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Farmer participation in the Equitable Payments for Watershed Services in Morogoro, Tanzania

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Abstract

This article contributes to the limited empirical evidence on the determinants of landowners' participation decision in land use-modifying (active agricultural land) Payments for Ecosystem Services (PES) programmes in developing countries. It examines how resource manager characteristics, the features of a PES program, and the institutional context of its implementation determine resource managers' decisions to participate in the Equitable Payments for Watershed Services (EPWS) program in Tanzania, in order to shed light on factors that determine participation in land use-modifying PES programs more widely. The EPWS program has been implemented in the Kibungo Juu ward of Morogoro region in Tanzania by CARE-WWF Tanzania to promote the adoption of sustainable land management (SLM) practices such as agroforestry, reforestation and terracing to improve the quality and quantity of water for downstream users. We used a multi-method approach to collect qualitative and quantitative data. We find that the adoption of SLM practices was determined by the farm size, information, participation of farmers in the program design and the change in the farm management. These findings suggest that, the design of land use-modifying PES programs require considerable care to ensure participation of small landholders, availability and access to right information, participation of farmers in the design of programs, local compatibility of practices and support of initial costs of adoption.

Keywords – Ecosystem services, Payments for ecosystem services (PES), watershed, land use-modifying, agriculture, farmer, participation, Tanzania

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1. Introduction

A payment for ecosystem services (PES) approach has attracted considerable interest from both researchers and policy makers in developed and developing countries as a conservation solution to halt the decline of ecosystem services (Landell-Mills and Porras, 2002; Wunder, 2008; Wunder et al., 2008). In developing countries, the PES approach is hoped to contribute to poverty alleviation on equal footing with ecosystem management (Kosoy et al., 2008; MEA, 2005; FAO, 2007). Worldwide, numerous PES initiatives are being implemented at varying scales, ranging from local initiatives for conserving watersheds to regional and global arrangements for biodiversity and carbon sequestration services (Corbera et al., 2007; Landell-Mills and Porras, 2002; Wunder et al., 2008). There are also PES initiatives for landscape beauty and for bundles of several ecosystem services (Landell-Mills and Porras, 2002).

One key hallmark of the PES approach is voluntary transactions which distinguishes it from command-and control measures (Wunder, 2005). This feature requires the potential ecosystem service providers to have real land use choices (Wunder, 2005). However, this choice can be influenced by landowners own characteristics, program characteristics and the program institutional context (Kosoy et al., 2008; Pagiola et al., 2008). In turn, these are likely to influence the outcomes of a PES program as they are contingent on sufficient enrolment of land owners and fulfilment of the programs management requirements (Pagiola, 2008). This illustration suggests that the understanding of the factors that determine the landowners' decision to enrol in a land use modifying PES program is imperative. It is particularly important because the determinants of land owner's participation decisions are likely to differ from one context to another (Mullan and Kontoleon, 2009).

Recent reviews in developed and developing countries have revealed that PES programs are diverse in their design, geographical (i.e. ecological, institutional and socio-economic), and cost (in terms of opportunity and transaction costs) context (Wunder et al., 2008; Landell-Mills and Porras, 2002). In both developed and developing countries, the difference between user-financed and government-financed programs is common (Wunder et al., 2008). According to Wunder et al. (2008) user-financed PES programs are funded by the actual users of environmental services while the government-financed PES programs are financed by the governments on behalf of service users (Wunder and Börner, 2011; Wunder et al., 2008). User-financed PES programs; (1) are more closely tailored to local conditions and needs, (2) are better targeted, (3) have greater willingness to enforce conditionality, (4) have better monitoring and, (5) have far fewer confounding side objectives than government financed programs (Wunder et al., 2008). In developing countries, government financed programs tend to embrace multiple objectives such as poverty alleviation which is held on equal footing with ecosystem management (Kosoy et al., 2008).

Another distinction made between PES programs is between “land-diversion programs” and “working-land programs” (Zilberman et al., 2008, p.2) or “use-restricting” and “use-modifying” (Wunder and Börner, 2011, p.278). According to Zilberman et al. (2008, p.2) “land-diversion programs” are those programs where lands are diverted from agricultural production to conservation, and “working-land programs,” are the programs where lands remain in agriculture but production activities are modified to achieve environmental objectives. This distinction is quite similar to the Wunder and Börner (2011) differentiation where the “use-restricting” PES programs are those which provide incentives to reduce or suspend agricultural and forestry activities on land with ecosystem services provision potential. On the other hand the “use-

modifying" PES programs are those programs in which incentives are offered to adopt technologies and practices that enhance ecosystem services provision on land under productive uses. In general, use-restricting is a common feature of forest-based PES programs while use-modifying is a common feature of agricultural-based PES programs (Wunder et al., 2008).

While there are numerous PES programs implemented to protect and restore ecosystem services nested in forestry (Landell-Mills and Porras, 2002) and in agriculture (FAO, 2007; Ribaudo et al., 2010), the majority of the programs are "use-restricting" rather than "use-modifying". According to the global survey conducted by Landell-Mills and Porras (2002), about four-fifths of PES programs are use-restricting and the majority of these programs are found in developing countries (Wunder et al., 2008; Wunder and Börner, 2011). Whilst the majority of use-modifying PES programs are found in developed countries, such as the EU and US agri-environmental programs (Baylis et al., 2008), in recent years, interest in land use-modifying PES programs for the supply of ecosystem services has considerably grown in developing countries (Wunder and Börner, 2011; FAO, 2007; Ribaudo et al., 2010; Branca et al., 2011).

