WILLINGNESS TO PAY AND ACCEPT COMPESATION FOR CONSERVATION OF THE USANGU PLAIN IN MBARALI DISTRICT, TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN MANAGEMENT OF NATURAL RESOURCES FOR SUSTAINABLE AGRICULTURE OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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ABSTRACT

Payments for ecosystem services (PES) compensate individuals or communities for undertaking actions that increase the provision of ecosystem services such as water flows. These payments rely on incentives to encourage behavioral change and can consequently be considered part of the broader class to stimulate market-based mechanisms for environmental policy. This study was carried out to estimate willingness of both downstream and upstream user of Usangu plain to Pay and accept compensation for conservation to aid flow of water downstream throughout the year. The specific objectives were to estimate downstream willingness to pay (WTP), upstream willingness to accept (WTA) compensation for conservation and adoption of environmentally friendly practices and to determine factors influencing WTA compensation for conservation. Primary data were collected through questionnaire which was administered to a random sample of 200 respondent's upstream Usangu plain in four villages, while data for WTP were gathered through checklists. Data were analyzed using descriptive statistics whereas data from choice experiment was analyzed by Conditional Logistic Model (CL) to elicit WTA compensation for conservation, Multinomial logistic model (MNL) was used to assess the factors influencing WTA compensation. Results show that downstream users were not willing to add any addition payment apart from what they pay as water user fees. Further results from CL show that upstream users are willing to accept several proposed conservations and environmentally friendly practices if they are compensated based on the performed practice and this is highly influenced by socio economic factors including age, education level and marital status. It is concluded from this study that both users of the plain are aware of the degradation status of the plain and their willingness to participate in conservation varies. The study therefore recommends involvement of all stakeholders in the development of conservation goals.

DECLARATION

I, Doris Itaely Munisi do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

…… …….

Doris Itaely Munisi Date

(MSc. MNRSA)

The above declaration is confirmed by;

…… …….

Prof. Felister Mombo Date

(Supervisor)

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DEDICATION

I dedicate this work to my beloved parents the Late Mr. Itaely M. K. and Mrs. Joyce D. Itaely and my siblings Ndascoy, Fortune, Humphrey and Eleanor Itaely, whom together have believed and supported me throughout my entire academic journey.

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LIST OF ABBREVIATION AND ACRONYMS

CE	Choice experiment
CES	Compensation for Environmental services
CL	Conditional logit model
FDG	Focus Group Discussion
GRR	Great Ruaha River
KII	Key Informants Interview
MES	Market for Environmental services
MNRT	Ministry of Natural Resource and Tourism
NGOs	Non-governmental organizations
PES	Payment for Ecosystems
PWES	Payment for water Environmental services
RBWO	Rufiji Basin Water Office
RES	Reward for Environmental services
RUNAPA	Ruaha National Park
RUT	Random Utility Theory
SPSS	Statistical Package for Social Science
TANAPA	Tanzania National Parks
TANESCO	Tanzania Electricity Supply Company
TEV	Total Economic Value
TZS	Tanzania Shillings
WTA	Willingness to Accept
WTP	Willingness to Pay
WUA	Water User Association(s)

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

For years, human societies have been depending directly and indirectly on goods and services that are provided by natural ecosystems (Ouyang *et al.*, 2018). These goods and services include clean water, timber, food, air purification, carbon sequestration, spiritual and aesthetic values as well as nature-based tourism (ecotourism) and recreation (Blume *et al.*, 2011). The dependence of man on the ecosystems is augmenting because of increasing human and animal populations, technological advancement as well as prosperity (Daw *et al.*, 2012). This dependence has lead into overutilization and degradation of these ecosystems (Mombo *et al.*, 2011).

Water, as one of goods provided from ecosystems, is essential for economic and social development (Musamba *et al*., 2011). Water as a resource can unite people that share its source such as river, lake or ocean but can also initiate misunderstandings among users because of competition (Musamba *et al.*, 2011). For the past few decades water demand for various activities has increased leading to occurrence of conflicts among its competing users (World Bank, 2005). This increase in water demand and watershed degradation constitutes some of the driving forces for water scarcity which brought the critical need for conservation of water resources (Musamba *et al.*, 2011).

Water scarcity is a function of supply and demand (Musamba *et al.*, 2011). Water demand for different land uses such as industrial, livestock production, hydropower production and irrigated agriculture for paddy, maize and vegetables production is increasing despite its degradation consequences as witnessed in the Usangu Plains (Beatus, 2011) which

calls for strategic plan for conservation which among other Payment for ecosystem services can be used as a tool for conserving degraded environments (Gómez-Baggethun *et al.*, 2010).

Payment for ecosystem (PES) is a direct conservation approach that seeks to support the positive environmental externalities through the transfer of payments from the beneficiaries of the environment services to those providing these services that are usually the upstream communities (Swai, 2016). These payments encourages the upstream land management practices to help protect environment to aid flow of ecosystem downstream and thus this scheme is increasingly regarded as a viable policy alternative for degradation problems (Farley and Costanza, 2010). These schemes works in the manner that funds collected from ecosystem services beneficiaries, usually downstream are used as an incentive for upstream user or ecosystem service providers to improve their land management practices (Sangkapitux and Neef, 2009). The ecosystem services including water flows are provided by land and water managers in the upstream whose decision, either individually or collectively has impact on flow regimes and quality and quantity of water available downstream as observed in Usangu Plains (Fisher *et al.*, 2010).

The Usangu Plains in Mbarali District constitutes one of the most important ecological systems in Tanzania that supply water for various economic activities (Lankford *et al.*, 2004). There are several water uses in the plains including domestic water uses, irrigation agriculture uses for mainly paddy production which is an important economic activity in the plain that directly and indirectly support more than 30 000 households and 250 000 people respectively (Franks *et al.*, 2013). Other uses of water in the plain include fishing and livestock uses. The plains also contribute water to the Great Ruaha River (Kadigi *et al.*, 2004) which is important to Ruaha National Park (RUNAPA) and

hydropower production in Mtera and Kidatu hydropower stations downstream. Huge abstraction of water in upstream irrigation schemes has resulted into serious water scarcity for downstream users including Great Ruaha River (Kadigi *et al.*, 2005; Mtahiko *et al*., 2006), the Ruaha National Park and Mtera-Kidatu hydropower systems (Kadigi *et al.*, 2004). Based on the realities above there is a critical need for conservation of the Usangu upper Plain to restore water flows downstream for other uses through introduction and application of payment for ecosystem services.

The conservation of water in Usangu Plains should involve participation of all beneficiaries of water upstream and downstream of the plains. It is therefore important to investigate the willingness of downstream users to pay for conservation as well as the willingness of communities living in the upper catchment to accept compensation. This information is currently lacking and the proposed study aims at filling this knowledge gap to inform different stakeholders for sustainable management of water resources in Usangu Plains.

1.2 Problem Statement and Justification

1.2.1 Problem statement

Availability of adequate water for all uses is important for economic development of every country; this is because water is a necessary input to production in almost all economic sectors (Mallois, 2010). Poor management of water and degradation constitute some of the main causes of water shortage and scarcity in many parts of the world including Usangu Plain in Tanzania (Musamba *et al.*, 2011). The challenge of water scarcity is also attributed by increasing demand for water in its different uses (Kadigi *et al*., 2005).

Studies by Kadigi *et al.* (2004); Malley *et al.* (2009); Mtahiko *et al.* (2006); Katambara *et al.* (2013) and Njau *et al.* (2013) suggest that water shortage in Usangu Plains is caused by several factors, including high consumption and poor allocation of water for agriculture production (dry and wet season irrigation practices), deforestation as well as environmental degradation associated with the establishment of large-scale irrigation schemes such as the Kapunga Rice Project. This call for identification of strategic plans and sustainable conservation efforts to restore water flow downstream the Usangu plains for other sectoral and inter-sectoral uses. Mtahiko *et al.* (2006) suggest that one way of conserving water could be that dry weather irrigator to return at least 25% of water to rivers, Moreover Kadigi *et al.* (2004) concluded that alteration of irrigation paddy production in Usangu will have effect on livelihood of people depending on paddy irrigation.

