BENEFITS OF SPRING PROTECTION AND WILLINGNESS TO PAY FOR IMPROVED WATER SUPPLY IN EMUHAYA DISTRICT

By

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A56/65060/2010

Bsc. Agricultural Education & Extension (Honours)

A Thesis Submitted to The University of Nairobi in Partial Fulfillment of the Requirement for the Award of the Degree of Master of Science in Agricultural Resource Management (Resource Economics Option)

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DECLARATION

STUDENT DECLARATION

This thesis is my original work and has not been presented in any other university for examination.

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This thesis has been submitted for examination with our approval as university supervisors.

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DEDICATION

This work is dedicated to my parents: David and Dorcas Amondo. My siblings: Eric, Charles, Henry and Edward.

ACKNOWLEDGEMENT

I would like to thank everyone who helped me in this study. First, I would like to thank The University of Nairobi for giving me the opportunity to pursue my postgraduate studies. Your kind support has been appreciated so much. I would also like to thank Sustainable Organic Farming Development Initiative (SOFDI) and National Council of Science and Technology (NCST) for their financial support towards this study.

Special thanks to my supervisors Dr. Kironchi and Dr. Wangia for their advice, tips and for helping me sort out the best direction to take with this thesis. Your expertise and feedback has been invaluable.

I am also grateful to the entire staff of university, faculty of agriculture and other graduate students especially Sylvester, Oliver, Nicholas, Sara, Juma, Ruth and Penina for their support and encouragement.

I wish to extend my special thanks to my colleagues and family who in one way or another supported and encouraged me during field work and writing up of the thesis. I am also grateful to the respondents in Emuhaya for taking their time to listen to me and for their kind participation during the interviews.

Finally, I thank the almighty God for enabling me to successfully bring this thesis to completion.

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LIST OF ABBREVIATIONS

ATP	Affordability to Pay
CDF	Constituency Development Fund
CVM	Contingent Valuation Method
DO	District Officer
FAO	Food and Agricultural Organization
GOK	Government of Kenya
HPM	Hedonic Price Method
JMP	Joint Monitoring Program
KWAHO	Kenya Water for Health Orgaization
MDG	Millennium Development Goals
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric administration
NRM	Natural Resource Management
PES	Payment of Ecosystem Services
ROK	Republic of Kenya
SOFDI	Sustainable Organic Farming Development Initiative
SPSS	Statistical Package of Social Scientist
SSA	Sub Saharan Africa
TCM	Travel Cost Method
UNEP	United Nation Environmental Program
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WHO	World Health Organization
WTP	Willingness to Pay
WTA	Willingness to Accept
WSS	Water Supply and Sanitation Services

ABSTRACT

Supply of reliable and safe water is essential for human health and survival, food security, empowernment of women and protection of natural resources. Lack of water impedes economic development, prevents progress towards gender equality and puts people's health in danger. This study focussed on benefits of water spring protection on the lives of community members and institutions governing the use and management of the protected facility. There was a further assessesment of environmental benefits by the respondents willingness to pay (WTP) and the factors influencing them to pay. Semi-structured questionnaire was used to generate qualitative and empirical data on 200 randomly selected respondents using protected and unprotected springs in Emuhaya District of Vihiga County. Contigent valuation method was used for valuation of environmental benefits. Logit model was adopted to evaluate factors influencing WTP while the benefits and institutions of existing water structures were analyzed using descriptive methods. An independent t-test was also run to determine whether the socio-economic variables were statistically significant between households with protected springs and those with unprotected springs. The results indicated that lack of cooperation, insufficient funds/poor contributions and lack of frequent meetings were the main challenges hindering major developments towards water supply. These challenges mostly arose in the water user groups. Majority of respondents using protected springs (56.2%) had not received training on the use of the facility. The results also revealed that spring protection had significant benefits in terms of time saving, water quality and sanitation, agriculture, health aspects and social capital. Upto 93% of respondents were willing to pay in order to receive satisfactory spring protection services with a mean WTP of Ksh 111. Regression results showed that source of support, membership to group, farm size and time were significant in explaining the variations in the

WTP for spring protection at 95% level of confidence. Generally, the maintenance of the springs was still impaired due to lack of information on how to maintain in order to ensure sustainability. This led to a recommendation of further training of the community at large on conservation issues especially at spring site to ensure the resource is used sustainably and conserved for future generation. There was also a need of further studies on impact of time saved due to spring protection on agricultural productivity.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background information

Reliable and safe supply of fresh water resource is widely recognized as a both fundamental human need and a key input into economic activity (Were et al, 2006). Water supply and sanitation are essential for human health and survival, for food security and the empowerment of women as well as the education of girls, for reduction in productivity losses due to morbidity and malnutrition and for the management and protection of natural resources (Hesselbart, 2005). This illustrates that water security has real economic, social, ecological, and political value especially in the Horn of Africa and must therefore become economically more efficient, ecologically sustainable and also socially justifiable especially in water crisis regions (Martius et al, 2009). Therefore, ensuring rural water security is amongst the most important duties of the government worldwide **(**Tambe et al, 2010).

However, although the crucial importance has been widely recognized, the right to safe water and adequate sanitation remains a promise unfulfilled for the world's poorest citizens and reliable and safe supply of water resource remains one of the most important global environmental challenges (Rechkemmer, 2004). During the last three decades Kenya, Tanzania and Uganda faced serious problems in providing drinking water and sanitation facilities to entire population (Sattler, 2010). Kenya in particular, is facing a complex water resource crisis because of three legacies. Natural legacy which makes it to be categorized among the most water scarce countries in the world with a limited per capita freshwater resources endowment of less than $650m^3$ per person per year. Management legacy characterized by rapidly growing demand for

water for most of sectoral uses, lack of artificial storage capacity to meet demand and also mismanagement through unsustainable water and land use policies, laws, institution, weak water allocation practices, growing pollution and increasing degradation of rivers wetland and lakes (Republic of Kenya, 2004). This water crisis carries significant social, economic and political risks such that growing demand over limited water endowment generates competition and causes conflict over water supply hence adversely affecting the poor and communities without adequate representation in allocation of decision making.

Population growth is the most important demographic trend affecting water resources (Sherbinin, 1998). Kenya has a relatively high population growth (in 1990 the population was about 23 million and in 2008 the population increased to about 40 million people (World Bank 2010; Marshall, 2011). This population Growth trend has resulted in reduction of per capita water availability because of increased demand for food production and household use. Moreover, it has also led to increased demand for land and housing hence leading to serious fragmentation and encroachment into forest areas which are major water catchment areas. Increase in population as well as the country increasing use of water for agriculture, domestic and industrial purposes has led to increased need for funding, management and development of water resources.

Kenya's rural population remains to have a much lower access rate than the urban population. In 2006, the access rate was 49 percent and 85 percent respectively (Marshall, 2011). However, Kenya rural areas have relatively high access levels of water and sanitation services compared to other SSA countries (Republic of Kenya, 2004).