In addition, while there is a considerable amount of research on the determinants of participation in PES programs in both developed and developing counties, the focus of the majority of these studies is on developed countries such as on the Agri-Environment Programs of the European Union (Brotherton, 1991; Langpap, 2004; Vanslembrouck et al., 2002; Wossink and Van Wenum, 2003) and the Conservation Reserve Program in the United States (Cooper, 2003; Ervin and Ervin, 1982; Langpap, 2004). Research conducted in developing countries is focused on the use-restricting PES programs in Costa Rica (Zbinden and Lee, 2005), China (Uchida et al., 2007) and Mexico (Kosoy et al., 2008; Pagiola, 2008). This trend is not surprising giv-

en extensive implementation of PES programs in developed countries and use-restricting PES programs in Latin America and Asia. The recent years interest on land use-modifying PES programs in developing countries call for research to explore what it takes to motivate a land manager to participate in these programs.

In this article we examine the factors behind land owners' participation in a land use modifying PES program, focusing on the Equitable Payments for Watershed Services (EPWS) program piloted in the Kibungo Juu ward of Morogoro region in Tanzania by CARE-WWF Tanzania. We analyse resource manager characteristics, program characteristics and the program institutional context as potential key factors determining participation to shed light on factors affecting who is able to participate and benefit from PES programs in developing countries.

The paper is structured as follows: Section 2 reviews the literature on participation in PES programmes and in the adoption of agricultural technology. Section 3 describes our materials and methods. In Section 4 we present the findings on the extent to which farmer characteristics, program factors and social and cultural factors influence participation in the EPWS program. In Section 5 we discuss the findings in light of the literature, and in section 6 we draw conclusions and make policy recommendations.

2. The determinants of landholder participation in a conservation program

A considerable amount of empirical research has sought to explain landowners' adoption of agricultural technologies and participation in conservation programs in both developed and developing countries (Brotherton, 1989; Knowler and Bradshaw, 2007; Kosoy et al., 2008; Pagiola et al., 2007; Wilson, 1997; Wauters et al., 2010; Yiridoe et al., 2010; Zbinden and Lee, 2005). In these studies, a number of potential independent variables are selected on the basis of prior theorising and tested using logistic or

probit regression to identify which variables significantly correlate with the adoption of agricultural innovations and environmental conservation programs. In this article we use insights from these studies to explore the determinants of farmer participation in a PES program. According to Brotherton (1989), Wilson (1997) and Kosoy et al. (2008), the variables that influence participation of a landholder in a conservation program can be grouped into the farmer and farm characteristics, the program factors, and factors regarding the program's institutional context.

Farm and farmer characteristics clearly are factors that can affect participation in a program or technology adoption decisions. The literature has established the role of age and education of the head of household as important determinants in participation (Ayuk, 1997; Azizi Khalkheili and Zamani, 2009; Kosoy et al., 2008; Langpap, 2004; Mullan and Kontoleon, 2009). Level of education of the household decision maker is key in determining the household's ability to obtain and process information and to implement knowledge intensive conservation practices and agricultural technologies (Zbinden and Lee, 2005). Other important factors shown to influence adoption of technologies and programme participation include land tenure (Schuck et al., 2002), labour availability (Zbinden and Lee, 2005), access to information (Mullan and Kontoleon, 2009; Zbinden and Lee, 2005) and impact on household income and land opportunity costs (Wunder, 2006).

Program factors that can affect participation include program rules, incentives, information flow, farmer participation in the program design (Biggs and Farrington, 1991) and the magnitude of changes in farm management practices required by the program (Brotherton, 1989; Wilson, 1997). Kosoy et al. (2008) suggest that program factors critically influence the extent to which a PES program is voluntary. For example, a targeting approach encourages those farmers with land that can generate significant and

sustainable environmental benefits to participate (Kosoy et al., 2008; Mullan and Kontoleon, 2009; Wünscher et al., 2008). In some Latin American PES programs, the requirement of formal land tenure to access payments discriminates against poor farmers (Grieg-Gran et al., 2005). A targeting approach may also discriminate against other groups, for instance when the program promotes participation of poor households by targeting program activities to communities with low levels of development (Kosoy et al., 2008). Mayrand and Paquin (2004) highlight that the ability of the program administrators to set up a trustworthy governance structure is crucial for the farmers' buy-in and participation in the program. The level of participation in the PES programs that involve farmers in their designs has been found to be high because farmers develop ownership of the program (Kosoy et al., 2008; Murdoch and Marsden, 1995). Program administrators may also influence participation through eligibility requirements such as area targeting, minimum and maximum land holdings and commitment to conservation (Ferraro, 2009; Mullan and Kontoleon, 2009; Pagiola et al., 2005; Wünscher et al., 2008).

The wider institutional context also influences participation in programs and adoption of agricultural technologies (Corbera et al., 2009; Kosoy et al., 2008; Pagiola et al., 2007; Pagiola et al., 2005). Important aspects of the wider institutional context include tenure systems, access and availability of credit, social and cultural values such as the importance of non-timber forest products to households (Kosoy et al., 2008; Murdoch and Marsden, 1995). For example, in Mexico the appreciation of non-timber forest products favour forest conservation and influence land managers' willingness to participate in payments for biodiversity conservation projects (Kosoy et al., 2008). Miranda *et al.* (2003) in turn highlight how the ability of small holders to borrow money for financing PES activities and thus to participate was constrained by the fact that the na-

tional banking system in Costa Rica did not consider forestry activities eligible for funding.