In this case conservation will aid restoration of water sources through various interventions such as tree plantation which need involvement of both users of the plain, downstream which are considered as beneficiaries and upstream which are considered as provider of ecosystems.

Seeing the direct implication of conservation to people, it is essential to study about their willingness to pay for conservation (payments which will be used as compensation) as well as willingness to accept compensation for undertaking actions that increase the provision of ecosystem services and encourage behavioral change and can consequently be considered part of the broader class to stimulate market based mechanisms for environmental policy. Thus, this study aims at determining the willingness to pay for conservation of the plain by downstream users of the Usangu plains and willingness to

accept compensation for conservation by communities living in the upper catchment the information which is lacking.

1.2.2 Justification

The findings from this study will help conservationist and other stakeholders in providing the information for informed decisions in implementation of conservation programs, and will provide useful insights to these stakeholders in conservation of water resource present in the area (Usangu Plain and particular Great Ruaha River). In addition, the information will help the investors to plan for efficient projects based on use and allocation of water, thus improving water flow downstream to increase production in various economic activities including hydropower production.

1.3 Objectives

1.3.1 Overall objective

The overall objective of this study is to evaluate the willingness for water users to pay and willingness of communities to accept compensation for conservation of water resources in Usangu plain to improve water flows downstream thus to inform sustainable management and utilization of water resources.

1.3.2 Specific objectives

i. To evaluate the willingness of downstream water users of Usangu plains to pay for conservation.
ii. To evaluate the willingness of communities living in the upper catchment of the Usangu Plains to accept compensation for effective watershed conservation.
iii. To determine factors influencing willingness to accept compensation for water conservation in Usangu Plains.

1.4 Research Questions

i. What are the factors that influence the willingness to pay and willingness to accept compensation for watershed conservation?

ii. How much are the downstream water users willing to pay for conservation of water resources in the upper catchment of Usangu Plains?

iii. Are the communities in the upper catchment of Usangu Plains willing to accept compensation for water conservation initiatives?

1.5 Conceptual Framework

A conceptual framework is used in research to outline possible courses of action or to present a preferred approach to an idea and it represent key ideas and complex interactions of a number of important constructs on the outcome variables (Ryan and Bernard, 2000). Willingness of water users downstream to pay for conservation and willingness of upstream water users to accept compensation brings together the upstream communities and downstream communities to support each other in ensuring the management of water sources. In such a case, the paid funds from downstream water users will be used as an incentive for the upstream communities to accept any conservation initiative proposed which might include changing their water use and management practices. Willingness to pay by downstream water users may be influenced by socio-economic factors such as education, income, age, gender, and household size. In addition willingness to accept compensation by upstream users may also be influenced by the benefits of alternative proposed and other socio economic factors such as education level, income farm size just to mention few.

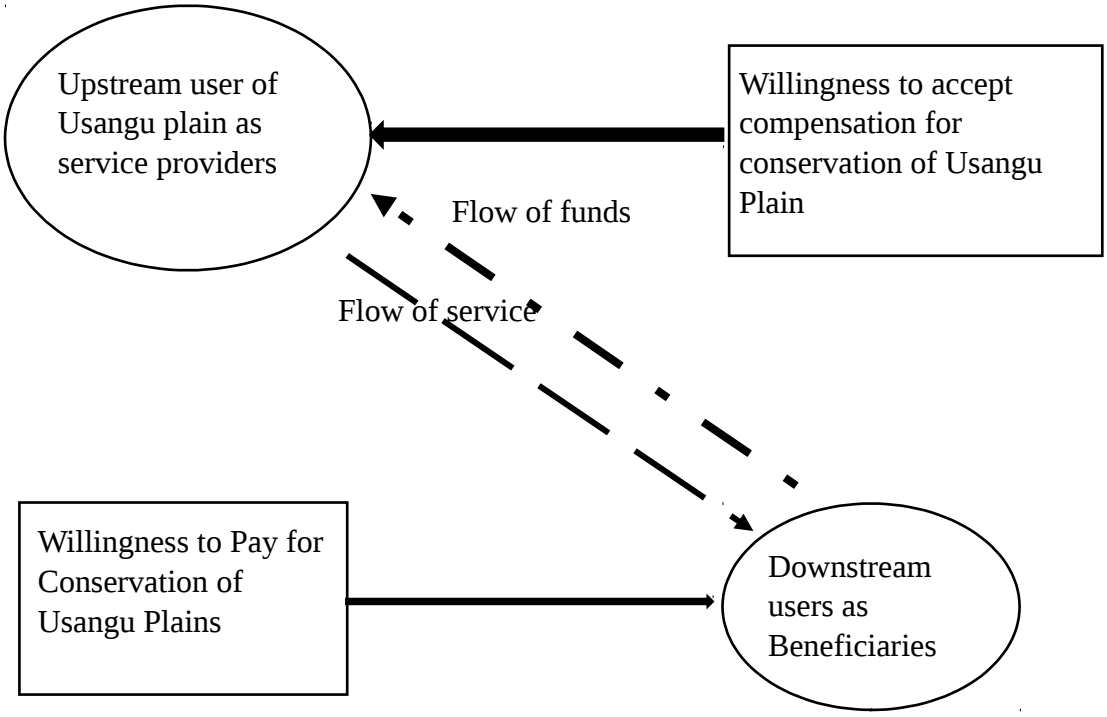

Figure 1: Conceptual framework for payment for ecosystem adopted from Sangkapitux et al. (2009)

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview of Payment for Ecosystem (PES)

Payment for ecosystem is schemes in which beneficiaries or user of ecosystem services (buyers) provides payment to steward or ecosystem services provider (seller) (Bremer *et al.*, 2014). The concept was originally meant to raise public interest and to establish a framework to highlight the social benefits of ecosystem conservation as the rate of loss of biodiversity was becoming increasingly evident (Milderet *et al.,* 2010). Different authors have tried to define PES differently, As defined by Wunder (2006) PES is voluntary transaction in which a well-defined environmental service (ES), or a land-use likely to secure that service, is being purchased by at least one ES buyer from at least one ES provider if, and only if, the ES provider secures ES provision. Another definition by Milder *et al.*(2010) explains PES as an approach to environmental management which uses cash payments or other compensation to encourage ecosystem conservation and restoration. These two definition shows that PES includes direct payments from ecosystem services beneficiaries to land stewards, as well as indirect payments earned through Eco certified production.

PES often involves a series of payments to land or other natural resource managers in return for a guaranteed flow of ecosystem services (Bremer *et al.*, 2014). The basic idea behind PES is that those who provide ecosystem services like any other services should be paid for doing so (Zhen, 2011). PES therefore provides an opportunity to put a price on previously un-priced ecosystem services like climate regulation, water quality regulation and the provision of habitat for wildlife and, in doing so, brings them into the wider economy (Bremer *et al.,* 2014).

Different authors have used different terms to describe payment for ecosystems. In some cases PES is used interchangeably with other terms such as Compensation for Environmental Services (CES) (Maes *et al.,* 2016), Market for Environmental Services (MES) (Silvertown, 2015) and Reward for Environmental Service (RES) (Cilliers *et al.*, 2012). However, in other cases a clear distinction is tried to be made among these terms. MES is widely used to indicate an approach associated with economic incentives in the presence of multiple actors, choices and competition (Milder *et al.*, 2010). The term reward is used in place of payment to overtone entitlement and justice for service providers (Bullock *et al.,* 2011) while compensation for environmental services indicate payment provision to service providers who bear costs for supplying environmental services (Kaczan *et al.*,2013).

For any conservation plan to be implemented effectively people that benefit from ecosystem should be involved and willing to participate in conservation process. PES is also one among the tools used for managing the degraded ecosystem and associated ecological and economic servicers (Mombo *et al.,* 2014). It is an important mechanism that link between conservation outcome and market based incentives approaches (Fisher *et al.*, 2010). Payment for ecosystem services work under four main principals which including voluntariness which implies change in action and behavior for both ecosystem service beneficiaries which agrees to pay for conservation and ecosystem service supplier which agrees to participate in conservation, fairness which implying recognition of local cost and trade off made for public gain, shared responsibility and collective management of natural resources, conditionality which implying that payment are only made when a certain ecosystem service is generated that also demonstrate additional improvement compared to the baseline condition and lastly is the principal of pro-poor which emphases

on improvement of local people wellbeing and not to harm them (Kaczan *et al.*, 2013; Redford and Adams, 2009).