Enhancing water resource management and increasing efficiency in water sanitation service provision are among the aims of water sector reforms. Kenya has embedded its water sector

reforms into overall poverty reducing strategies in the vision 2030 (Sattler, 2010). Motivated by MDG and pressured by donor agencies the Government introduced new water policies, emphasizing economic value of water. There is close link between water and poverty which is clearly spelt out in the Poverty Reduction Strategy Paper (PRSP) and MDGs where the specific targets rely on the improvement in water sector (Sattler, 2010). PRSP recognizes that water is a basic need and important catalyst both for economic and social development (GOK, 2006). Similarly, achieving MDG target on safe water and sanitation will enhance achieving other MDG targets on gender equity, reduced poverty, and improved child attendance to school, reduced waterborne diseases which are major causes of child mortality and other MDGs. Because of the broad effects of inadequate access to water the major focus is on the fight against poverty and seeks to "halve by 2015 the proportion of people without sustainable access to safe drinking water and sanitation becomes important target (Sattler, 2010).

Improved water supply basically involves better physical access and the protection of water sources from contamination so that water meets minimum criteria for accessibility (Hutton and Heller, 2007). Improved water access especially in rural areas provides a significant step towards poverty reduction (Moriarty et al, 2004). Similarly, time, energy and resources saved from improved water and sanitation can be used by household members to engage in productive and income generating activities (GOK, 2006). It also reduces the health risks and also the costs of preventing and treating ill family members and further the reduction of working days lost to water-related diseases and a positive impact on the household's income situation (Hesselbart, 2005).

Water and sanitation services can be improved through different water development mechanisms such as water tank, roof catchment, borehole, well and spring protection. A spring is a place on

the earth's surface where ground water emerges naturally and whose water source is mainly rainfall that seeps into the ground uphill from the spring outlet (Jennings, 1996). Naturally occurring springs are important sources of drinking water in rural western Kenya as they contribute 72%. Despite of their importance, most of the springs are currently left unprotected from contamination due to human, animal and storm runoff and residents drinking water from these contaminated springs suffer from waterborne diseases such as cholera, typhoid fever, bilharzias', skin infection, hepatitis and diarrhea. These diseases often lead to death if no immediate medical attention is given (Kremer et al, 2009). In Kenya, 60% of hospital attendance is due to preventable diseases of which approximately 50% of the illnesses are related to sanitation, hygiene and water (IEA, 2007).

Spring development is usually designed to make ground water discharge more efficient, facilitate community use, maximize storage capacity and protect the source from pollution and contamination (Bekele, 2004). This technology is widely used in humid regions of Africa to improve water quality at existing spring sources (Mwami, 1995; Lenehan and Martin 1997; UNEP, 1998). It has been practiced for quite some time in Kenya and is gaining recognition in the provision of safe water for domestic use and ensures regular supply and adequate clean water leading to significant improvement in health.

1.2 Problem statement

Reliable and safe supply of fresh water resource is widely recognized as both fundamental human need and key input into economic activity (Were et al, 2006). The lack of access to safe drinking water and to basic sanitation impedes economic development, thwarts progress towards gender equality and puts the health in danger. However, Kenya surface water coverage is only 2%, a water scarce category of 647m^3 per capita against the global benchmark of 1000m^3 (KWAHO, 2009) which is further exacerbated by pollution, over exploitation and degradation of catchments areas, rapidly growing demand for water for most uses and mismanagement through unsustainable water and land use policies, laws and institutions (GOK, 2006).

According to Mumma (2005) the Government of Kenya has undertaken institutional reforms in order to address the above problems and ensure the sector meets the supply and resource needs of the un-served and marginalized. Due to lack of compliance with proposed reforms on part of some actors in the water sector and the fact that there is lack of deliberate efforts to invest in the development of available water resources such as sinking of shallow wells and the protection of springs, the problem has continued to persist.

Springs are the main sources of water in Emuhaya and yet some of them are left unprotected hence susceptible to contamination causing water related diseases. Carter et al (1999) observed that many water and sanitation programmes in developing countries have not continued to work overtime and the fact that there is limited women and community participation in implementation, maintenance and cost recovery of water services the perennial problem of water has persisted in Emuhaya and beyond. Long term sustainability of water projects is further threatened by numerous attitudinal, institutional and economic factors (Carter et al, 1999). Failure of this is partly due to poor understanding of the issues of its benefits and sustainability.

1.3 Justification

According to Mondi (1997) rationale of natural spring protection is to secure the integrity of wetland by protecting it from human or livestock damage and also to contain, filter and store a limited quantity of spring water for local use. Therefore improving water supply and sanitation has a positive impact on the individual income and poverty situation of the beneficiary household. Reducing the time and energy burden of water collection by providing increased supply of safe water enables household members to engage in other activities, among them productive and income generating activities, health improvement due to improved quality and reduction in cost of preventing and treating ill family members. Furthermore, the reduction of working days lost to water-related diseases also have a positive impact on the household's income situation and lastly environmental protection which are the desirable aims of water and sanitation programs in developing countries.

Sustainable Organic Farming and Development Initiative (SOFDI) is an NGO active in western province. Currently a major focus of SOFDI is carrying out the work of protecting springs and in this way providing access to clean water for the people. A single protected spring can supply water to 100 - 400 people depending on the area and the water capacity. SOFDI is currently active in Emuhaya and Butere Districts where they have protected approximately 70 springs (Shikanga Simon, personal communication, May 24, 2012) and have identified more springs for protection.

In view that there is growing demand for protection of more springs in other areas, there was a need to investigate and learn from the past efforts so as to better plan and address any shortcomings in the event of further spring development. The study would provide relevant information that can help in planning by various stakeholders based on the benefits of spring

protection on the rural communities. This is due to the fact that the members were directly involved in valuing the improvement based on how it had impacted on them and how they perceived the benefits.

1.4 Objectives

1.4.1 Broad objective

To evaluate the benefits of springs protection on the lives of the community members in Emuhaya District and asses their willingness to pay for improved water supply due to spring protection.

1.4.2 Specific objectives

1. To document challenges and institutions that affect successful water supply to rural communities.
2. To determine the socio-economic and environmental benefits of spring protection.
3. To determine factors and households' willingness to pay for improved water supply conditions due to spring protection.

1.5 Research questions

1. What challenges and institutions do affect successful supply of water to rural communities?
2. Does spring protection have any significant socioeconomic and environmental benefits?
3. Are households willing to pay for improved spring protection services?

CHAPTER TWO

2.0 LITERATURE REVIEW

Provision of adequate safe water and sanitation is vital for improving life and fundamental to a healthy and productive society (GOK, 2006). It promotes health, educational advancement, gender equity, income equality and environmental sustainability (IEA, 2007). It is in relation to this fact that Kaliba et al (2003) observed that lack of access to safe water and basic sanitation is at the heart of the poverty trap, especially for women and children, who suffer in terms of illness, drudgery in collection of water, and lost opportunities because of the time that water collection consumes.