While there is substantial literature on PES program participation in developed countries, (Ervin and Ervin, 1982; Vanslembrouck et al., 2002; Wossink and Van Wenum, 2003; Langpap, 2004) the literature on participation in developing country PES programs is still relatively limited and focuses on Latin American countries (Echavarría, 2002; Pagiola, 2008; Wunder and Albán, 2008; Munoz-Pina et al., 2008) and China (Grosjean and Kontoleon, 2009; Uchida et al., 2007; Ferraro, 2009). These previous studies frequently analyse the determinants of participation in programs related to forest systems. Also, existing literature focuses on the determinants of participation in PES programs financed by third parties such as governments rather than by the users. Also, while farmer characteristics (Kosoy et al., 2008; Zbinden and Lee, 2005), program attributes (Corbera et al., 2009; Kosoy et al., 2008; Pagiola et al., 2005), and institutional context (Grosjean and Kontoleon, 2009; Uchida et al., 2007) all influence participation, studies that take into account all these factors are rare. Thus the current understanding of the determinants of program participation by farmers is incomplete. This is why Kosoy et al. (2008) call for replacing the naïve rational choice view (which maintains that resource managers narrowly consider costs and benefits when deciding whether to participate in a PES program) with a more comprehensive and context sensitive understanding. Finally, most participation studies are quantitative, with qualitative materials and methods seldom used to gain deeper insight into the determinants of participation. In what follows, we seek to fill these gaps in the literature.

3. Materials and Methods

3.1. The Case Study

We examined the Equitable Payments for Watershed Services (EPWS) program piloted by CARE-WWF Tanzania in Kibungo Juu ward of Morogoro Region in Tanzania as a case study to investigate determinants of farmer participation in a PES program related to an agricultural system. EPWS programs like the one we examined are of interest to conservation NGOs, local and central government authorities and researchers because of their wide potential applicability in Tanzania and in the developing world more generally. The study site is in the Uluguru Mountains, a part of the Eastern Arc Mountain Range, located in the Morogoro Region about 200km west of Dar Es Salaam. The Uluguru Mountains range from about 200 – 2,638m and receive an annual rainfall of about 1,000 and 3,000 mm/year. Natural forest cover in the Uluguru Mountains was estimated to have been 500 km^2 but this has declined due to deforestation to 300km^2 in 1955 and 230km^2 in 2001 (Lopa and Mwanyoka, 2010). A complex network of tributaries from the mountains joins to form the Ruvu River, the main source of water for Dar es Salaam's over four million inhabitants.

Morogoro region's population grows 2.7% per annum and is associated with significant conversion of forested land to farmland and with logging for timber, building materials and fuel wood (Yanda and Munishi, 2007; Paavola, 2008). Between 1995 and 2000, cultivated land area increased by 300% while high forested area decreased by 2%, woodlots by 20% and bush land by 12% (Yanda and Munishi, 2007). There are 50 villages bordering forested areas in the Uluguru Mountains, with a combined population of about 150,000 people (CARE and WWF, 2008). Most farmers own less than two hectares of land and practice semi-intensive subsistence farming using slash-and-burn practices (CARE and WWF, 2007). The Uluguru farmers grow maize and rice,

cassava, banana and pineapple in their fragmented fields. Crop yields are low due to low soil fertility: for example, the average maize yield is about 200 kg/acre (CARE and WWF, 2008).

Hydrological analysis of the Ruvu River by CARE-WWF indicated substantial decline in water quality between 1992-2003 (2007). Overall turbidity levels achieved 100-200 Nephelometric Turbidity Units (NTU) at the end of the period, having increased by about five NTUs per year (CARE and WWF, 2007). This has increased the costs of water purification for downstream water users and resulted in water shortages. The largest water user is the City of Dar es Salaam Water Supply Company (DAWASCO) which spends 2 million US$/year removing sediment from the water it takes from the Ruvu river (CARE and WWF, 2007; Yanda and Munishi, 2007). These costs are expected to increase with expected increases in frequency of high turbidity episodes, which may require DAWASCO to temporarily stop water supply.

The EPWS is a pilot program which uses the Payments for Ecosystem Services (PES) approach to achieve environmental and livelihood objectives. It is implemented by a consortium formed by WWF Tanzania and CARE-Tanzania (CARE-WWF Tanzania), which acts as an intermediary between the service providers and users. The purpose of the EPWS is to promote the adoption of SLM practices such as agro-forestry, reforestation and terracing (Branca et al., 2011; Lopa and Jindal, 2011). These soil conservation practices are expected to reduce turbidity episodes, improve soil fertility, and boost crop yields and farm income. The program is implemented in the catchment of the Mfizigo River which is one of the tributaries of the Ruvu River (see Figure 1).

The EPWS program started in 2006. The downstream service buyers are DAWASCO and Coca Cola Kwanza Ltd. and the upstream service sellers are the villages of Lukenge, Kibungo, Lanzi, Dimilo and Nyingwa in the Kibungo Juu ward (Lopa and

Jindal, 2011). In these villages 1,215 households were expected to participate in the program and change their agricultural practices and implement sustainable land management (SLM) practices over 2,240 ha of farmland (Branca et al., 2011). CARE-WWF Tanzania carries out a number of tasks as an intermediary to facilitate the operation of the EPWS program (Thuy et al., 2010). CARE-WWF Tanzania produced the business case scenarios to facilitate negations between the service providers and the service users (WWF, 2006). In 2006-2007 it also conducted feasibility and other studies on the (1) legal and policy system for PES in Tanzania, (2) social system and livelihoods of communities around the Uluguru Mountains, (3) hydrology of the Ruvu River catchment, (4) land use/cover change of the Uluguru watershed and (5) potential costs and benefits of the program. It also provided education for farmers in the Kibungo Juu ward on the concept of the EPWS and its potential benefits to the environment and their livelihoods in village meetings and workshops.

