significant factor of participation in carbon project, however, age showed positive relation with participation. This may be due to as age of household head increases the awareness on different development programs also increases.

In comparison the participant households were larger in size than nonparticipant which is in line with Hedge (2010) who revealed that the total house hold member in participants in an agroforestry based payments for ecosystem services project in Mozambique are less than that of nonparticipants.

Hedge and Bull (2009) estimates of the project impact on the consumption expenditure (i.e. total of expense on food-grains, vegetables, meat, cooking oil, cloths, etc.) per capita, which is a proxy for income, statistically significant difference across two groups. Present finding also showed similar result, the per capita expenditures for clothing and footwear as a proxy of per capita income for participant households is quietly higher than nonparticipant households. This means that the target groups incurred more consumption expenditure than what they would have, had they not participated in the project.

Similarly, the number of main meals including animal protein (i.e. poultry and beef) in last seven days is greater in target group than control group, which is not consistent with Loos (2009). It is in line with Hedge (2010) who revealed that fishing was a major activity in participant area, but that was not due to the effect of carbon project, rather availability of fish in the area. In present study this was happened may be due relatively better financial performance of participant households.

Summary and Conclusions

Residents around forest obtained and forgone various NTFPs and other benefits in participating nature regeneration project. Fodder, fuel wood, medicinal plants, honey and financial benefits are among the main benefits received and estimated in average Birr 5559.57, 4716.67, 275.84 and 2190 respectively per household per year. Charcoal, fuel wood, poles and grazing land are the main benefits forgone and estimated in average Birr 1815.63, 7200, 663.75 and 2250 respectively per household per year.

Beside the estimation of benefits received and forgone, result also showed the impact of household's project participation on their annual income. Based on the study's econometric analysis, the following variables were found to be in determining household income in Humbo district: carbon project participation, level of education, land size, family size and animal ownership significant at 0.1, 0.01, 0.01, 0.05 and 0.05, respectively. Project participation and other determinant factors of income like education of household head, land size, family size and livestock ownership had a positive impact on income at 0.1, 0.05 and 0.01 significance level.

There is also socio-economic and welfare difference between participants and nonparticipants in Humbo nature regeneration project. Among various variables, variables that showed a significant difference were household head age, family size, per capita expenditures for clothing and footwear as a proxy of per capita income and the number of main meals including animal protein (i.e. poultry and beef) during the last seven days. Thus participant households showed significantly higher magnitude in these variables.

Recommendations

- Increased investment on health center (especially animal health center) also needed to sustain livestock contribution to income.
- Greater investment in education and training in rural areas to improve the capacity of the labour force, and to equip young people with the knowledge and skills to secure good livelihoods.
- Finally, in design, promotion and implementation of activities related to increase rural household participation on project to secure benefits differences on household head age and family size should be considered.

REFERENCES

Austin D, Faeth P, Seroa da Motta R, Young C, Ji Z. and Junfeng L. (1999) How much sustainable development can we expect from the clean development mechanism? World Resources Institute, Washington, DC

Ayele ,T.,2008. Livelihood Adaptation, Risks and Vulnerability in Rural Wolaita, Ethiopia. PhD Research paper. Norwegian University of Life Sciences, Norway.

Brown K, Corbera E (1997) Exploring equity and sustainable development in the new carbon economy. Climate Policy.

Central Statistical Agency of Ethiopia, 2005 .Ethiopia Demographic and Health Survey. Addis Ababa, Ethiopia.

Douglas R. , Dettmann ,T., Rinaudo,T., Hailu ,T., Assefa,T., 2010. Poverty Alleviation and Environmental Restoration Using the Clean Development Mechanism: A Case Study from Humbo, Ethiopia.*Journale of Environmental Management,* 48:322–333.

Eraker, H., 2000. CO2lonialism in Uganda. *NorWatch Newsletter*. No. 5, 2000. http://www.norwatch.no/index.php. [Accessed17th July 2004]

Ermias Melaku,2011. Contribution of non-timber forest products to the household economy in bonga forest area, south west Ethiopia M.Sc. Research paper. Hawassa University, Ethiopia.

Ervin, C.A., Ervin, D.E., 1982. Factors affecting the use of land conservation practices: hypotheses, evidence and policy implications. *Land Econ*. 58, 277–292.