Agriculture, energy, livestock, manufacturing, environment and tourism are key sectors of the Kenyan economy whose performance is directly dependent on water security. Agriculture sector uses 76% of the total water consumption and industry 4%. This implies that 80% of water is used by the agriculture and industry and has a direct bearing on economic production. Rural and urban domestic water supply accounts for most of the remainder and has a direct impact on public health (GOK, 2006).

Availability of water especially for kitchen gardens enables growth of a variety of crops throughout the year leading to economic gains from selling of crop produce and in year round there are increased employment opportunities which have direct economic benefit on local community (Whittington and Choe, 1992). This results in a positive impact on income and poverty reduction of the beneficiary household.

2.1 Water governance and institutions

Alinon and Kalinganire (2008) observed that natural resources degradation is taking place at very high rates due to bio-physical, socio-economic and political factors and recognized bylaws as a tool for better management of the natural resources. Therefore, improvement in NRM is widely seen as linked to improved governance (Hilhorst, 2008).

Although governance and institutions are always used together, they are different in real sense and it is important to distinguish the two. Governance refers to the way institutions are shaped by the society and how power and decision making are exercised within existing institutional setting (Info Resources, 2008). Environmental governance comprise of rules, practices, policies and institutions that shape how humans interact with the environment (UNEP, 2009). In defining access and management of natural resource and in sanctioning trespassers, institutions of local governance are involved. Similarly, customary or informal local governance institutions also continue to play an important role in management of natural resources (Hilhorst, 2008).

On the other hand, institutions do not have standard definition. They can be understood both as enabling (in providing way through which negotiations are made for their way through the world) and constraining (in providing the rules of action) (Mehta et al, 1999). According to Matsaert (2002) institutions are defined as organizations or set of conventions, policies or legislations that regularize social behavior. They often arise and develop from peoples actions, values, interactions hence are constantly evolving. Institutions can be formal or informal and can take different forms ranging from values, traditions, norms, conventions, rules and regulations to laws and the constitution. They also include mechanisms for accountability, conflict resolution and sanctions. Institutions operate at all levels from household to international arena and in all spheres from the most private to the most public (Matsaert, 2002).

An organization is also important since it forms the central unit of interaction in NRM and is a means of improving the resource management. There are three sectors where NRM can take place that is, (private sector, collective action and public sector) which differ by the assignment of property rights (PR) and incentive of compliance which make people cooperate. In private sector PR are assigned to individuals and utility is the primary incentive for cooperation. Collective action property rights are assigned to groups and cooperation based on normative-voluntary incentives. Lastly, in public sector, property rights are assigned to state and cooperation enforced with sanctions and penalties as the primary incentive. In practice, a given resource may be affected by a combination of management entities but it is useful to consider the incentive structure and level of operation (Meinzen-Dick and Rasmussen, 1995).

From the late 1970s, there has been increasing number of field studies of user managed resource system which suggested that government management was neither the only option nor even always the best option (Meinzen-Dick and Rasmussen, 1995). Hence, devolving management responsibility to local organizations has been seen as increasingly attractive (Meinzen-Dick and Rasmussen, 1995). A number of initiatives have emerged to promote participatory and decentralized natural resource management, more sustainable and equitable form of resource use and to reduce conflicts (Hilhorst, 2008). Emergence of local government has the potential to strengthen decentralized management of natural resources. However, local governments need to collaborate with already existing organizations and structures in order to succeed in managing natural resources in a flexible, productive, sustainable and equitable way (Hilhorst, 2008).

Natural resources are managed either individually or collectively by a variety of actors (Info Resources, 2008). However, in developing countries, it is unfeasible for each individual to operate independently in NRM hence interest in privatization has led to deal with local

organizations in order to improve financial performance and cost recovery (Meinzen-Dick and Rasmussen, 1995). Similarly in migrant areas, local organizations have been promoted by government agencies and private sector firms, mainly to increase efficiency and effectiveness of NRM while social NGOs have promoted local empowerment. This indicates how control and decision making over natural resources is being transferred in many places from highly authoritarian government agencies to local people. In addition, conservation initiatives must start at the level where all users are at stake for them to succeed unlike the rules/laws imposed from the top. Current emphasis on user groups and local management as an alternative to state control over resources has its roots in both academic studies and policy pressures (Meinzen-Dick and Rasmussen, 1995). Local organizations may play critical roles in adaptive process; in managing common property resources, regulating private resource management to protect community interests, organizing community investment to improve natural resource conditions, sharing knowledge about NRM, cooperating to market products or environmental services from NRM or advocating for community interest with policy makers and other influential external actors. At local level village committees engage in the enactment of the rules to regulate the access and use of renewable natural resources and guarantee their peaceful utilization (Alinon and Kalinganire, 2008).

Moreover, village water user committee represents all sections of the community including women. Village user committees first apply for help, then assist in construction and finally are responsible for maintenance through appointed and trained caretakers. All the above levels of action constitute significant levels of social action and studies of collective action have established a general consensus about the conditions for successful management of common property resources (Crow et al, 2009). Collective action arises in instances where there are significant incentives to cooperate (Pandolfelli et al, 2007). Consequently, community

organization success in management of natural resources depends on a larger extent on the ability of local communities to self organize themselves into collective action groups. Groups in particular bring together individuals with common problems and aspirations and who as individuals cannot meet the goal as efficiently as when in group (Obare, 2005). Therefore, by pooling together their capital, labor and other resources, members/local institutions in NRM may improve livelihoods, ensure ecosystem resilience, improve agricultural productivity and ensure sustained availability of environmental services (Mogoi et al, 2007). These profitable activities if undertaken by individuals would involve greater risks and efforts. Through this collective action, as much as collective action can enhance cooperation, they can also result in conflict, fractional division and power politics (Mehta et al, 1999). In general, common views, opinions and willingness to work together drive them towards a common goal.

Collective action and modification of property rights are essential to address many of the critical challenges of water shed management- devolving NRM to local communities, internalizing environmental externalities, negotiating use rights over resources and resolving conflict among stakeholders (Meizen-Dick et al, 1995). Recent work has urged for the need to see institutions governing water as rooted in social practice, history and culture. Considerable literature now emphasizes the importance of institutions in making and sustaining livelihoods and in managing and governing the natural resources that contribute to them. In NRM literature, institutions are considered to be key in sustainable livelihoods adaptations and knowledge on institutions is seen as central to successful policies (Mehta et al, 1999). Were et al (2006) observed that lack of standards and enforcing institutions around open springs implied increased degradation at the source.

2.1.1 Reforms in water institutions in Kenya

Ministry of Water and Irrigation in Kenya has undergone various institutional reforms in order to ensure that the sector meets the supply and resource needs of the un-served and marginalized population. According to KWAHO (2009) the first water law to be enacted was Water Ordinance 1927, followed by the Water Act Cap 372 of 1974 which committed the Government in ensuring availability of potable water, at reasonable distance, to all households by the year 2000 but in 1980s the Government experienced budgetary constraints and could not deliver water to all Kenyans by the year 2000 on its own. This led to devising ways inorder to involve other stakeholders in provision of water services. Therefore, in 1997, the Government published a manual which indicated the transferring of the management of water supply schemes to communities who were to act as custodians by taking over the responsibility of their maintenance and operation (Mumma, 2005).