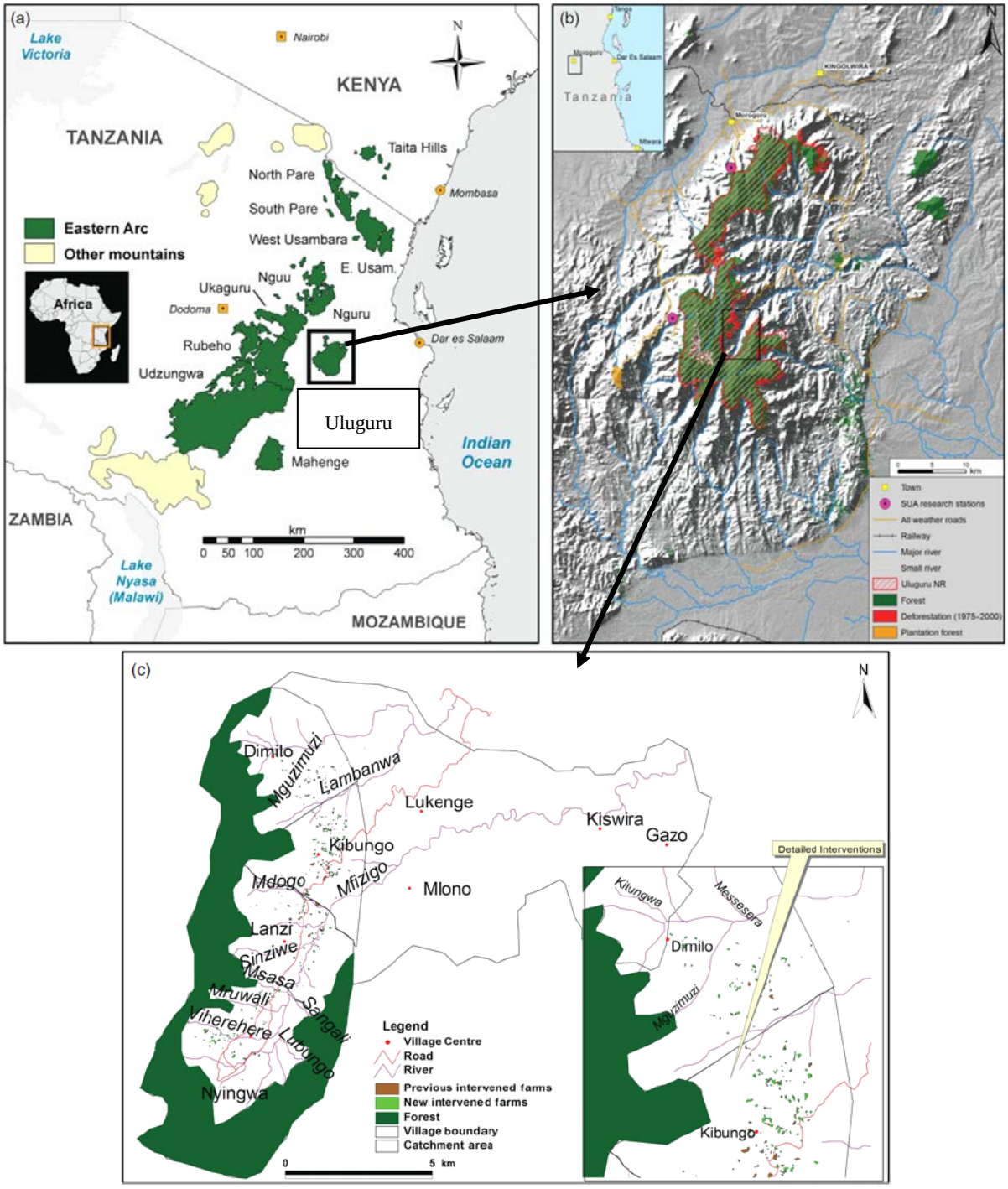

Figure 1: (a) The Eastern Arc Mountain (b) The Uluguru Mountains showing the location of the EPWS program. (c) Kibungu sub-catchment in the Uluguru Mountains, showing the location of villages and small streams and the location of the focal villages and individual farmers' fields under project interventions (inset).

Source: adapted from Lopa et al.(2012)

A Memorandum of Understanding (MoU) was signed between the service providers (the Kibungo Juu ward) and the service users (DAWASCO and Coca Cola Kwanza

Ltd) in 2008, stipulating the roles and obligations of all parties. The service providers were to ensure the supply of water by implementing SLM practices while the service users were to provide payments to the service providers for the provision of the service. DAWASCO and Coca Cola Kwanza Ltd committed to pay US$ 100,000 and US$ 200,000 respectively in total over four years. Also, an Intermediary Group (IG) including the representatives of service sellers (project implementing village members), service buyers (DAWASCO and Coca Cola Kwanza Ltd), government agencies and community based organizations was formed to lead the EPWS program and to scale it up to cover other catchments in the Uluguru Mountains when the role of CARE-WWF Tanzania in the pilot project comes to an end.