FAO - Food and Agricultural Organization, (1999). *State of the World's Forests.* Rome: United Nations Food and Agricultural Organization.

Gujarat D.N. (2004). *Basic Econometrics*. Fourth edition. New York. The McGraw−Hill Companies

Hedge, R., and Bull, G.Q. 2009. Performance of an Agro-forestry based Payments-for-Ecosystem Services Project in Mozambique: A Household level Analysis. Unpublished manuscript, Faculty of Forestry, University of British Columbia, Vancouver.

Hedge, R., Bull, G.Q., and Northway, S. 2009. Income Shocks and *Miombo* Woodland Resource Use: A household level study in Mozambique, Unpublished manuscript, Faculty of Forestry, University of British Columbia, Vancouver.

Houghton, J., 1997. *Global Warming: the Complete Briefing*. 2ed. Cambridge: Cambridge University Press.

Houghton, J., Ding,Y., Griggs,D.,M., Noguer,M., van der Linden,P.G., Dai,X., Maskell,K., C.A. Johnson,C.A., *Climate Change 1995: The Science of Climate Change: Contribution of Working Group 1 to the Second Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge: Cambridge University Press

IPCC (Intergovernmental panel on climate change), 2001. *Climate Change 2001: Synresearch paper Report*. A Contribution of Working Groups I, II and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Watson, R.T. and the Core Writing Team (eds.)]. Cambridge University Press, Cambridge, UK, and New York, USA.

Green S. B. (1991). How Many Subjects Does It Take To Do A Regression Analysis? *Journal of Economics*, 26 (3), 499-510.

Jaramillo, VJ**.**, R. Ahedo-Hernández, R., and J.B. Kauffman, 2003. "Biomass, Carbon, and Nitrogen Pools in Mexican Tropical Dry Forest Landscapes". *Ecosystems* 6: 609-629

Jehovaness A., 2010.Determinants of rural income in Tanzania: An Empirical Approach. Research approach 10/4, Dares salaam, REPOA

Jindal R, Swallow B, and Kerr J (2008) Forestry-based carbon sequestration projects in Africa: potential benefits and challenges. Natural Resources Forum 32:116–130

Jindal, R., 2004. Measuring the socio-economic impact of carbon sequestration on local communities: An assessment study with specific reference to the Nhambita Pilot Project in Mozambique. (unpub.) University of Edinburgh, UK. Available at: www.miombo.uk.org/research.html. [Accessed10th Jun 2009]

Jindal, R., B. Swallow, J. Kerr J., 2006. Status of Carbon Sequestration Projects in Africa: Potential Benefits and Challenges to Scaling Up. WP 26. World Agroforestry Centre, Nairobi.

Loos, Tim Kagiso, 2009. Socio-economic Impact of a Jatropha-Project on Smallholder Farmers in Mpanda, Tanzania: Case Study of a Public-Private-Partnership Project in Tanzania. Master Research paper, University of Hohenheim, Institute for Agricultural Economics and Social Sciences in the Tropics and Subtropics

Mohammed Adilo (2007).The contribution of non-timber forest products to rural livelihood in Southwest Ethiopia. M.Sc. Research paper. Wageningen University, Netherland.

Ndoye O., Pérez M. R. and Eyebe A. (1998).The Markets of Non-Timber Forest Products in the Humid Forest Zone of Cameroon. Rural Development Forestry Network Paper 22c, London

Omades Ope, 2010. Determinants of income among farm households in Orlu Agricultural Zone of Imo State, Nigeria.Federal University of Technology,Nigeria, Imo State, IBEKWE.

Richards M (2003) Poverty reduction, equity and climate change: challenges for global governance. The Overseas Development Institute, London, Natural Resource Perspectives, Number 83

Robertson, K, Loza-Balbuena, I, & Ford-Robertson, J (2004) "Monitoring and economic factors affecting the economic viability of afforestation for carbon sequestration projects." *Environmental Science & Policy* 7 (6): 465-475

Sarah C., 2009. Socio-Economic Benefits In Plan Vivo Projects: Trees For Global Benefits, Uganda.

Secretariat of the Convention on Biological Diversity (2008) Ethiopia— overview. http://www.cbd.int/countries/?country=et. Accessed 16 December 2009.