2.2 Payment for Ecosystem Services in Tanzania

In Tanzania several studies on payment for ecosystem services have been conducted and highlighted that these schemes are aimed at acknowledging the efforts of various natural resources managers to ensure sustainable flow of ecosystem goods and services. The study done by the Ministry of Natural Resources and Tourism (MNRT, 2007) on Payment for Water Environmental Services (PWES) on Rufiji River Basin highlighted that The overall goal of developing PWES was to supplement efforts by forest and water resource managers through stakeholder participation of all those who use the ecological services of the forest and those who manage the forest catchment areas as well as the riverbanks and other water sources along Rufiji River Basin to ensure a sustainable flow of hydrological services through mobilizing financial resources for their management, based on the benefits they generate. Results from this study showed that for successful implementation of PWES sensitization and awareness creation on integrated water resources management among stakeholder is important. Majority of people that are utilizing water from the basin are willing to pay only if water quality for domestic use and quantity for other economic activities such as irrigation could be ensured and more transparent proposed system of payment for managing water environmental services could be more transparent.

Another study done by (Lalika *et al.*, 2017) also on the Payment for Watershed Conservation along Pangani River Basin (PRB) located in Northern part of the country in Tanga, Kilimanjaro and Arusha Regions showed that population increase has triggered the previous land use systems to new ones that support the growing demand of the population for more area for human settlement, agriculture and supply of water for the

increased domestic and industrial uses thus market based instruments which includes payments for ecosystems are considered important as they will motivate upstream land holders to take into account the effects of their actions when making decisions about their own land uses. The result also shows about 90% of smallholder farmers were confident of their decision and ability to pay for watershed conservation this is mainly because of their dependency on water for domestic use as well as agriculture.

Another study by (Mombo *et al.,* 2014) on the scope for introducing of Payment for Ecosystem as strategy to reduce Deforestation in Kilombero wetland catchment area reported that conservation preference for both rural and urban dwellers is positive but the willingness to pay (WTP) for conservation is very small for both communities. Rural communities willingness to pay approximately less than 1% of what they receive from the market which is three times lower than that of the urban communities willingness to pay.

2.3 Water Management in Usangu

Water Management in Usangu goes as far back as 19th when the area had abundant water, land, pastures, rich soils and wildlife (Patel *et al.,* 2014). Native people of the plain (Wasangu) gave great respect to water resources as they regard Usangu wetlands as ritual place. During this period traditional irrigation systems in different places of the country varies depending on physical condition of the pace and tribes in that particular place however irrigation was only for subsistence agriculture (Patel *et al.,* 2014). Informal and customary rights for resource management were adapted although most were quite dynamic.

Irrigation rice production in Usangu was firstly introduced by Arabs in 18th century where farrow irrigation for rice production was practiced (Franks *et al.,* 2013). After the

Germany invasion in Usangu in 1890s cost sharing was introduced and irrigation system was developed but there was no any specific institutional direction or management (Hart *et al.*, 2014). During this time non-irrigated land were typically privately owned and farmers contributed to construction and maintenance of joint irrigation systems (Patel *et al.*, 2014). Each year irrigated land was subjected to redistribution by village Chief.

After independence the new government abolished local taxes and started supplying water as free basic service (Franks *et al.*, 2013). Due to the high income potential of irrigating rice, of livestock- keeping and labor work on large state farms, in-migration in Usangu during 1970s resulted into population increase which caused tension over land and water resources use (Franks *et al.*, 2013). Although formal water use right regimes existed during this period, many farmers had no clear notion of property rights for water and there was virtually no control over water use (Patel *et al.*, 2014). Despite substantial efforts, the government had failed to achieve the goal of providing all rural dwellers with adequate and easy access to water by 1991 (Maganga, 2002). This is claimed to be due to lack considerate property right and ownership of water schemes where most local communities considered those irrigation systems as responsibility of the government (Patel *et al.*, 2014; Tarimo *et al.*, 1998). Moreover, peoples local participation in planning and operation of schemes was hardly changed and no single rural interest group for water management emerged during the 1970s (Patel *et al.*, 2014). Having the state responsible for the overall development and operation and maintenance of the water systems with no cost recovery or commitment from the users, and with a policy of “free water for all” approach proved to be a failure (Maganga, 2002).

In 1986 new water policy was developed and water fees were re-introduced in 1994. The policies give responsibilities to village councils and Water Use Association (WUA) to

manage small water supply and irrigation systems (Maganga, 2002). However management of larger systems are still under central authorities. As part of development initiatives various smallholder schemes where developed in 1980s which again led into immigration of people in Usangu and increase conflict between irrigators and pastoralists. Even after the devolution and handover of irrigation schemes, farmers still relied on government to intervene and maintain or rehabilitate the infrastructure. Farmers had little concept of equitable water distribution and an operating schedule was difficult even after the training of scheme managers.

2.4 Willingness to Pay (WTP) and Accept (WTA) Compensation for Conservation

The difference between willingness to pay and willingness to accept has been studied extensively in the environmental economics literature through stated preference studies largely contingent valuation (CV) studies or experimental approaches (Kliebenstein, 2018; Horowitz and Mcconnell, 1999; Horowitz *et al.*, 1994). The valuation literature suggests that willingness to accept will generally exceed willingness to pay measures since the latter is strictly limited by individual budget constraints while the former is not (Randall and Stoll, 2018). Tunçel and Hammitt (2014) suggested that the difference in measures is related to substitutability between goods and hence, in the context of valuing public goods, the difference between willingness to pay and accept depends on the availability of private good substitutes. Specifically, equality between willingness to pay and accept should only be expected when close substitutes are available. Horowitz and Mcconnell (2002) suggested that the greater the difference to an ordinary private good, the larger the difference between willingness to pay and willingness to accept.

The experimental literature initially presented some alternative explanations with (Kahneman *et al.*, 1990) proposing that an endowment effect could lead to these

differences. Tversky and Kahneman (1991) suggested that their theory of reference dependent preferences could be used to explain divergences between willingness to pay and accept. That is, people evaluate gains and losses differently. However Plott and Zeiler (2005); Plott and Zeiler (2011) presented evidence that the endowment effect identified by Kahneman *et al.* (1990) is a figment of the design and execution of the experiments that seek to demonstrate this effect.

2.5 Methodological Approach for WTP and WTA

Many methods for measuring the utilitarian values of ecosystem services are found in the resource and environmental economics literature. Some are broadly applicable, some are applicable to specific issues and some are tailored to particular data sources (Charles, 2015). A common feature of all methods of economic valuation of ecosystem services is that they are founded in the theoretical sayings and principles of welfare economics. Most valuation methods measure the demand for a good or service in monetary terms, that is, consumers' willingness to pay (WTP) for a particular benefit, or their willingness to accept (WTA) compensation for its loss (Ouyang *et al.*, 2018).

2.5.1 Total Economic Value (TEV)

The value of natural resources is often considered within the framework of Total Economic Value (TEV) which takes into account both the use and non-use values individuals and society gain or lose from marginal changes in ES (Maes *et al.,* 2016). TEV refers to the total gain in wellbeing from a policy measured by the net sum of the willingness to pay (WTP) for a marginal gain or willingness to accept (WTA) for a marginal loss, aggregated across the affected population.