The most current and third law is the Water Act of 2002 which resulted due to water sector reforms. Its an Act of Paliament which emphasizes management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water; to provide for the regulation and management of water supply and sewerage services. The reforms in Water Act adresses four themes; the separation of the management of water resources from the provision of water services; the separation of policy making from day to day administration and regulation; decentralization of functions to lower level state organs; and the involvement of non-government entities in the management of water resources and in the provision of water services (Mumma, 2005). The involvement of supporting agencies and communities in the design, implementation , monitoring, review and evaluation of project enhances the sense of ownership and this in turn

empowers people to make decisions relevant to their perception and needs, concerning the work which help safeguard the long term sustainability (Water Aid, 2006).

In Water Act 2002 the Kenya Government commited itself to adopting human rights approach which encourages the Kenya Government in collaboration with other service providers (companies, NGOs, community groups and person) to ensure right to water and sanitation for all people regardless of their background, income and living conditions (KWAHO, 2009). Therefore, under this Act everyone is entitled to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic use.

Recognition of the role of NGOs in the provision and management of water resources and community groups in the management of ongoing and new projects especially at village level clearly illustrates how the Ministry of Water and Irrigation has restructed overtime and evolved its role from that of a water service provider to that of facilitator. This poses a greater opportunity of improving water supply services (Mumma, 2005).

2.1.2 Water quantity and climate change

Water is a key medium through which climate change impacts upon human populations and ecosystems, particularly due to predicted changes in water quality and quantity (Darrow et al, 2010). Climate change presents a serious obstacle to the realization of the rights to water and sanitation and will have wide-ranging impacts on water supply many of which will be felt through changes in water availability, floods and droughts (Stern, 2006; IPCC, 2007). The main impacts of climate change on human beings and the environment occur through water, where changes in water quantity and quality affect food availability, stability, access and utilization (Bates et al, 2008). This further leads to decreased food security and increased vulnerability of

poor rural farmers, especially in the arid and semi-arid tropics. Globally, water demand is expected to grow in the coming decades, primarily due to population growth and increasing affluence (Bates et al, 2008).

Water supplies and sanitation systems are vulnerable to present-day climate variability (Howard and Bartman, 2010). With respect to water quantity, climate change is likely to shift the timing of seasonal events and cause water levels to fluctuate at varying temporal scales due to such factors as increased water surface temperatures. Therefore, improving water resource management should be a central component of climate change adaptation strategies (Darrow et al, 2010). Moreover, good water resources management is critical in building resilience in countries and communities, and in supporting adaptation to unavoidable changes (Howard and Bartman, 2010).

Climate change will have impacts on natural water stores, such as mountain glaciers and groundwater. Groundwater is most commonly the primary source of drinking water in Africa, particularly in rural areas which rely on low-cost dug wells, boreholes and springs. Its recharge is projected to decrease with decreased precipitation and runoff, resulting in increased water stress in those areas where groundwater supplements dry season water demands for agriculture and household use (Bates et al, 2008). However, climate change impacts on groundwater are poorly understood and relatively little is known about available groundwater resources in many regions (Howard and Bartman, 2010). This hinders the development of sustainable and resilient water supplies. In addition, without taking climate change into account, the limited progress made towards increasing access to drinking-water supplies and sanitation is likely to suffer reversals in the near future (Howard and Bartman, 2010). So far, water resource issues have not been adequately addressed in climate change analyses and climate policy formulations (Bates et al, 2008). Yet, within the paradigm of integrated water resources management, it is critical that

drinking-water supplies are protected to ensure the quality of water and to ensure sufficient quantities of water (Howard and Bartman, 2010).

2.2 Studies on benefits and impact of improved water supply

There are several studies that have been conducted on the benefits, impact and sustainability of the water and sanitation projects. A study conducted by Were et al (2006) on water, women and social organization in western Kenya highlands illustrated how rural communities successfully mobilized local investment in water systems in an environment where most groups have failed to do so. They further found that safe and easily accessible water brought a range of benefits to those households, especially through activities where women had special responsibilities. Households with improved water access reported time savings, improved health, cleaner clothes, and increased production of tea seedlings, milk and vegetables, with the net result of significant increases in income controlled by women.

Carter et al (1999) conducted a study on impacts and sustainability of community water supply and sanitation programs in developing countries. This study concluded that inadequate water supply and sanitation services in developing countries results in excessive expenditure of time and energy, water- and excreta-related disease and lack of privacy in defecation. The study further noted the following: that water and sanitation projects often fail to achieve significant impacts in all these aspects, and systems are often under-utilized, broken down or abandoned. Achievement of sustainability requires incentives for all stakeholders involved in use, maintenance, financing, and continuing support of water and sanitation services; community participation can be made to work in the short to medium term, but its prospects for long term success are limited partly because communities rarely have the sustainable capacity to manage their own infrastructure in complete independence of Government or NGOs. Therefore, the study

recommended new models of permanent, evolving and improving service provision for the long term. In addition, the incentives for service providers be financial and full involvement of community members at all stages of project implementation and management complemented with support in training, education, financial subsidy, technical assistance, maintenance and rehabilitation. Similarly, the study recommended that financial costs which communities are expected to raise as a contribution to capital or recurrent expenses should be acceptable, affordable, or practicable and communities to own infrastructure.

Malloy-good and Smith (2008) carried out an analysis of cost and benefit of improved water and sanitation for women and girls in SSA. The study revealed that water and sanitation projects are labelled public goods and as such social marginal benefit achieved from improved water and sanitation is greater than private marginal benefit and men and boys are considered free riders as they share the benefits of having water without paying for them because of non excludability nature of these resources. The study further indicated that, without intervention an individual would not posses the means to provide the good due to the fact that the cost of implementing the project would exceed individual willingness to pay.

To reinforce on the above, World Bank study indicated that water projects are best sustained when implemented with gender and poverty sensitive approaches and failed sustainabilty of water and sanitation services project is a direct result of not involving women in the planning process. It recommended that International agencies and NGO should involve community members in all aspects of the project, encouraging formation of committes, training in implementation and maintenance so as to increase ownership and sustainability.

2.3 Valuation of environmental improvement

Neoclassical economic theory assumes that environment is an economic good. Hanemann (2005) argued that water has an economic value only when its supply is scarce relative to demand and whenever its available in unlimited suppy its free in economic sense. Nevertheless water has traditionally been regarded as a “free” good instead of a scarce good in water economics. Hence people neglect the value of water because they can obtain it freely, it has no price, not scarce, its a common property and is not traded in a market. Since explicit markets for improvement in environment fail to exist, valuation of environmental products like the facilities for safe drinking water faces critical problems. However emergence of non market valuation has applied the same notion of economic valuation that deals with valuation in monetary terms to items that are not sold in the market (Hanemann, 2005). Use of non-market valuation applies to positive as well as negative environmental impacts of water projects hence valuation can play a key role in decisions to preserve or not.