SNNPRBOARD (Southern Nations Nationalities and Peoples Region Bureau of Agriculture and Rural Development). 2007. Annual Report of Agriculture and Rural Development Bureau. Southern Nations Nationalities and Peoples Region, Hawassa, Ethiopia.

Sundar, N. (2000). Unpacking the ''joint'' in joint forest management. Development and Change, 31(1): 255–279.

Taayab N (2006) Exploring the market for voluntary carbon offsets. IED, London

Tipper R (2002) Helping indigenous farmers to participate in the international market for carbon services: the case of Scolel Te. In: Pagiola S, Bishop J, Landell-Mills N (eds) Selling forest environmental services: market-based mechanisms for conservation and development. Earthscan, London

UNEP (United Nation Environment Program), 2002. The clean development mechanism. United Nations Environment Programme (UNEP) Collaborating Centre on Energy and Environment, Risø National Laboratory, Roskilde,Denmark.

Watson, R., Ian R. Noble, Bert Bolin, Ravindranath, N.H., David J. , (2000). *IPCC Special Report on Land Use, Land-Use Change and Forestry*. Cambridge: Cambridge University PressWunder, S., 2008. Payments for environmental services and the poor: concepts and preliminary evidence. *Environment and Development Economics*, 13: 279-297.

APPENDICES

Appendix 1: T-test of selected household characteristics for the two survey groups

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SEX	Equal variances assumed	3.119	.080	.880	128	.380	.03996	.04539	-.04986	.12978
	Equal variances not assumed			.842	94.971	.402	.03996	.04744	-.05421	.13413
DEPENDRTIO	Equal variances assumed	2.194	.141	.069	128	.945	.00202	.02933	-.05601	.06006
	Equal variances not assumed			.071	123.750	.944	.00202	.02855	-.05448	.05853
AGE	Equal variances assumed	.056	.813	3.278	128	.001	6.29971	1.92184	2.49703	10.10239
	Equal variances not assumed			3.259	111.841	.001	6.29971	1.93319	2.46928	10.13013
FAMSIZ	Equal variances assumed	.037	.847	5.190	128	.000	1.64620	.31718	1.01861	2.27379
	Equal variances not assumed			5.170	112.687	.000	1.64620	.31841	1.01535	2.27705
EDUC	Equal variances assumed	.000	.995	.230	128	.818	.03850	.16711	-.29216	.36916
	Equal variances not assumed			.230	113.113	.819	.03850	.16759	-.29353	.37052

Appendix 2: T-test on different welfare indicators for the two survey groups

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
LANDSIZ	Equal variances assumed	.225	.636	-.155	128	.877	-.02087	.13472	-.28743	.24570
	Equal variances not assumed			-.151	104.287	.880	-.02087	.13787	-.29426	.25253
CASHAGRNCME	Equal variances assumed	1.887	.172	.187	123	.852	123.12728	658.184	-1179.7066	1425.961
	Equal variances not assumed			.183	103.419	.855	123.12728	673.085	-1211.7147	1457.969
EXPENCLOTHSHOS	Equal variances assumed	7.156	.008	3.168	128	.002	2423.2042	764.999	909.52370	3936.885
	Equal variances not assumed			3.742	78.291	.000	2423.2042	647.599	1,134.00905	3712.399
TLU	Equal variances assumed	2.737	.100	1.533	128	.128	.46197	.30129	-.13418	1.05812
	Equal variances not assumed			1.582	124.763	.116	.46197	.29208	-.11610	1.04004
TOTASSET	Equal variances assumed	1.617	.206	1.268	128	.207	24428.241	19258.2	-13677.350	62533.83
	Equal variances not assumed			1.180	82.968	.241	24428.241	20707.4	-16758.261	65614.74
VALUEOFHOUS	Equal variances assumed	1.638	.203	1.261	128	.209	24203.850	19186.6	-13760.057	62167.76
	Equal variances not assumed			1.172	82.450	.245	24203.850	20657.5	-16887.203	65294.90
VALUEOTHASS	Equal variances assumed	1.775	.185	.746	128	.457	224.39084	300.665	-370.52590	819.3076
	Equal variances not assumed			.780	127.276	.437	224.39084	287.499	-344.50528	793.2870