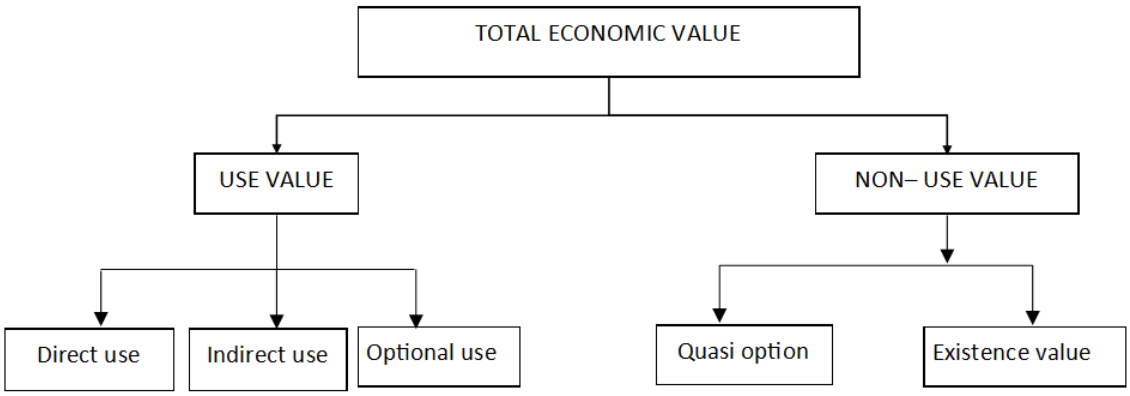

Figure 2: Total economic value framework

Under the total economic value framework total economic value Ecosystems services and natural resources can be evaluated based on whether they are categorized as direct or indirect use values, and they are several valuation techniques which include stated preferences methods which include choice modeling and Contingent valuation method reveled preference methods include travel cost method and hedonic pricing (Vieira, 2012). In this study we employ the stated preference method for assessing the willingness to pay and accept compensations.

2.5.1.1 Revealed preference methods

These approaches/methods are based on looking at decisions people make regarding activities that utilize, or are affected by an environmental service, to reveal the value of the amenity. These values are estimated based behavior in complementary market and the work well for direct use values such as timber harvesting, fishing and hunting.travel cost method and hedonic pricing are popular example under reveled preference methods.

2.5.1.2 Stated preference methods

These are direct method to value ecosystem services, individual are asked to state directly their preferences on ecosystem services. It is therefore used extensively to estimate the

value of non-market goods in the context of environmental policy and management. One advantage of these methods is its flexibility that allows a wide range of environmental changes that can be valued (Vieira, 2012). Valuation method used under stated preferences includes contingent valuation and choices modeling which is further broken down to choice experiments, choice ranking and choice rating.

2.6 Choice Experiment

This study employs choice experiments technique to estimate the willingness of water users to pay and willingness of communities to accept compensation for conservation of Usangu Plains. The technique has been used to estimate willingness to pay across a number of fields including transportation, Environmental (Hatton *et al.*, 2010) and health economics (Bekker-grob *et al.*, 2012). This survey based approach facilitates valuation of attributes that may not be directly observable in markets. It enables identification of individual attributes that are more important in consumer choices and estimate marginal WTP for these attributes. Furthermore it involves simulating the context in which consumers would normally make choices among a set of competing alternatives. This is achieved by designing an experiment in which attributes are systematically and independently varied to produce multiple choice scenarios (Tait *et al.*, 2016). Economically choice experiments were inspired by Lancaster microeconomic theory in which individual derive utility from characteristics of good rather than the good itself (Sukanya, 2014). As a result change in price of good can cause a discrete switch from one bundle of good to another that will provide the most cost-effective combination of attributes.

Table 1: Stages in choice experiment exercise

Stage	Description
Selection of attributes	Identification of relevant attributes of the good to be valued. Literature reviews and focus groups will be used to select attributes that are relevant to people. A monetary cost is typically one of the attributes to allow the estimation of WTP
Assignment of levels	Focus groups, pilot surveys, literature reviews will be used in selecting appropriate attribute levels. A baseline `status quo' level will be included.
Choice of experimental design	Complete factorial designs will be used to allow the estimation of the full effects of the attributes upon choices: that includes the effects of each of the individual attributes presented (main effects) and the combination of different attributes offered (interactions).
Construction of choice sets	The profiles identified by the experimental design will then be grouped into choice sets to be presented to respondents. Profiles can be presented individually, in pairs or in groups.
Measurement of preferences	Individual preferences will be measured based on their choices.
Estimation procedure	MLT regression or maximum likelihood estimation procedures will be used.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of Study Area

3.1.1 Geographical location

The study was conducted in four villages of Usangu Plains Mbarali district namely Ubaruku, Chimala, Ukwavila and Kapunga which represented the upstream user of the plain and Mtera TANESCO, RUNAPA which presented the downstream user of the plain since they utilize water in GRR which is filled by various small rivers and stream originated from the plain. Usangu plains are situated at 1040 meters above the sea level, an upper catchment of the Great Ruaha River, located in the Southwest of Tanzania, Mbarali District between approximately latitudes 7°41′ and 9°25′ South, and longitudes 33°40′ and 35°40′ East. The plains encompasses an extensive wetland, comprising seasonally flooded grassland and a much smaller area of a permanent swamp commonly known as *Ihefu* which collects water from all the rivers in the Uporoto and Kipengere mountain ranges (Gama, 2018). The area is tropical wet and dry characterized by uni-modal type of rainfall with mean annual rainfall of 669 mm moderate to high temperature ranging from 17˚c-29˚c low wind speed and high relative humidity (Mdemu and Francis, 2013).

3.1.2 Socio economic activities

Main activities done in Usangu flood plains are agriculture and livestock keeping, there is large scale paddy production in the area. Major farm are Madibira, Kapunga rice and Mbarali (highland estates) covering 3000, 3200, 3400 hectors respectively (Rubens, 2018), where three farming system are recognized in Usangu plain name maize- mixed farming in high Usangu, Paddy farming system in middle Usangu and Agro-pastoral

system in lower Usangu. Other economic activities include tourism, wildlife, mining, forestry (timber and logging), and fishing (Mtahiko *et al*., 2005).

3.1.3 Topography and hydrology

Usangu plain consist several rivers that originates from South and South-East highland of the plains. Major rivers include Ndembera, Mbarali, Ruaha, Kimani, and Chimala with small other rivers provides major sources of irrigation water to most irrigation schemes in the plains. Water from Rivers of the upper catchments of the Great Ruaha River is utilized by villages which it crosses (Mdemu and Francis, 2013).

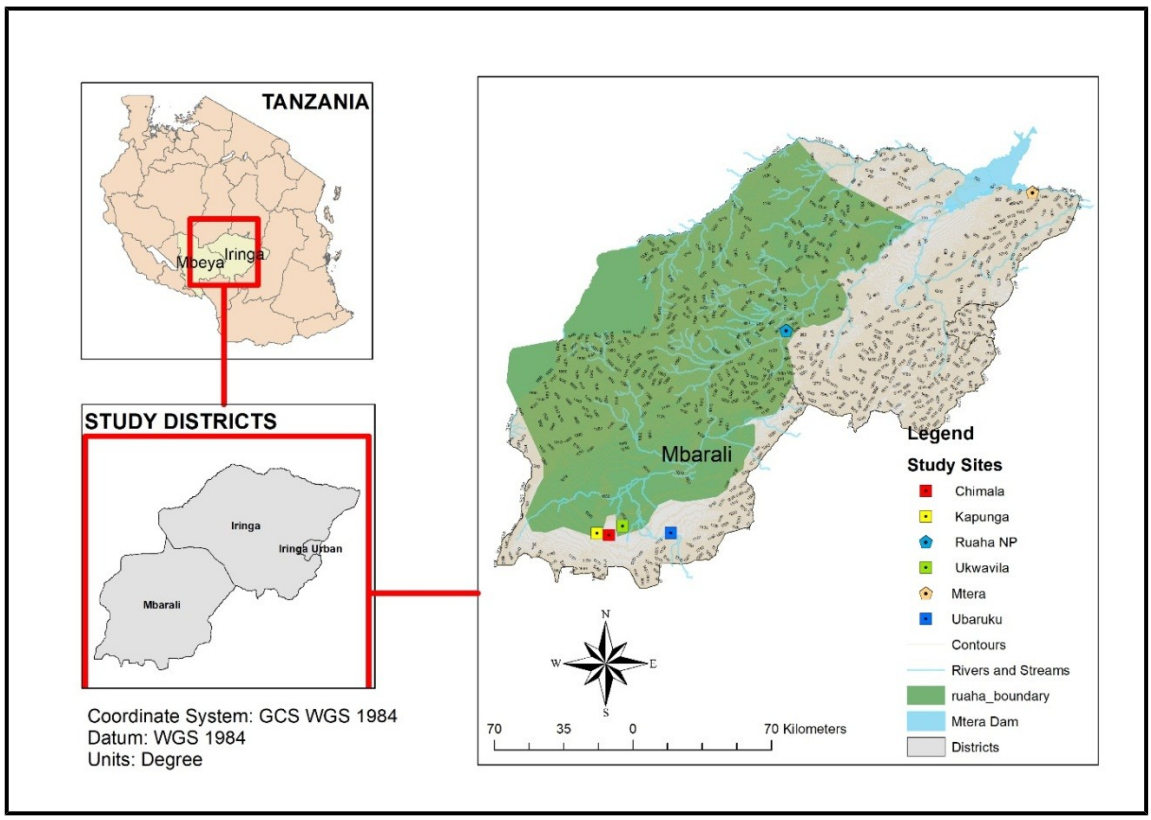

Figure 3: Study area map

3.2 Target Population

The target population of this study was upstream water users of Usangu Plains which include domestic water users, small-scale and large agriculture producers main those