There is increased concern about maintainence and protection of water supply for communities that acess water from natural sources such as rivers, streams, ponds and springs. Though some few rural communities in Africa have been able to improve their water supplies, most of them have not because they consider water from natural sources free. In some cases, spring protection has been done without community involvement hence lack of ownership of the project by the community. NGOs have tried to involve community in maintenance and protection of springs such that the maintenance role is entirely dependent on the community. The conservation of this improvement for future use involves a certain cost to the community which is not present in the market such that if this cost is not met the sustainability of the water resource is threatened. However this cost depends/contingent upon the benefit/utility the communities derive from the improvement in the water resource in terms of their socio-economic and environmental

wellbeing. Therefore, it was essential to evaluate spring protection improvement from an economic perspective so as to inform the policy choices. The main objective of economic valuation was to enable policy makers identify the best management practice. Based on the scarcity of resource, policy makers are obliged to make choices which can be guided by maximizing the benefits while considering the competing uses.

Some authors have also conducted studies on assessing the economic value of environmental goods or services. In the field of environment economics, a variety of methods are developed to measure benefits of improvement of environmental quality and infrastructure such as public works. Non market valuation approach is often used in environmental economics. This approach is divided into two broad categories; revealed preference and stated peference (Alberini and Longo, 2006). Revealed preference method includes travel cost method and hedonic price method, which infer the values from data on behavioural changes in actual markets, with actual purchase and consumption of marketed good and services related in some ways to the missing markets of non market resource (Carson et al, 2003). Stated preference methods such as conjoint analysis, choice experiment and contigent valuation attempt to solve the problem of non market valuation of resource by capturing the costs and benefits that may be neglected by other methods. These methods are commonly used to estimate non- use values of environment by directly surveying the consumers willingness to pay (WTP) or willingness to accept (WTA) for existing or potential environmental attributes.

The most common method used is contingent valuation method (CVM). Contigent valuation method is the most popular method in recent years because it can cover wide range of themes. It measures project benefits in monetary terms by directly asking people's WTP for such projects through a questionnarie survey while assuming that they will be implemented. It has an

advantage over the others because apart from placing a value on use value its remains the only technique capable of placing a value on commodities that have a large non-use component of value. This method has been the subject of methodological research and applied in estimating both use values and non-use values of environmental goods. Many applications of the method deal with public goods such as improvements in water or air quality, amenities such as national parks, and private non-market commodities such as reductions in the risk of death, days of illness avoided or days spent hunting or fishing. The method has been widely used to estimate WTP in water supply and sanitation project preparation (Gunatilake et al, 2007).

2.3.1 Application of CVM

The use of CVM for measuring WTP for social projects is well accepted and widely used in many different circumstances in developing countries (Mehrara et al, 2009). The CVM has improved significantly during the last 50 years and Smith (2006) one of the pioneers of the method, argues that contigent valuation (CV) research has witnessed robust progress, enabling better understanding of consumer preferences especially in analysis, survey research methods, sampling and experimental design, and policy applications (Gunatilake et al, 2007).

Fujita et al (2005) conducted a study on WTP and affordability to pay (ATP) for water and sanitation. They estimated WTP through a CVM questionnaire survey, while ATP was computed with reference to available data including the household survey data in the area. The study found out that WTP was approximately twice of the current average payment level and ATP was in the range from 10% -20% lower to 20% higher than the current average payment level. The implication of this result was that although the beneficiaries' valuation on the improvement of the water and sanitation services was high, the room for increasing the tariff

level for financing a portion of the project cost would be small due to their limited payment capacity.

Kaliba et al (2003) examined WTP for improved domestic water supply in rural areas of central Tanzania. Using multinomial logit functions they found that interaction between the water quality variable and proposed bids were important in making choices with reference to the type of improvement desired. In addition they also found that respondents who wanted to increase water supply in Dodoma region were willing to pay 32 Tsh above the existing tariff of 20 Tsh/bucket. In the Singida region, the analogous amount was 91 Tsh per household per year above the existing user fee of 508 Tsh per household per year. The research concluded that project sustainability from a financial viewpoint is largely determined by the degree to which it continues to deliver its intended benefits over a long period of time. In villages where there was strong satisfaction on projects' performance, individuals were willing to contribute more resources for improvement and community members were highly motivated and participated strongly in the daily management of the projects.

Adekunle et al (2006) also conducted an empirical analysis of WTP for environmental service of trees by corporate organization. They sought to find ways of making forest a more competitive land-use and enable sustainable management of the tropical forest in order to make good economic sense. They focussed on payment for ecosystem/environmental services (PES) of the forest as a useful tool in mitigating forest degradation as well as incentives to forest service providers. Using contigent valuation surveys they derived monetary valuation for the environmental services of urban forest trees in University of Agriculture, Abeokuta (UNAAB) urban environment. The researchers found that 77% of the respondents were willing to pay various amounts ranging from N5 – N1000 monthly. The study therefore concluded that the

sampled respondent valued the environmental services of the forest especially the shade provided for them during their meetings to the extent that they are willing to contribute towards the continued existence of trees and by implication the forests in the University environment.

Lastly, Kremer et al (2009) studied the impact of source water quality improvements achieved via spring protection in rural Kenya using a randomized evaluation. The study utilized travel cost method (revealed preference) to estimate WTP values. They found out that spring protection led to large improvements in source water quality as measured by the fecal indicator bacteria *E. coli*. Water quality gains at the home were smaller on average, but this finding depends critically on households' water source choices. They also found out that the average willingness to pay for the moderate gains in home water quality due to spring protection was at least US$3.27 per household per year.

The current study approach built on the existing literature on the benefits of improved water and sanitation services situations and willingness to pay for spring protection. The study further determined institutions, processes and challenges that affect successful supply and maintenance of water to rural communities. The study therefore resulted into recommendations of improving service provision for long term and ensuring full involvement of community members at all stages and creating incentives for all stakeholders involved in use, maintenance, cost recovery and continued support. By eliciting WTP, valuation of the benefits was enabled and the maximum value households were willing to pay towards operation costs was found to be acceptable and affordable. Therefore, ownership and sustainability of the project will be achieved in longrun.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study area

Emuhaya district lies in the Vihiga county of Western Kenya and was hived off the former Vihiga district which initially occupied an area of 563 km^2 and located on the fringes of the Rift Valley in the Lake Victoria basin. It is sub-divided into two administrative divisions (Luanda and Emuhaya), eight location and 30 sublocations. The climate in the area is equatorial with bimodal pattern of rainfall fairly distributed throughout the year and with mean annual precipitation of about 1900 mm which peaks in April and June for long rains and September and November for short rains (Kipsat et al, 2001). The district lies in the lower midland zone, consisting mainly of red loamy sand soils derived from sediments and basement rocks. The soil supports sugarcane, maize, beans and sorghum and offer good potential for crops like tea and coffee production. Despite having favorable warm and humid climate and good soils, the area is not self- sufficient in food production (Bunyore Community Development Organization, 2010). This is because of high population densities and subsequent sub-division of land along inheritance lines that has resulted in diminished farm sizes which in turn limits the amount of land that can be put into production (Nyangweso et al, 2007).