Many local actors have been involved in the establishment and implementation of the EPWS program. Village governments organised public meetings in which CARE-WWF Tanzania program officers introduced the EPWS program. People were encouraged to organize themselves into small groups for implementing program activities such as for the construction of terraces and tree planting. Within the terrace construction groups sub-groups were formed for keeping goats, pigs and chickens for manure, meat, milk and eggs and for the production of high-value market produce such as beans, cabbages, tomatoes, bananas and vegetables. Terrace construction groups have 5-8 farmers while tree-planting groups have about 20 people. Members work together to construct terraces, goat and pig huts and during land preparation. Group leaders (chairperson, secretary, treasurer and two other members) from the five villages have established one network group which meets every month to monitor the implementation of project activities, plan new activities, and make decisions on the implementation of the EPWS project.

3.2. Methods

We used both quantitative and qualitative approaches to collect and analyse data. The first stage involved a review of the literature, observation of farms involved and not involved in the EPWS program, semi-structured key informant interviews with CARE-WWF Tanzania officers administering the program, and a focus group discussion with 8 participating and non-participating farmers in October and November 2010. The first stage of material collection sought to generate grounded knowledge about targeting, eligibility rules, payments, and land change management requirements of the EPWS programme, its institutional context of implementation and the farmers' reasons for participation and non-participation. The key informants included present and past village leaders, teachers, the ward forest office personnel and the EPWS program office personnel (see recommendation of Bernard (2006) and Babbie (2008)).

The second stage involved a household survey based on a structured questionnaire to identify the determinants of farmer participation and non-participation in the EPWS program. It was informed by a standard economic model which assumes that a farmer or resource manager decides whether to participate in a program on the basis of available resources and other factors subject to natural and institutional constraints (Horowitz, 1970; Rahm and Huffman, 1984). The questionnaire was tested with a small number (N=7) of households and in one focus group meeting with village leaders in November, 2010. The fieldwork was conducted from March to May 2011 in four villages. The number of households surveyed was 233: of these 60 were from Kibungo Juu village, 70 from Nyingwa village, 48 from Dimilo village and 55 from Lanzi village. The sample included 116 participating and 117 non-participating households. Within each village, households were selected for survey using stratified random sam-

pling generated by using the wealth ranking technique to ensure representativeness (see Chambers (1994) and White and Pettit (2004)).

We used a logistic regression framework to determine what factors are significant for the farmer's decision to participate in the EPWS program. This followed practice in past studies on program participation and adoption of agricultural technologies (Ayuk, 1997; Lise, 2000; Mullan and Kontoleon, 2009; Thangata and Alavalapati, 2003; Yiridoe et al., 2010; Zbinden and Lee, 2005). Factors hypothesised to influence farmer participation decisions are presented in Table 1. They include variables related to farmer characteristics such as age, gender and education of the household head, household labour (number of members aged 16 – 64), household wealth (i.e. farm size and income sources), land tenure, information availability (i.e. program logistics in extension services), past land uses, importance of non-timber forest products, access to credit, inclusiveness of the program and the magnitude of change in land management required by the program. Given these hypothesized determinants of participation, the general form of the participation model is:

$$E(Y_i) = \alpha + \beta_1 GENDER + \beta_2 AGE + \beta_3 EDUC + \beta_4 HHSIZE + \beta_5 MEMBERSHIPS + \beta_6 WEALTHG + \beta_7 INFO + \beta_8 LANDOWN + \beta_9 EXLUSE + \beta_{10} ACCREDITS + \beta_{11} PARTICIPATORY + \beta_{12} CHANGEIFMR + \varepsilon$$

(Equation 1)

Where:

- Y_i -is the dependent variable – participation;
- α -is the constant
- βs -are the coefficients of each explanatory variable.
- ε -represent errors due to unobservable factors

Table 1: The explanatory variables used in the logistic regression equation (1)

Variable Name	Description	Expected Sign
GENDER	Gender of household head: 1 if male; 0 if female	-
AGE	Age of the household head	-
EDUC	Years of schooling of the household head	+
HHSIZE	Number of working people in the household aged between 16 – 64 years old	+
FSIZE	A farm size of the household	+
LANDOWN	Household land tenure: 1 if own private land; 0 otherwise (i.e. rented).	+
ImportNTFP	Importance of non-timber forest products (NTFP)	+
INFO	Access to EPWS extension services: 1 if yes; 0 if otherwise	+
EXLUSE	Past land use: 1 if implemented conservation practice in the past; 0 otherwise	+
MEMBERSHIPS	Number of affiliations that the household has	+
PARTICIPATORY	Participatory nature of the program 1 if participatory in the design phase and 0 otherwise	+
CHANGEIFMR	Change in farm management required (1= difficult, 0=otherwise)	+

In the third stage, the determinants of participation found to be significant were explored further on the basis of 32 key informant interviews and 16 focus group discussions (FGD). The key informant interviews were conducted with CARE Tanzania EPWS program officers, village leaders, 8 representatives from EPWS groups in each program village and 8 EPWS participating and 8 non-participating households. FGDs were used to capture divergent viewpoints about the determinants of participation decisions (Hopkins, 2007). Following guidance from Hopkins (2007) and Creswell and Plano Clark (2007), participants with experience and knowledge of the phenomenon under investigation were selected. Representatives of local organizations and participating and non-participating households were selected for FGDs with separate FGDs conducted with EPWS participating and non-participating households in each program village. The size of FGDs was between 8-10 people. The key informant interviews and FGDs were conducted in 'Swahili', audio recorded and then transcribed in English.

The content analysis approach which was informed by Neuendorf (2002) was used to analyse key informant interviews and FGD data.