Appendix 3: T-test for access to services for two survey groups

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
EDUCACC	Equal variances assumed	.160	.690	.614	128	.540	.07261	.11820	-.16127	.30649
	Equal variances not assumed			.623	119.424	.535	.07261	.11663	-.15832	.30355
HEAACC	Equal variances assumed	.160	.689	1.119	128	.265	.13060	.11674	-.10038	.36159
	Equal variances not assumed			1.142	121.833	.256	.13060	.11437	-.09580	.35700
JOTRNG	Equal variances assumed	.184	.669	1.406	128	.162	.17495	.12441	-.07121	.42111
	Equal variances not assumed			1.456	125.667	.148	.17495	.12012	-.06277	.41267
CREDITACC	Equal variances assumed	3.191	.076	.218	128	.827	.02827	.12943	-.22784	.28437
	Equal variances not assumed			.227	126.623	.821	.02827	.12434	-.21778	.27431
MKTACC	Equal variances assumed	17.607	.000	1.490	128	.139	.21832	.14649	-.07154	.50819
	Equal variances not assumed			1.590	127.660	.114	.21832	.13735	-.05345	.49009
TRANACC	Equal variances assumed	7.531	.007	1.806	128	.073	.16959	.09389	-.01619	.35537
	Equal variances not assumed			1.841	121.429	.068	.16959	.09210	-.01274	.35192
AGREXT	Equal variances assumed	2.390	.125	1.287	128	.200	.17788	.13821	-.09561	.45136
	Equal variances not assumed			1.355	127.852	.178	.17788	.13131	-.08194	.43769
TAPACC	Equal variances assumed	2.909	.091	-.512	128	.609	-.04483	.08749	-.21794	.12827
	Equal variances not assumed			-.536	127.358	.593	-.04483	.08360	-.21025	.12059
SWATACC	Equal variances assumed	.355	.552	1.228	128	.222	.18129	.14763	-.11083	.47340
	Equal variances not assumed			1.214	109.508	.227	.18129	.14931	-.11463	.47720
CONF	Equal variances assumed	.263	.609	1.274	128	.205	.14425	.11319	-.07972	.36822
	Equal variances not assumed			1.278	115.399	.204	.14425	.11288	-.07934	.36784
SECUR	Equal variances assumed	7.739	.006	1.277	128	.204	.11745	.09198	-.06455	.29945
	Equal variances not assumed			1.333	127.046	.185	.11745	.08811	-.05691	.29180
DESCMAKING	Equal variances assumed	2.764	.099	.582	128	.562	.05556	.09547	-.13336	.24447
	Equal variances not assumed			.621	127.582	.536	.05556	.08944	-.12141	.23252

Appendix 4: T-test for food security indicators for the two survey groups

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
NOMEALS2	Equal variances assumed	.059	.809	.918	128	.361	.13986	.15242	-.16172	.44145
	Equal variances not assumed			.903	107.466	.368	.13986	.15487	-.16714	.44686
NOMEALPROT	Equal variances assumed	13.120	.000	2.827	128	.005	.44298	.15668	.13296	.75300
	Equal variances not assumed			2.992	128.000	.003	.44298	.14807	.14999	.73597
SHORTAGE30	Equal variances assumed	.099	.753	-.891	128	.375	-.20614	.23141	-.66402	.25173
	Equal variances not assumed			-.894	115.673	.373	-.20614	.23062	-.66292	.25064
SHORT12	Equal variances assumed	4.575	.034	-1.036	128	.302	-7.79727	7.52555	-22.68786	7.09332
	Equal variances not assumed			-1.058	121.918	.292	-7.79727	7.37050	-22.38800	6.79346

Appendix 5: Variable Inflation Factor for the continuous explanatory variables

Variable	**Tolerance**	**VIF**
AGE	0.870	1.149
FAMIYSIZE	0.703	1.422
LANDSIZ	0.899	1.113
TLU	0.742	1.347

Appendix 6: Market prices of NTFPs in the area

NTFPs	Unit of measurement	Minimum	Maximum	Average
Charcoal	100kg(2sack)	60	80	70
Fuel wood	Load	15	25	20
Grass	Load	20	30	25
Honey	Kg	20	30	25
Wax	Kg	5	5	5

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