using water for irrigation and downstream users which are mainly organizations that utilizes water for tourism activities and hydropower production namely Ruaha National Park and Mtera and Kidatu Hydropower plant which produces more than 70% of national hydroelectric power before joining Rufiji River and empting its waters to the Indian ocean (Rubens, 2018).

3.3 Research Design

Cross sectional research design was employed in this study where data were collected at a single point in time from selected sample of respondents in the identified villages to represent the population of Usangu plains water users. The main advantage of using cross-sectional design is that it provides useful data for simple statistic description and interpretations (Chris and Diane, 2012).

3.4 Sample Size and Sampling Procedure

3.4.1 Sampling procedure

The study used stratified sampling where the strata consisted of upstream and downstream water users which included Ruaha National Park and Mtera-Kidatu hydroelectric power stations. Usangu plain was purposely selected due to the fact that the plains play an important ecosystem services role. There are small rivers and streams in the plain which are source of water for the Great Ruaha Rivers. Further, presence of large- and small-scale paddy producer who are the main consumer of water and claimed to cause ecosystem disturbances such as water shortage because of various agricultural activities and improvements. Simple random sampling was used to obtain respondent from upstream and therefore data for willingness to accept compensation for conservation was collected.

3.4.2 Sample size

Sample size is one of the important determinants in survey estimate that depends on precision (amount of sample error that can be tolerated by the researcher) and confidence level (level of certainty that the true value of the variables is captured within the standard error or sample error) this is according to (Fisher *et al*., 2002). The greater the precision of estimates and confidence in results, the larger the sample needed (Fisher *et al*., 2002). Another factor which is equally important in determination of sample size is amount of resources available for the study (time, money and personnel). Generally the number of respondents for the study depends on type of research whether is descriptive, correlational or experimental (Suphat, 2007). For a descriptive research, the sample should be 10% of the population. But if the population is small, the 20% of the population may be required. For correlational study at least 30 subject are required to establish the relationship. According to (Bailey, 1994) a sample of at least 30 respondents is at least adequate. This is consistent with Boylds *et al.* (1981) observation that sample should be at least 5% of the total population. This study adopted the guidance by Bailey (1994) accordingly, a total sample of 200 respondents from four villages (Ubaruku 50,Ukwavila 46, Kapunga 48 and Chimala 52) were sampled. Further, key informant interviews were selected from Rufiji Basin Water main office Iringa, Ruaha National Park and TANESCO Mtera office, and four Focus Group discussions were conducted in four visited villages.

3.5 Data Collection

3.5.1 Primary data

First preliminary survey was conducted in upstream Usangu plain Mbarali District in the four chosen villages namely Ubaruku, Kapunga, Chimala and Ukwavila and downstream plain in Ruaha National Park, Mtera Hydropower station and Rufiji Basin Water Offices (RBWO) who are responsible for water allocation and management in Usangu Plains to

obtain attributes and levels used in choice set questionnaire (Appendix 1). Primary data were collected by using questionnaires, face to face interviews with Key informant (KII) and Focus Group Discussions (FGDs) to supplement the information from the questionnaire survey. Also literature review was used to supplement the information used to design a choice set questionnaire used to collect data on willingness to accept compensation for conservation by obtaining the attributes and levels that are mostly used in previous studies and which have effects in respondent's choices (Alpizar *et al.*, 2001).

3.5.1.1 Data for factors influencing WTP and WTA for conservation

Data for factors affecting willingness to pay and willingness to accept compensation for conservation was collected using questionnaires (Appendix 1). Questionnaire was administered to individuals living downstream plain to obtain the information of factors that influence willingness to participate in conservation (by paid or accepting compensation).

3.5.1.2 Data for estimation of WTP and WTA for conservation

Data for Willingness of downstream water users to pay (WTP) for conservation of upstream Usangu plain were collected through key informant interviews (appendix 2) and two focus Group Discussions (Appendix 3) with various government agencies including TANESCO Mtera and Ruaha National Park. Data for willingness of upstream users of Usangu Plain to accept compensation for conservation were collected by using choice set questionnaires (Appendix 1). Individuals from upstream the plain were administered with choice set questionnaire which was also contain socio-economic questions for Willingness to Accept (WTA) compensation. Orthogonal design using SPSS version 16 was used to create choices which were used for designing 4 choices set. Each choice set contained three alternatives, two alternatives were obtained from the designed choices and the other –the so-called *status quo* – refers to the 'no change' alternative, i.e. maintaining the

existing utility of the current practice and receiving no compensation. The randomly selected 200 respondents from four villages were asked to state their preferences and willingness to accept compensation according to the 4 choice sets and a total of 800 observations were recorded. Below is the definition of choices and table with attributes and attributes levels used in choice experiment.

3.5.1.3 Defining choices

The first attributes used to elicit willingness to accept compensation for conservation was planting trees near water sources so as to protect the water sources as well as prevents erosion that could cause destruction of banks of water sources such as river banks and decrease in water levels because of seepage loses as highlighted by (Kashaigili *et al*., 2003) constructions of irrigation canal and other development in agriculture has led to destruction and disturbances of natural ecosystem thus the proposed way which can be used to restore the condition is protection of water sources by planting trees the same approach was also used by Sangkapitux and Neef (2009) in their study on willingness to pay and accept compensation for conservation of watershed in Indonesia.

The second attribute used was cleaning of irrigation canals to remove all the overgrown grasses and other plants that prevent continuous flow of water. By cleaning these water canals water that was loss could be released and used for other activities. As highlighted by Jason (2018) overgrown in irrigation canals has been obstacle for continues flow of water has led to unnecessary water loss.

The third alternative was to use alternative source of water for irrigation and other uses, this could aid continuous flow of water from various sources to the great Ruaha River that is used downstream. For years paddy irrigation has been blamed to be source of water

shortage downstream as they do massive abstraction during growing seasons. As highlighted by (Gama, 2018) the use of underground water for irrigation in economical feasible in the study area.

Lastly was the amount of money upstream users are willing to accept to adopt and perform proposed environmental friendly practices as to aid conservation of Usangu Plain particularly water sources. Is has been developed based on focus group discussions and key informant interviews with Rufiji water basin officials which highlighted that they usually pay for water based on the use and amount of water requirements.

Table 2: Attributes and attributes levels used in choice set

Attributes	Levels
Planting and managing trees near water sources	3 trees/year, 2 trees/year,1 tree per year
Cleaning the irrigation canals	2 times /week, 1 time/week, once in every growing season
Use of alternative water sources	Use of ground water, harvesting and use of rain water
Compensation	100 000, 80 000, 60 000 (TZS/year)

3.5.2 Secondary data

Secondary data was obtained through review of the recent literature on various rtopics and related studies. Others source of secondary information included consultation with village officials in four visited villages, Rufiji basin water officials and expert from Sokoine University of Agriculture.

3.6 Data Analysis

Data obtained from field surveys were analyzed by using Statistical Package for Social Science (SPSS) version 16, excel and Stata. Data were then presented in form of tables.