The altitude range is 1300 m and 1500 m above sea level, generally sloping from west to east with undulating terrain characterized by occasional hills and valleys ,with streams flowing from North East to the South East, draining into Lake Victoria. This undulating terrain makes it possible for occurence of springs in the area because most springs in many situations occur on rocky, hillsides and seepage slopes. The district has a population of 300,000 inhabitants with a high population density of 1350 persons per square km and a birth rate of 3.5% p.a. The district is rated among the district with the highest birth rates in the country according to 2009

population projections (Bunyore Community Development Organization, 2010). This has led to serious fragmentation of agricultural land into uneconomical units and great environmental degradation. The area is inhabited by people of the Bunyore ethnic group, a Bantu Luhya-speaking people and it is estimated that about 60% of Emuhaya population lives below the poverty line.

Figure 1 : Emuhaya division in (Vihiga County) and the surrounding counties

3.1.1 Water resources in the study area

The study area has fair surface and ground water resources due to adequate and fairly distributed rainfall. It has two major rivers (Esalwa and Jordan) that traverse across the district. However, only about 20% of the total population has access to potable water source for drinking within a kilometer. It has also been observed that springs are the main sources of water in the area and most are inadequately maintained and protected (Figure 2). In general, Emuhaya district faces water problems due to lack of deliberate efforts to invest in the development of available water resources such as sinking of shallow wells and the protection of springs. This condition is exacerbated by low health standards and poor sanitation.

Figure 2: Women fetching water from unprotected spring using cans and jerricans

Small-scale water supply projects are currently operational in the study area and managed at the village level and financing for such water projects is divided among the beneficiaries, the government and donors (Kaliba et al, 2003). Initial protection cost are provided by NGOs whose fund pays for the purchase of locally procured materials, employ technical and management back-up staff , training courses and running costs while the communities who are beneficiaries raise funds to cover operational and maintenance costs and further contribute time, labor and local materials. In addition, the community participates in the management through formulation of village water committees that oversee and manage the utilities on behalf of community members and formulate by laws which is of greater emphasis. Women participate almost in all stages of project development and management. Water Act 2002 spells out decentralization of water sector by dividing responsibilities to all levels of operation thus improving efficiency of resource allocation.

3.1.2 Sustainable Organic Farming and Development Initiative (SOFDI)

Sustainable Organic Farming and Development Initiative (SOFDI) is an NGO active in western province with the mission of improving living conditions of peasant farmers on a sustainable development basis. The two cornerstones of SOFDI's activities are the transfer of knowledge for the sustainable production of sufficient and healthy food supply by means of organic farming and for providing adequate access to clean water. Major projects include organic farming, spring protection, jiko project, goat and soya project (available at http://www.sofdi.com). Currently a major focus of SOFDI is carrying out the work of protecting springs and in this way providing access to clean water for the people.

A single protected spring can supply water to 100 - 400 people depending on the area and the water capacity (Figure 3). SOFDI is currently active in Emuhaya and Butere Districts where they

have protected approximately 70 springs (Shikanga Simon, personal communication, May 24, 2012). It has an eight steps program in developing a protected spring that include; Application to SOF-DI by the local community concerned, inspection of spring by SOF-DI; establishment of an eight-member committee, which takes responsibility for expenditure for maintaining the protected spring; contribution of the required locally-available materials by the community; all other materials (cement, wire netting, pipes) provided by SOF-DI; trained bricklayer encases the spring, with the villagers being obliged to help; a tablet inscribed with the name of the spring and the donor set in concrete; official inauguration of spring by SOF-DI; hygiene workshop; course in hygiene and sanitation and finally once a year the spring is inspected by SOF-DI and an account of its condition is given (Shikanga Simon, personal communication, May 24, 2012)

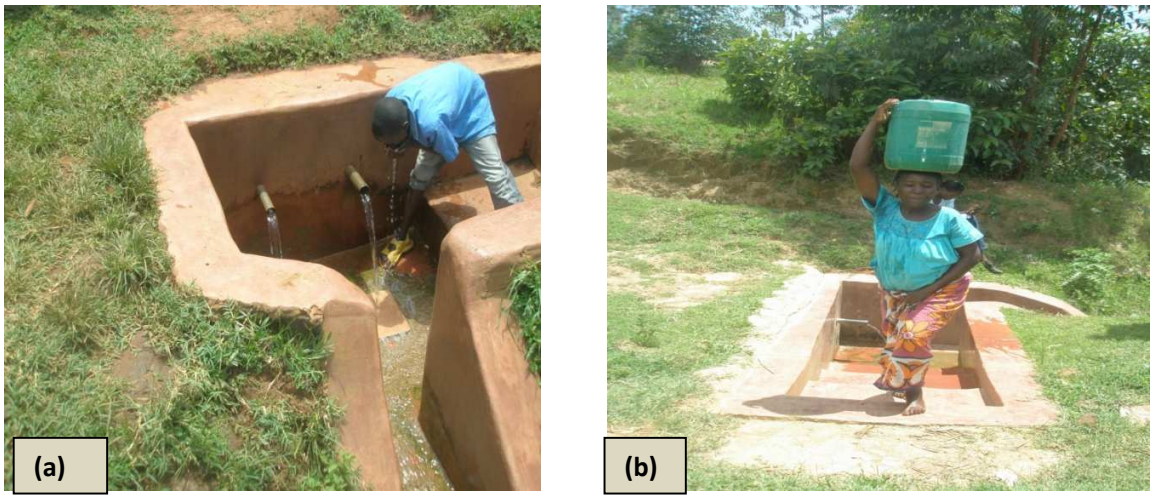

Figure 3: (a) A child drinking water from a protected spring consisting of two outlet pipes and (b) a woman climbing protected spring exit stair cases

3.2 Theoretical framework

The study adopted contingent valuation method which is a survey based elicitation technique used to estimate willingness to pay values for a specified improvement in environmental quality. The method was used because it remains the only technique capable of placing a value on commodities that have a large non-use component of value as well as the use value. Because the proposed improvements in water supply through spring protection currently do not exist in some communities at the location of the study, CVM, which ask individuals what they would do under hypothetic circumstances, was necessary as WTP for improved services could not be extrapolated from the existing conditions (FAO, 2007).

There are different approaches to modeling WTP, which involve the respondent choosing one option from a range of other alternative services or goods based on their expectations. The model most appropriate for analysis of responses to WTP bids was the conventional of obtaining a "no" or a "yes" using single-bounded dichotomous CVM by Hanneman et al (1991). This model utilizes McFadden (1981) random utility hypothesis which has become a standard approach in modelling WTP and has been widely adopted in WTP studies (Cao et al, 2010).