4. Results

Respondents included 65% males and 35% females and their average age was 48 years. Almost 70% of the respondents had 7 or more years of education while the remaining 30% had not completed primary school. The wealth ranking exercise identified 55.4% of respondents as middle income, 31.3% as poor and 13.3% as rich. Males made up 80% of the rich, 62.8% of the middle income, and 63% of the poor. The respondents' average harvest included 197kg of maize, 111kg beans, 50kg groundnuts, 74 boxes of bananas and 45 boxes of cassava. Irrigation was practiced by 41.6% of farmers: of them, 74% used traditional furrow, 22.7% used buckets and 3.1% used a combination of the two.

The main occupation of nearly all respondents (95.7%) was farming, the rest were self-employed (3%) or wage employees (1.3%). The most commonly grown crops include cardamom, rice, maize, beans, groundnuts, cinnamon, sugarcane, banana, cassava, sweet potatoes, tomatoes, cabbages, and pineapple. The average farm size was 3 acres: the largest among the respondents was 6.5 acres and the smallest less than an acre. Over half of the households (54.1%) owned private land, 42% cultivated lineage land and 3.9% rented or shared crop lands. Most farms (65.3%) were on moderately hilly or flat terrain, 20% on hilly terrain and 14.7% on flat terrain. Most farms had dark brown silt soils locally known as *fifisi* (85.2%) and the rest had either red soil (12.1%), clay soil - *kikododo* (1.3%) or grey soil - *fibwefibwe* (1.3%). Over three quarters (78.1%) of the farmers used the soil quality to determine land use, the

rest (21.9%) did so on the basis of road access. The farmers' average walking time from their cultivation to the nearest service road was 60 minutes.

Two thirds (66.2%) of the farmers were aware of the availability of extension services in their villages and 55.1% had received assistance from them. Over half (56.1%) of the farmers considered that the availability of extension officers had improved a little or a lot with the EPWS, while for 38.8% it had remained the same. Conservation practices had also become more common after the EPWS. Over half (52.2%) the farmers had planted trees on their farms before EPWS, while after its implementation 75.4% had planted trees. Agro-forestry practices spread from 46.7% of farmers before EPWS to 53.3% after it. In addition, after EPWS 37.3% constructed bench terraces, 33.5% piled soil up *(fanya juu)* and 42.5% reforested.

There were clear differences between the EPWS program participating and non-participating households (see Table 2). The heads of EPWS participating households were younger (AGE) than those of non-participating households. They also had received more education (EDUC) than the non-participating heads of households. The EPWS participating households were also larger (HHSIZE 16-64), with more members to contribute to farm work. Finally, the EPWS participating households had larger farms (FSIZE) and more sources of income (INCOMES).

Table 2: Descriptive statistics for explanatory variables

Name of the Variable	Sample		Not-Participating (n=117)		Participating (n=116)	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
GENDER	0.65	0.48	0.58	0.50	0.72	0.45
AGE	47.73	15.14	51.71	15.88	43.72	13.26
HHSIZE	2.74	1.30	2.55	1.29	2.93	1.28
EDUC	6.21	2.18	5.68	2.20	6.74	2.03
FSIZE	3.00	1.46	2.46	1.27	3.55	1.44
LANDOWN	1.50	0.57	1.59	0.62	1.40	0.51
EXLUSE	0.46	0.50	0.38	0.49	0.54	0.50
INFO	0.54	0.50	0.25	0.43	0.84	0.37
MEMBERSHIPS	1.52	1.43	1.08	1.22	1.96	1.49
ImportNTFP	3.09	0.99	3.09	0.84	3.10	1.12
PARTICIPATORY	0.60	0.49	0.25	0.44	0.90	0.31
CHANGEFM	1.97	1.25	1.34	0.82	2.61	1.29

The determinants of participation in EPWS are reported in Table 3. The size of farm, access to information (to EPWS extension officer), participatory nature of the program in the design phase, and the magnitude of required changes in farm management are all positive and significant determinants of farmer participation in the EPWS program. Other positive variables which proved not significant include education of the head of household, household head's social affiliations, household labour, past conservation experience, and type of land ownership. Variables that negatively influence participation in the EPWS program include gender of the household head, the importance of non-timber forest products and the age of household head but none of them proved significant in the analysis.

Farm size (FSIZE) is a positive and significant determinant of farmer participation in the EPWS program. In light of the key informant interviews and focus groups, farmers who have large land holdings are more likely to adopt SLM practices than small land

holders. They are more flexible, wealthier and able to handle risk of crop failure by dividing up farms for use for different purposes unlike smaller land holding farmers. It was also revealed that the farmers with small farms were reluctant to construct terraces or use *"fanya juu"* measures. The reason for this was the small size of their farms which were considered too small to produce enough food during the first 3-5 years of soil fertility regeneration following the construction of terraces. In the construction of terraces the fertile top soil was buried beneath unfertile rocky soil leaving the top soil unproductive. A farmer from Lanzi village explained that "if I construct terraces … my children will die of food shortage; as without manure you will not be able to harvest anything".