3.6.1 Analysis for factors influencing WTP/WTA for conservation descriptive statistics

Descriptive statistics and regression analysis were used to determine factors influencing willingness to accept compensation for conservation. Descriptive statistics were run to obtain mean, median, mode and frequencies of socio-economic characteristics of respondents from upstream Usangu Plain.

3.6.2 Estimation of WTP for conservation and WTA compensation

Willingness to pay and willingness to accept for conservation by water users was analyzed by using content analysis and conditional logistic regression using an equations developed based on characteristic theory of value (Lancaster, 1966) which states that an individual derives utility of a good from bundle of characteristic (attributes) rather than directly from good themselves and Random Utility Theory (RUT) which highlighted that individual chooses alternative that provides them with the highest utility (Luce, 1959; McFadden, 1973). These theories are the bases of Choice Modelling practices (Arabamiry, 2013). Utility is the function of two component deterministic component (observed) and stochastic component.

$$U = V + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where indirect utility function (V) can be illustrated as follows:

$$V_i = \beta_{K.} X_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

β Is the coefficient vector of *K* attributes that associate with alternative *i* and *X* is the vector of attributes. From an outcome (such as conservation), a particular level of satisfaction or utility will be driven by the individual. By selecting an alternative *i* conditional choice probability is as follows (McFadden, 1973).

$$prob(i) = \frac{\exp(\mu \beta_K X_i)}{\sum_{j=c} \exp(\mu \beta_K X_i)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

μ and c are the scale parameter and choice set, respectively, whereby the respondent who has a choice task faced with a series of attributes (generated by the researcher). Each choice set comprises offered alternatives which include attributes. Since one of the components of utility is unobserved (error term), the analysis is faced with one of the probabilistic choices (Bateman *et al*., 2002). Thus, the probability that respondent *n* to choose alternative (Train, 2009) is indicated as follows:

$$P_{¿} = prob\left(V_{¿} + \varepsilon_{¿}\right) > \left(V_{jn} + \varepsilon_{jn}\right); j \neq i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

$$P_{¿} = prob\left(V_{¿} - \varepsilon_{¿}\right) > \left(V_{jn} - \varepsilon_{jn}\right); j \neq i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Following(McFadden, 1973) the willingness to pay (WTP) will be calculated as follows

$$WTP = b_y^{-1} \ln\left[\frac{\exp\left(V_i^1\right)}{\sum_{i \neq c} \exp\left(V_i^0\right)}\right]$$

Where;

V^0 represent utility of initial state and V^1represent utility of alternative state.b_y is the marginal utility of the income, corresponding to coefficient of cost attributes. WTP can be shown from marginal rate of substitution of any attribute to the cost attribute (McFadden, 1973). When the linearity assumption holds this is known as implicit price. The WTP estimate in equation above becomes $-b_c/b_y$. Attributes used in evaluating WTA were coded as two dummy variables because each had three levels except for one attribute (Use of Alternative Source of water) which had two levels and thus only one dummy variable.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of Upstream Respondents

Socio- economic characteristics were important parameters in this study since they have economic and socio influence on both willingness to Accept (WTA) and (WTP) compensation for conservation of Usangu Plain. In this section, different characteristics of the sampled individuals mainly age, sex, marital status, education level, households' size and Farm size were identified and discussed.

4.1.1 Education level of the head of the household

Education level of individuals within a particular community is an indicator of the level of community's human capital. In social analysis, education level of the households is an important factor that can help in estimating the adoption rate, the degree of risk taking and the ability of diversifying the available resources for livelihood support (Gama, 2018). Results from Table 3 shows that more than 70% of the head of the household's attained primary school. Education plays a major role in the socio-economic development of many societies through the adoption and innovation of new initiatives in the effort of improving the standard of living and livelihood (Kajembe *et al.*, 2009).

Table 3: Education level of the head of the household

	Frequency (n=200)	Percent
No formal Schooling	5	2.5
Primary	140	70.0
Secondary	52	26.0
Collage	3	1.5
Total	**200**	**100**

4.1.2 Sex of the head household

A result in Table 4 below indicates that 75 % of households were headed by male and only 19% of household were headed by female. High percentage of male headed households was due to the fact that people in the area follow a patriarch system whereby men are considered to be the head of the households and own most economic activities. However, sex of the household heads influences resource ownership as well as household decision therefore is expected to have influence on the willingness to accept compensation to engage in various conservation activities (Gama, 2018).

Table 4: Sex of the household

	Frequency	**Percent**
Male	159	79.5
Female	41	20.5
Total	**200**	**100**

4.1.3 Household's size and age of the head of household

Table 5 show the mean age of the household head in the study area is 41 years while mean household size is 5 members. It is argued that age of head of the household and household size could partly influence decisions on willingness to accept compensation (Stewart *et al.*, 2004).

Table 5: Mean household size and age of the household head

	Age of respondent	**Household size**
Mean	41.65	4.57
Minimum	19	2
Maximum	67	7

4.1.4 Income generating activity

Crop farming particularly paddy production, livestock keeping and small businesses were major Income generating activities identified in the study area. Findings from Table 6 shows that Majority of the households 78.6 % perform crop farming as their main income generating activity. Majority of crop produced in the study area are paddy, maize and vegetables near water sources such as rivers. Crop farming particular rice and livestock keeping are blamed to cause much of environmental disturbances.

Table 6: Income generating activities

	Frequency	**Percent**
Crop farming	166	83.0
livestock keeping	17	8..5
Others	17	8.5
Total	**200**	**100**

4.1.5 Income level

Mean income level of household in the study area ranges from 1 280 000 TZS to 7 500 000 TZS with maximum income of the household per growing season (November to June) being 7 500 000 TZS and the minimum 1 280 000 TZS per growing season as shown in Table 7. Majority of the respondents reported that they generate their income from selling their paddy in which 1acre which is equivalent to 0.405 ha of land under good management can produce up to 25 bags of paddy which are sold between 80 000-10 0000 TZS. Income of the household plays a vital role in determining willingness of individual to accept compensation for involvement and adaptation of environmentally friendly practices that will lead to conservation. As highlighted by (Sangkapitux and Neef, 2009) in their study of Willingness of upstream and downstream resource managers to engage in compensation schemes for environmental services in Thailand, low income households are more willing to engage in compensation schemes than high income

households simply because they consider compensation scheme as alternative way to generate a secure stream of cash income and to reduce their general livelihood risks.

Table 7: Mean income of household

	Income
Mean	3 063 475
Std. Deviation	1 688 436
Minimum	1 280 000
Maximum	7 500 000

4.1.6 Marital status

The study results in Table 8 shows that majority of the respondents (76%) were married. Marital status plays an important role in determination of willingness to accept compensation for conservation.

Table 8: Marital status of the head of the household

	Frequency	Percent
Single	48	24
Married	152	76
Total	**200**	**100**

4.1.7 Farm size

Results from Table 9 shows that majority of the respondent in the study area are small scale farmers with farm size between 1-3 ha. It is believed that small sized farm owners will be more willing to participate in conservation through adaptation of various practices that will lead to conservation and improvement of water flows to benefit various users including downstream.

Table 9: Household farm size

	Frequency	Percent
Below 1 Hectare	63	31.5

1-3 hectares	124	62.0
4-5 hectares	13	6.5
Total	**200**	**100**

4.2 Factors influencing Willingness to Accept (WTA) compensation for conservation

Literature recognizes different factors that influence WTA compensation for different ecosystem services including water regulating services. These factors could range from demographic to socio-economic factors such as age, sex, education and household size among others. A brief discussion of demographic and socio-economic factors underlying respondents WTA compensation is provided in this section.