3.2.1 Non- market valuation for the environmental good.

In contingent valuation (CV) surveys, respondents are assumed to compare utilities. The theoretical framework in this study captures the environmental benefits based on classical theory of consumer choice where by an individual is assumed to demand goods that maximizes his utility subject to his income. Random utility maximization (RUM) is a concept that provides a link between the statistical model of observed data and an economic model of utility maximization. It arises when it is assumed that although individual preferences are deterministic

they contain some components that cannot be observed by the researcher and are treated as random variables. This unobserved components can be characteristics of the individual or item being observed and they can represent the variations in preferences among the individuals or measurement error. The random component **ε** is included in the utility model in order to modify the indirect utility function. There is an indirect utility function given by V (.) from the economic theory standpoint and it describes the maximum utility a household can get from their income (Y) subject to the prices of the good (P) and the level at which the non- market environmental good (Q) will be provided.

If it is assumed that the indirect utility function depends on the non market good Q and income y and the price vector P is left out, with the stochastic vector ε the indirect utility function is v (Q, y, ε). In valuation problem the individual considers an environmental improvement (in this case, spring protection project) from Q^0 to Q^1, ($Q^1 > Q^0$). This is an improvement so that $v(Q^1, y, \varepsilon) \geq v(Q^0, y, \varepsilon)$.

This will cause a positive improvement in an individual utility**.** The respondent is then offered with the cost of improvement and asked if he would be willing to pay for that price. Under the assumption of utility maximization, respondents in DC would accept or reject a bid amount for the change in the level of provision of a good depending on which choice would have the highest utility. Response of the respondent is yes if

$$V(Q1, y- A, \varepsilon) \geq v(Q0, y, \varepsilon) \quad (1)$$

And no if

$$V(Q1, y- A, \varepsilon) < v(Q0, y, \varepsilon) \quad (2)$$

Thus the probability that the respondent answers affirmatively is

$$Pr\{yes\} = Pr\{v(Q^1, y- A, \varepsilon) \geq v(Q^0, y, \varepsilon)\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

This can be expressed as compensating surplus that satisfies

$$V(Q^1, y- CSU, \varepsilon) = v(Q^0, y, \varepsilon) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$CSU = CSU(Q^0, Q^1, y, \varepsilon) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Is the respondent maximum willingness to pay for the change from Q^0 to Q^1

The respondent answers yes if the cost is less than his WTP and no if otherwise. Then

$$Pr\{yes\} = Pr\{CSU((Q^0, Q^1, y, \varepsilon) \geq A\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

There are two standard monetary measures of welfare in environmental valuation where one can ask people WTP for an environmental quality or WTA compensation for renouncing the improvement. WTP and WTA concepts are derived from the Hicksian welfare measures of compensating variation and equivalent variations. WTP measures amount of money an individual is willing to pay for an increase/improvement in quality or quantity of an environmental good/service. This is the maximum amount of money a household could give up in a situation (after the change in environmental quality) without being worse off than the initial situation. It measures whether an individual is willing to forego their income in order to obtain more environmental goods and services (Adekunle et al, 2006). WTA on the other hand measures amount of money an individual is willing to accept compensation for a decrease in quality or quantity of an environmental good/service. It is the minimum sum of money that could compensate the household for the respective utility loss while getting extra money. WTA is just a method of weighing opportunity cost (Cao et al, 2010). Carson et al (2003) indicate that the appropriate welfare measures depend on the property rights for the good.

Studies have shown that WTA is substantially higher than WTP (Horrowitz and McConell, 2002). In most CV studies the economic value or cost of the environmental improvement in question were only from individual WTP and researchers have spent less energy on understanding WTA and this may be regarded as the problem of hypothetical bias exhibited with WTA. Moreover National Oceanic and Atmospheric Administration (NOAA) contingent valuation panel 1 recommended the use of WTP over WTA because it gives more conservative estimates and avoids possibility of overestimating the value of a good unlike WTA which is not constrained by the budget (Arrow et al 1998, Ahtiainen, 2007).

3.2.2 Elicitation method

Different elicitation methods have been used in the previous CV surveys. Open-ended questions about WTP were often asked in early applications of CVM. Other methods include; the iterative bidding approach (Randall et al, 1974) which starts by querying individuals at some initial dollar value and keeps raising (or lowering) the value until the respondent declines (accepts) to pay. The final dollar amount is interpreted as the respondent's WTP. Alternative approach is payment card method where a number of possible WTP values are listed on a card, and to ask the respondent to pick the amount on the card that best represents his willingness to pay. The amount chosen by the respondent can be interpreted as the respondent's WTP. The most widely used approach to eliciting information about the respondent's WTP is the so-called dichotomous-choice format commonly known as take-it -or –leave- it. It uses two bidding procedures; singlebounded and double-bounded. The singlebounded model approach recovers the bid amount as a threshold by asking one dichotomous choice question, while the double bounded offers a second bid following the response to the first bid (Hanemann et al, 1991). This study adopted the DC referendum format and single bound dichotomous choice format in particular. Valuation question was posed by asking respondents a referendum question which inquired if they were

willing or not to vote for improvement in spring protection/management which would require a management fee. The respondents responded “yes” if they were willing to pay for the service and “no” if otherwise. Respondents had to make decisions about a given price similar to the way they decide to or not to buy a certain product in the supermarket. They had to say yes or no to a specific sum of money that should be paid to obtain the environmental improvement. If the respondent answers yes, then willingness to pay is greater than or equal to the offered price, and if s/he answers no, willingness to pay is less than the offered price. This format is incentive compartible in the sense that its in respondents strategic interest to acceppt the bid if his WTP is greater than or equal to the price asked and reject if otherwise (Bateman et al, 2002). However this method provides only limited information about the willingness to pay.

3.3 Data sources and structure of the questionnaire

This study used primary data which was collected by interviewing a representative sample of randomly selected households in Emuhaya. Data for the broad objective of evaluating the benefits of protected springs on the lives of the community and assessment of their willingness to pay was collected through a semi-structured questionnaire that was careful designed to capture information required based on previous studies on impacts and CVM questionnaire. The semi-structured questionaire had five major sections; background information and household composition, water facility and social organization, benefits of spring protections interms of (health, agriculture, environment), resource based livelihood activities and the last one on WTP.

The WTP section consisted of a single bound dichotomous choice bid followed by an open ended question eliciting maximum WTP to cover the cost of proposed improvement. This section also consisted of some questions on what motivated people to pay or not to. Open ended questions were used as follow up questions on WTP as they improve the likelihood of receiving

bid amounts that would provide a more precise estimate of individual WTP (Ojeda et al, 2008). This section was dependant upon the other sections which had some questions of introduction, background information/family composition (age, sex, reources, family size, distance, education), institutions and benefits because the WTP value is contigent upon these and such information has been utilized in previous CVM questionaires. The information from the CV questionnaire was intended not only to help respondents reveal their true values as accurately as possible, but also in reducing the rate of rejection.