Table 3: The logistic regression results for a farmers' participation in EPWS program

Variable	Estimated Coefficients	S.E	t-Ratio	Marginal effects	Odds ratio
ENDER	-0.15	0.52	-0.29	0.78	0.86
EDUC	0.01	0.12	0.08	0.96	1.01
FSIZE	0.38	0.17	2.24**	0.03	1.46
MEMBERSHIPS	0.05	0.16	0.31	0.75	1.05
INFO	1.45	0.48	3.02***	0.00	4.28
HHSIZE (16-64)	0.15	0.2	0.75	0.45	1.16
PARTICIPATORY	2.77	0.45	6.16***	0.00	15.94
EXLUSE	0.48	0.42	1.14	0.26	1.61
CHANGEIFMR	0.76	0.46	1.65*	0.10	2.14
LANDOWNT	0.33	0.48	0.69	0.49	1.39
ImportNTFP	-0.12	0.48	-0.25	0.80	0.89
AGE	-0.02	0.02	-1.00	0.30	0.98
Constant	-3.82	1.43	-2.67**	0.01	0.02
Nagelkerke R^2					0.67
Likelihood Ratio Test X^2					13.955 (8df)
Hosmer and Lemeshow Test					0.083
Proportion of observation correctly predicted as participants					%86.2
Proportion of observations correctly predicted as non-participants					%80.3
Overall percentage correctly classified (%)					83.3
Total number of observations					233

*Significant at = 10%.

**Significant at = 5%.

***Significant at = 1%.

The farmers' access to information (INFO) is another positive and significant determinant of farmer participation in the EPWS program. Focus group discussions illustrated that the public meetings conducted by the EPWS officers in each program village provided information that was used to make participation decisions. Information about the EPWS program was also disseminated by the CARE staff stationed in program villages to provide technical assistance. It was also spread and obtained from farmer to farmer interactions: information on experienced harvest improvements was often obtained from neighbours and it was considered an important reason for adopting the SLM practices of the EPWS program. For example, a farmer from Lanzi Village said that "I did not join the EPWS program from the beginning because I did not believe what the EPWS experts were telling us but when I witnessed what my brother was harvesting from his small terraced farm, I was convinced that constructing terraces was a deal. I immediately hired terrace construction experts and asked the CARE experts to provide advice to construct terraces in my three acre farm".

Other methods through which information was received by farmers included local training workshops to create awareness and develop practical skills for adopting and implementing project measures. Nearly 700 farmers were trained between July 2009 and June 2010 in sustainable land management practices, including the construction and use of *"fanya juu"* and bench terraces, tree nursery establishment and management, tree planting methods and field management, grass strip farming techniques, practices to improve soil moisture and production, and animal husbandry for income generation and manure production.

The participation of farmers in the design phase (PARTICIPATORY) of the EPWS program is also a positive and significant determinant of participation. Key informant

interviews and focus group discussions suggest that the design phase involved consultative (functional) participation in the context of research and village meetings in which the EPWS programs' SLM practices were marketed to farmers. However, the consultation did not determine programme content. For example, a farmer from Kibungo village told that "if the program was collaborative and our opinions were asked and considered in the design of the program, we would have preferred to start the EPWS program by keeping livestock for manure followed by construction of bench terraces and "*fanya juu"*. The program did not choose to do so. According to an EPWS program officer, "the farmers are required to engage in SLM activities that have additionality impact for the improvement of water for them to be eligible for payment".

Another positive and significant determinant of farmer participation in the EPWS program is the magnitude of required change in farm management (CHANGEIFM). Key informant interviews and focus group discussions highlighted that the adoption of agro-forestry measures and reforestation were easier to adopt than the construction of bench terraces and *"fanya juu"*. The main constraint for the adoption of the *"fanya juu"* and terraces was the high cost of labour needed for their construction and the lack of manure – without it terraces can take up to four years to regain fertility. This temporary crop yield decline was considered to endanger food security. According to a farmer in Kibungo village "we don't have enough food now because our harvests were very little due to the lack of manure". In tribal lands, customary land tenure does not allow the construction of permanent structures such as terraces or *"fanya juu"*.

5. Discussion

The findings of this study contribute to the limited existing empirical evidence on the determinants of landowner participation in land use-modifying PES programmes

where payments are intended for the adoption of technologies and practices that enhance ecosystem services provision on land under productive uses in developing countries. Our results demonstrate that participation of landowners in the EPWS program is positively associated with the household farm size, access to information, farmer participation in the program design and the magnitude of change in farm management required by the program. Some of these findings are consistent with other studies that have investigated participation or adoption of agricultural conservation technologies. The farm size variable is in line with De Marchi and Ravetz (2001) and Santos et al. (2006) studies on the adoption of soil and water conservation (SWC) measures such as bench terraces, "*fanya juu"* and stone terraces in Tanzania and Ethiopia respectively. Their results also reveal that the adoption of conservation measures is highly influenced by farm size.

The commonly established explanation for this finding is that larger farms can offer landholders more flexibility in decision making, greater access to discretionary resources, more ability to deal with risks and more opportunity to try new practices (Amsalu and De Graaff, 2007). It has also been revealed that farmers with large farms are often motivated to invest in land conservation to enhance their farm income hence increase their wealth as a result of having more farm size (Woldeamlak, 2007). Unlike farmers with large land sizes, farmers with small land sizes are often found to lag behind in adoption of terraces. This was also shown by Amsalu and De Graaff (2007) in Ethiopia whereby the loss of land fertility due to terracing and temporal yield decline discouraged the adoption of stone terraces by small land owners. The same result was obtained by Tenge et al. (2005) in the West Usambara mountains in Tanzania whereby the adoption of major soil and water conservation measures was low among farmers with small farms.

Access to information significantly influenced participation decisions in the EPWS program. This is not surprising because previous studies have long recognised the importance of information availability and access in the adoption and diffusion of innovation (Knowler and Bradshaw, 2007). Frondel et al. (2012) demonstrate that information about conservation programs helps to confirm or dismiss farmers' positive or negative views about a program or prior expectations and, more importantly, to avoid mistakes. Indeed, information is crucial for land owners to opt in or out of agricultural conservation program when they are well informed.