Table *10*: Multinomial logistic regression results

Social-economic factor	Coefficients	Standard Error	P-value	Marginal effect
Sex of head of the house hold	0.296	0.653	0.51	0.107
Age	0.053	0.045	0.032**	0.008
Education level	0.068	0.736	0.001**	0.015
Marital status	0.059	1.03	0.056**	0.029
Household members	0.872	1.964	0.657	0.007
Income generating activity	0.659	319.906	0.974	0.0371
Income	0.729	702.864	0.997	0.0000

Note: significant at 0.05 level

Results from Multinomial logistic regression on Factor influencing willingness to accept compensation for conservation of Usangu plain (Table 10) shows that age of respondents was significant at 5% significance level with ($P<0.05$) and positive sign indicating that the probability of accepting compensation for conservation of Usangu plain through participation in various proposed environmentally friendly practices increases with age. As one unit of age increases the probability to accept compensation increases by 0.008 as indicated by marginal effect value. A possible explanation might be the fact that older participants always have a low-income level, unreliable and unsecure jobs with high physical labor, as well as no alternative source of income. Hence, personal economic gain

through compensation payment seems to have been relatively easy and more cost effective for them, and they more often selected one of the proposed options with additional payments (Mashayekhi *et al*., 2016). Also, this may also be attributed by the fact that older people are more aware of the previous condition of plain when it was not disturbed by various human interventions and thus are more willing to participate and adopt practices that will lead to conservation of its natural condition. This was also identified through focus group discussion conducted in Ubaruku village that the area was more productive and there was no water and rain problems and thus they are willing to participate in conservation as long as the Government will ensure that there is no reallocation threat from their land for conservation. Education level of the household head was significant and has positive sign indicating that as the education level of the household head increases the willingness to accept compensation for conservation also increases, as one unit of education increases the probability to accept compensation for conservation by individual also increases by 0.015. This is because individual with high education level are believed to be more aware of the importance and impact conservation of water resources in water flows and availability than those with low education level. Other studies (Ndetewio *et al.*, 2013; Swai, 2016) reported similar findings. Marital status was positive and slightly significant as seen in Table 10 above in influencing willingness of people to accept compensation for conservation this implies that married people were more willing to accept compensation for conservation than single ones. and this might be contributed to the fact that marriage as an institute has effect on decision making (Pato, 2013). Other factors such as income generating activity, sex, household size and income showed a positive sign but were not significant in influencing the probability of respondent to accept compensation to participate in various conservation practices since its P-Value were greater than 0.05 at 5% level of significance.

4.3 Willingness of Downstream User to Pay (WTP) for Conservation of Usangu Plains

Downstream Usangu plain is entirely covered by big users of the Great Ruaha River which originates and receive water from various small rivers and stream in Usangu plain. Willingness to Pay for conservation of Usangu plains by Downstream users who are Ruaha Nation Park (RUNAPA) and Mtera and Kidatu Hydropower stations which are both Government official from key informants interviews show that 57% (represented by key informants from TANESCO Mtera) they are not willing to add any other payment apart from that which they pay as water user right via Rufiji Basin Offices because they believe that this payment is responsible for all the conservation and maintenances services for the irrigation water infrastructures that are blamed to be the source of massive water losses as highlighted by (Rubens, 2018) that the construction of irrigation schemes were the source of ecosystem disturbances in the area that causes water problems not only to downstream user but also to some parts of upstream Usangu plains. One of the interviewees from TANESCO Mtera said that

> "*We are paying so much for water that we use through Rufiji Basin, we are not willing to add anything on top of what we are currently paying, so far Rufiji Basin is Responsible for managing water use for all those who use water that is coming from Usangu plains"*

These results reflect to what was reposted by Ndetewio *et al.* (2013) who assessed the on their factors influencing Willingness to Pay for watershed services in lower Moshi. In their study they found, respondents refused to offer any additional payments apart from what they were currently paying through water user right. They argued that it is the responsibility of the government to finance the conservation activities through the money they are already paying through water user rights.

Another respondent from TANESCO Mtera had another view on the lack of water. He related with poor management of water (water license) and failure of Rufiji Basin Authority in managing water use among various water users.

> *"There is no problem of water in reality because several field visit has shown that there is a problem of overgrown in irrigation scheme and there are many other scheme that are not build which lead to water losses, apart from that farmers are the one who are responsible for opening the irrigation canals gates while this was supposed to be done by the authority or government official to ensure that water is used sustainably, only problem I see is poor water management which cause water loses, if the responsible authorities can work effectively we can receive more amount of water that can be reserved and used to generate power for a longer period"*.

The same result was also observed by Sokile *et al*. (2003) in their study on integrated management of water resource in Tanzania which highlighted that lack of integrated management of water resources in Usangu has resulted into inter-institutional conflicts, ineffectiveness and gaps in management. The study further showed that for effective water resource management, stakeholder's participation and clearly definition of roles and rules of each stakeholder are very crucial. The general management plan of Ruaha National Park highlighted inappropriate irrigation practices to be the sources of water problems that are observed in Great Ruaha River and RUNAPA.

On the other hand, interviewed officer from Rufiji Basin Authority said that both upstream and downstream user of Usangu Plain are willing and able to pay for water as for the fees made by the authority depending on volume and use requirements. The only

problem they highlighted is the rates of bids paid by user doesn't reflect the real value of water and this because of the priorities that are made by the government. One of the Rufiji Basin officer said that

> "*Water management in Usangu has increased and there is more Water User Association (WUA) (approximately 35 association in Usangu Plains only) for managing and follow up on water use in the area than any other place of the Rufiji Basin, these initiative has helped to increase water flow in Great Ruaha River*" which is mostly used by Ruaha nation Park and Mtera-Kidatu Hydropower plants.

These information's are somehow contradicting with the information collected from Mtera TANESCO which concluded that the reliable source of water for them is no longer GRR rather it is little Ruaha River which supplies water throughout the year although in small amount and Kisigo which is a seasonal river but supplies sufficient amount of water during wet season.

Furthermore, results from Key informant's interview from Ruaha National Park reveal that they are willing to pay for various incentives for conservation although they pay indirect way. This is represented by 43% of the total individual in Key informant interview. One of the interviewee highlighted that they have been doing various conservation activities including adding the Usangu Game Reserve as part of Ruaha National park in 2008 thus making it the biggest national park in the country, aiming at conserving the permanent wetland of Usangu Plain "Ihefu" which serves as an important wetland for the ecosystem of the park. Another initiative to ensure conservation is rewarding local people who perform well in management of water resources through the competition that they have established in 2017 in five pilot districts namely Makete, Wanging'ombe, Mufindi, Mbarali and Kilolo. These Environmental Awards aims at

emphasizing various groups in these five districts to participate in various activities including provision of education on the importance of environmental conservation, protection and conservation of water sources, plantation of natural trees and conservation of natural forests, conservation of wetland and lastly conservation of wildlife environment. Furthermore, they have highlighted that since the TANAPA environmental award has started various organization such as Water User Associations (WUA), schools, individual persons as well as Private organization has been involves. And currents the award involves 680 participants from the above-mentioned association. They highlighted that these incentives have helped much in managing and restoring of various water sources, through planting trees and managing wildlife areas. Another important thing highlighted was that they normally don't pay for water use through Rufuji basin because they maintain the natural environmental flows, the only thing they do is to reward various ecosystem services providers through incentives like Environmental Award where the winner is also given a certain amount of money. One interviewee from the office said

> "*We don't pay for water because we are not doing business as other downstream user and also because we maintain the environmental flow where animal and plants benefits, the only thing we do as an organization and beneficiary of ecosystem services is to give various people who did well in management of water sources and environment as whole rewards and incentives. We are also engaging in various social services support like building of classes for schools in nearby communities".*

4.4 Willingness of upstream user of Usangu Plain to Accept Compensation for Conservation

From the findings in Table 11 shows that among the presented 4 choices sets to the respondents in four villages of upstream Usangu plains. Choice 1 contains the following

alternatives (planting 3 trees/year, cleaning of irrigation Canal twice/week, use of ground water and compensations of 100 000 TZS). Choice 2 contains the following alternatives (planting 2 tree/year, cleaning irrigation canals once/week, use of ground water and compensations of 60 000 TZS) choice 3 has the following alternatives (planting 1tree/year, use of rain water, cleaning of irrigation canals once in every growing season, compensation of 80 000 TZS) Choice four has the following alternatives (planting 3 trees/year, cleaning irrigation canals once in every growing season, use of ground water and compensation of 100 000). Improved alternative that would lead to conservation were more selected then status Quo expects for choice set 2 where the status quo was more selected (46.26%).

Table 11: Choice selection by percent

	Alternative	**Frequency**	**Percent (%)**
Choice set 1	1	38	57.57
	2	10	15.15
	3 (Status Quo)	18	27.27
Choice set 2	1	25	37.31
	2	11	16.41
	3 (Status Quo)	31	46.26
Choice set 3	1	27	40.29
	2	28	41.79
	3(status Quo)	12	17.91
Choice set 4	1	12	17.64
	2	33	48.52
	3 (Status Quo)	23	17.91

Table 12: Results (model output) for upstream user willingness to accept compensation for conservation

	Model output			
Attributes	**Coefficient**	**s.e**	**P[|Z| >z]**	**Willingness to accept**
Planting trees			0.094	
3 trees/year	-1.0017	0.224	0.006	62 000 TZS/year
2 trees/year	-1.7446	0.197	0.022	58 154 TZS/year
1tree/year	0.1233	0.168	0.044	
Cleaning water Canals				
Twice /week	-2.2655	1.004	0.089	75 516 TZS/year
Once /week	-1.1109	0.273	0.068	37 030 TZS/year
Once /every growing season	1.0176	0.70	0.026	
Use of alternative source of water				
underground water	0.795	0.194	0.040	
Rainwater	2.219	0.84	0.32	
Compensation	-0.00003	0.07		
Log Likelihood ratio	*-205.96173*			
Number of observations	*800*			
Number of respondents	*200*			

The signs of the parameters are consistent with theory and priori expectations. The signs of the coefficient are used to determine the preference and willingness of respondents to adopt and perform various proposed practices that will aid water resource conservation as well as sustainable use of water in Usangu plains. The negative coefficients for planting trees (3 trees/year and 2 trees/year) and cleaning of water Canals so as to allow continuous flow of water suggest that these attributes contribute negatively to utility and therefore need to be compensated for. This means that the upstream communities are willing to conserve water sources through planting trees and increasing the frequency of cleaning irrigation canals to remove overgrow of grasses only if they can be compensated at different rates based on number of trees planted each year and frequency of cleaning the canals. Furthermore Marginal willingness to accept which was estimated by dividing the attribute coefficient with the price coefficient as proposed by Kamri *et al.* (2017); Mashayekhi *et al.* (2016) and Sangkapitux *et al.* (2009). Upstream user would need to be

compensated at the rate of about 62 000 TZS per year for planting three trees on 1% of their area and they need to be compensated at the rate of 58 153 for planting two trees on 1% of their area (Table 12). For an increase in frequency of cleaning irrigation water canals upstream Usangu plain user would need a compensation of more than 75 516 TZS per year for cleaning irrigation canals twice a week and 37 030 for cleaning irrigation canals once a week. These results suggest that the willingness to increase the frequency of cleaning water irrigation canal (twice a week) under a compensation scheme is lower than the willingness to adopt tree planting as mean to conserve water source in the plain and increase water flows.

The coefficients of using alternative source of water (underground water or rainwater) for agriculture activities as well as for domestic uses have a positive sign which means that upstream user of the plain do not need any compensation for adopting these practices. These results indicate that upstream user are increasingly aware of the need to switch to alternative water sources (Gama, 2018) as competition among water users within the same community and among various sectors in upstream-downstream dramatically increased as highlighted by Sokile *et al*. (2003); Kadigi *et al*. (2004) and Njau *et al*. (2013). According to Gama (2018) it is feasible to use underground water as alternative source of water for irrigation and domestic use to address the problem of water shortage in the study area.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Based on the findings from the study it can be concluded that both users of the plain are aware of the ongoing degradation of the plains. Upstream users the Usangu Plain are willing to engage in various conservation practices some with compensation and other with no complain of being compensated as suggested by their preferred choices. This implies certain conservation options are preferred by some people, whilst others will have a preference for other strategies based on the amount of compensation offered to engage in that particular practices. WTA compensation varies between the proposed practices and it is also influenced by socio-economic factors such as education level, and age among others.

In addition, result shows that downstream users are not willing to add any addition payment apart from what they are paying as water user fees, they are only willing to continue with the ongoing conservation programs in five pilot districts which are monitored by RUNAPA.

5.2 Recommendations

i. Based on the findings and conclusion of the study the following are recommended, PES scheme to be designed not only as an agreement between upstream and downstream resource manager. Other local stakeholders in the area (e.g. investors. local administration) to be involved to provide the bulk of the compensation needed to effectuate changes in land use practices.

ii. Management of water use in irrigation scheme specifically opening of irrigation canals to allow the use in the farm, should have a serious fallow up from either Rufiji basin officer or the district officer to allow rational use of the water and thus releasing water for other sectoral uses downstream.

iii. Further, downstream users of Usangu plain to engage more in conservation. This could be through more engagement and visitations to the water sources to encourage management of water sources as well as cleaning of water irrigation canals so as to release water that is lost by overgrown grasses in the irrigation canals.

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APPENDICES

Appendix 1: Questionnaire for determination of factors for willingness to accept compensation for conservation

Introduction

Good morning/afternoon/evening! I am……. from Sokoine University of Agriculture, Morogoro, and I am part of a research team conducting a study on willingness to pay and accept compensation for conservation of the Usangu upper catchment in Tanzania. I would like to assure you that the information that you will reveal in this interview will be used solely for purposes of research, and that your identity as well as your answers will be treated with confidentiality. In answering my questions, please remember that there are no correct or wrong answers. We are just after your honest opinion.

A. Introduction of Choice Set

You are provided with the following 4 set of choice and you are required to choose among the presented choices

Choice 1	Choice 2
Planting 3 tree/year	Planting 2 tree/year
Clearing of irrigation canal twice / week.	Clearing of irrigation canal once / week.
Use of underground water.	Use of ground water.
Compensation 100,000Tshs/ year.	Compensation 60,000Tshs/year.
Status Quo	

Example of choice set presented to respondents

B. Basic Information:

Name of Respondent: _____

District: _____

Ward: _____

Village: _____

C. Questionnaire for assessment of socio-economic profile

1. Age: _____ years old

2. Gender

a. Male _____ 1

b. Female_____ 2

3. **Marital Status**:

a. Single_____ 1

b. Married _____2

c. Others 3

4. What is your educational attainment?

a. No formal schooling_____ 1

b. Primary _____ 2

c. Secondary_____ 3

d. College level _____ 4

5. What is your occupation?

a. Crop Cultivation _____

b. Livestock keeping _____

c. Crop cultivation and livestock keeping

d. Employed _____

e. Others, please specify _____

6. Number of permanent members in the household? ……..

7. What is the household total Annual income (income/one growing season)

8. If you are practicing agriculture, what is the size of your farm?

a. Below 1hectare _____

b. 1-3 hectare _____

c. 4-5 hectare _____

d. Above 6 hectare _____

9**. What are payment modes you use for water use in your area?**

a. Taxation_____

b. Direct payment(Water user Associations)

c. No Payment

d. Both Taxation and direct payment

10. **What is your main source of water for irrigation**?

a) Rainfall only

b) Rainfall supplemented with surface irrigation schemes

c) Irrigation scheme only

11. **Have you experienced any environmental problem such as water shortage for your daily activities?**

a) Yes

b) No

Appendix 2: Key Informants' interview for information about willingness of downstream user to pay for conservation

Ruaha National Park and Mtera TANESCO offices

1. What are the major changes in the flow of Great Ruaha River that has been observed in recent time??
2. Is there any fees that you pay for water use to Rufiji basin office?
3. What are the major economic activities threatening the conservation of Usangu plain and GRR
4. What measures are you taking as downstream user of Great Ruaha River to make sure that Usangu Plain is conserved
5. What are your major sources of water?
6. What are you doing to make sure that the sources of water are wall managed and conserved?

Appendix 3: Checklist for focus group discussion

1. What was the situation of the basin several years ago (ie 1980, 1990, 2000, 2010)
2. Was/is there any kind of payment that you are supposed to give the government for maintenance of the catchment
3. Is the level of water in the catchment changing?
4. What economic activities are threating to the catchment?
5. Which crop cultivated in the catchment is the most valuable
6. If maybe you are told to value of change the crop cultivated in the catchment so as to improve it and to ensure that all water user benefit throughout will you be able to do that??
7. What environmentally friendly practices are you willing to adopt and kind of compensation are you expecting from the official so that the situation on the catchment to be improved.