Often, the sources of information about conservation practices include channels such as other farmers, media, meetings and extension officers (Knowler and Bradshaw, 2007). The choice of channel is crucial because some channels are significantly limited by the ability of potential adopters to access the available information and understand the message communicated to them (Napier, 1991). Some channels are more effective than others. In our study, farmer to farmer communication was acknowledged as important because information about the success of the technology from other farmers was frequently reported to influence adoption of SWC practices such as bench terraces, *"fanya juu"*, agro-forestry and high value crops. This suggests that positive farmer-to-farmer communication has the potential to increase adoption of program practices even after the program ends.

Our findings also show that farmers are more willing to participate when the program is participatory. In the case of EPWS, participation levels could have been higher if the farmer views on availability of manure had been given higher priority in the design of the programme. There are several reasons for using a participatory approach in the implementation of conservation projects. Firstly, it is reported to increase adoption levels; for example, Posthumus (2005) found that a participatory SWC programme

had a significant positive influence on the adoption decision compared to a top-down SWC programme. In addition, Pretty and Shah (1997) emphasise the importance of combining farmer knowledge with scientific knowledge while at the same time strengthening local capacities to experiment and innovate: this is something that a participatory approach can foster. In turn, Kessler (2006) considers participatory approach a necessary precondition for effective implementation of SLM practices (Ferraro and Pattanayak, 2006).

We also find that the magnitude of change in farm management required by the programme significantly influenced farmer participation in the EPWS program. This has also been reported that conservation technologies that are easy to adopt and appropriate for a farming system of a farmer are more likely to be adopted (Napier, 1991). However, when the program requires more substantial changes in farm management, farmers are less likely to participate or adopt (Wilson and Hart, 2001; Wilson et al., 1999). For example, Wilson et al. (1999) found that farmers who did not participate in environmentally sensitive area (ESA) programs did so because of the substantial changes that were required for land management. Similar findings have been obtained by Shiferaw and Holden (2000) in Ethiopia, Lapar and Pandey (1999) in the Philippines and Kerr and Sanghi (1992) in India. Often, lack of economic resources and high labour demands are reported to constrain adoption of some agricultural conservation practices such as construction of terraces and agro-forestry which require purchase of inputs to incorporate them effectively into the existing farming system (Napier, 1991).

While our significant determinants of participation in the EPWS are in line with many other studies on agro-environmental technology adoption, there are a number of findings which are unique to the study area. One is the acceptance of terraces under

EPWS with incentives compared to resistance to their adoption in the 1950s when introduced by the Uluguru Land Usage Scheme (ULUS) (Carswell, 2006; Young and Fosbrooke, 1960) under no incentives. This suggests that the acceptance of terraces may have been influenced by the PES payments. As such there is high potential of the PES approach to encourage agricultural pro-environmental behaviours such as construction of bench terraces and other conservation measures. Another novel finding is the obstacle that customary land tenure can create for participation: adoption of sustainable land management practices may not be compatible with the rules of customary land tenure which exclude the right to make permanent improvements to land.

Although the intention of the EPWS programs to achieve equity is considerable, the findings strongly suggest that the program disproportionally tend to go to the better off landowners. This suggests that achievement of this program objective may be limited due to the fact that participating farmers, who on average have larger farms, are more likely to participate than small land holders. The size of land holdings importantly influences the adoption of sustainable soil and water conservation and other practices implemented under the EPWS program. Indeed, from an economic perspective, targeting PES contracts to fewer landowners with big farms versus many small farms may make the programs more efficient in terms of reducing administrative expenses and increase the efficiency of the program. This implies that in realizing efficiency and environmental goals of PES programs, equity goals may not necessarily be achieved. This will in turn force policymakers to choose the optimal balance among the multiple goals.

6. Conclusion

We examined what factors determine farmer participation in the Equitable Payments for Watershed Services (EPWS) program piloted in the Kibungo Juu ward of Morogoro region in Tanzania by the CARE-WWF Tanzania. Our findings show that the farmers' farm size, access to information, participation of farmers in the design phase and the change in farm management required by the program significantly influence the decision to participate in the EPWS program. Given the increasing acknowledgement of the PES approach in encouraging pro-environmental behaviour; and the widely reported problem of watershed degradation in developing countries, our findings are important and as such there is an urgent need for PES programs that will effectively encourage behaviours that maintain water resources.

On the basis of our findings, we suggest that the effective design and implementation of PES programs in agricultural systems require a thorough understanding of resource manager characteristics, features of the PES program and the institutional context within which the PES program is implemented. This is particularly crucial because we have found that the participation of less wealthy farmers is not likely to be achieved unless necessary measures are taken to enable their participation. These can be very context specific such as when the supply of manure is key obstacle preventing construction of terraces on land needed for continuous food production. This is a critical issue which requires rigorous assessment of landholders' preferences from the local perspective during the design of PES programs. Also full participation of farmers/land managers in both program design and implementation could ensure that factors crucial for participation of more disadvantaged farmers do not become unnecessarily compromised.

The findings also suggest that the willingness to participate in the EPWS programme increased over time. While access to information through the EPWS extension officers and public events was important, farmers also waited to see if the early adopters benefited from the program. When the substantial benefits from participation became clear and could be communicated from farmer to farmer, the more cautious farmers also became willing to participate. This suggests that programs like EPWS should make a serious effort to generate demonstration cases and to allow sufficient time for recruitment of farmers.

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