Data was collected from both on households with protected springs and those without protected springs and also on situations after and before so as to compare the livelihoods of these households. Households using protected springs were the treatment group while those using unprotected springs were the control group. The questions related to the source of the project initiative, personal involvement in decision making, labour and financial contributions ,project benefits and consumer satisfaction with the services and management of the water utility were also asked.

3.4 Sampling Procedure

The sampling frame consisted of all households in Emuhaya District. Stratified sampling was used where the communities in Emuhaya district were divided into two stratas (households with protected springs versus those with unprotected springs) then systematic random sampling was used to select households to be interviewed.

In determining minimum sample size, Fischer's formula (Fisher's et al, 1998) was adopted. Households were used as the sampling unit.

$$\mathbf{n} = \frac{Z^2 pq}{d^2}$$

Where n = desired minimum sample size

z = statistically certainty chosen at 1.96 corresponding to 95 % confidence level

p = population proportion estimated to have a particular characteristic (85%)

q = (1- p) = 0.15

d = desired accuracy / level of precision (usually set at 0.05)

Substitution in the formula:

$$n = \frac{1.96^2 \times 0.85 \times (1 - 0.85)}{0.05^2}$$

N = 195 + 5 = 200

3.5 Survey design and administration

The draft questionnaire was pretested with four enumerators at Community Outreach Centre office which is in the middle of the study area. The final questionnaire was administered through face to face interviews to respondents who were randomly sampled. The study site was purposively sampled based on high existence of spring as the main sources of water. The population relevant for the study was individuals whose source of water is spring. Sampling unit was households using springs and only one person was interviewed from each household. The individual respondents were selected systematically at interval of 10 to ensure a total sample of 200, considering population densities and distribution of springs. A respondent was picked from every 10^{th} household considering the starting point from an arbitrary point (main road and spring were the common features used).

3.6 Methods of analyzing environmental benefits

Survey data was entered in Ms Access and later transferred to SPSS version 19 for analysis. Data was then analyzed using various descriptive and econometric procedures that include Ms Excel, SPSS and STATA.

3.6.1 Amount of WTP for the environmental benefits associated with improved spring protection

Central tendency theorem was applied to determine society's mean WTP for the environmental benefits associated with spring protection. Elicitation of WTP values have been riddled by many biases associated with poor CVM studies design (Arrow et al, 1998). It is in this respect that before WTP elicitation exercise, all anticipated biases associated with CVM surveys were re-evaluated, a plausible payment vehicle identified, a clear hypothetical market formulated and training of all interviewers to conduct the CVM format embedded surveys.

3.6.2 Payment vehicle

Definition and selection of appropriate payment vehicle on environmental component to be valued depends on the resource to be valued, socio-economic characteristics of the sample and institutional structure governing the area (Arrow et al, 1998). The payment used in the study is voluntary contribution in terms of money (cash) because the service being valued pertains to the resource use benefits of the households. Money was used as a payment vehicle because it is hypothesized that improved spring protection leads to reduced sickness that reduce health bills and improved productivity all of which translate to money.

3.6.3 Proposed program and hypothetical market

Contingent valuation studies should be able to present clearly and credible hypothetical scenario on the provision of environmental good to be valued (Amponin et al, 2007). The current study

utilized a conservation program on water resources that paid attention to providing solutions to water problems through establishment of a maintenance/management fund which would finance protection activities to be done by community members. These activities include cleaning at the spring site, caretaking and monitoring activities, investment in agro forestry at the site, repairs incase the structure breaks down and fencing. It is anticipated that these activities will affect water management by reducing illegal activities and ensuring more sustainable, stable and reliable water supply for various uses.

Hypothetical market was formulated and described to survey respondents before the elicitation of WTP values. This was done because elicited WTP values of a non-marketed good/service are "contingent upon" the hypothetical scenario in the survey (Gunatilake et al, 2007).

The following summarized hypothetical market formulated for household with protected and unprotected springs.

"….. As you know water system in your area has some problems and it has also been observed that springs in the area are inadequately protected hence susceptible to contamination and furthermore people spent a substantial amount of time fetching water. Some people incur expenses in boiling and treating water before drinking and unless something is done the water situation in your area is bound to worsen because of the increasing population. It is possible to improve water situation in your place through public, private interventions and community initiatives. In this area SOFDI has taken the initiative of spring protection. The perceived environmental benefits of spring protection include but are not limited to;

a) Improved health
b) Improved household income and poverty reduction
c) Reduced time and energy burden
d) Environmental protection

e) Reduced cost of treating water and ill members.

Suppose the intervention is successful in improving water quality, supply and access. However any improvement and maintenance of the system will cost money that will require payment for the investment put into the system through your contribution fee. Suppose this development is successful in providing the above significant improvement;

I am going to ask you some questions and would like you to answer them with ease so as to know if you or someone from your household would be willing to pay money to ensure that the Sustainable Organic Farming Development Initiative (SOFDI) water project will be successful in Emuhaya. SOFDI has decided to help you by constructing the water system in your area and your answer cannot change this fact. However the water system is going to be managed by a committee chosen by the people in the area and the committee will decide the amount each household will have to pay to operate and maintain the water system. Answers that you will give will not determine how much you will have to pay but will only be used to value water services."

3.6.4 Central tendency theorem

Mean willingness to pay was computed directly from the bids that respondents answered yes. The simple formula shown below was used to calculate the mean willingness to pay.

Mean WTP = Sum of willingness to pay values for improvement in spring protection by i^{th} respondent ÷ total number of respondents = $(\frac{\sum xi}{N})$

Where Xi is WTP for improvement in spring protection by ith respondent

N is total number of respondents

3.6.5 Determinants of willingness to pay

Discrete choice model

To determine the socio-economic variables that influence WTP the study adopted a logit econometric model as commonly and previously used in environmental studies by Lindberg et al (1997), Ahtiainen (2007) and Mehrara et al (2009). This model allows us to examine whether the explanatory variables are significant in determining WTP responses and whether they affect the responses as the economic theory, intuition and empirical expectations predict (Ahtiainen, 2007). It's a common method of estimation of WTP and belongs to the general class of binary choice models where the dependant variable is dichotomous. This allows researchers to gain information about the validity and reliability of the contingent valuation results (Haab and McConnell, 2002, Ahtiainen, 2007).

WTP depends on a variety of socio-economic factors that are given in the Equation.

Logit model is an extension and improvement of linear probability model.

$Y_i = \alpha + X_{i,\beta} + \varepsilon$ …… *(7)*

Dependant variable Y is equal to 1 if the household are willing to pay for the improvement in water and 0 if otherwise.

$Yi = P(Y = 1)$…… *(8)*

The method was chosen to analyze household's decision for paying for improved water services and to see if the independent variables will have a significant influence on the consumer WTP for improved water services.

$WTPi = X_i \beta + \varepsilon$ ……(9)

Simplified as $WTP = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_{4+e}$

Where $x_{i=}$ represents the ith explanatory variable (vector of observed characteristics of demand, socio-demographic, attitudinal, behavioral variables. To avoid serious weakness of having predicted values Yi falling outside the 0, 1 range the linear models is transformed into cumulative probability function

$Pi = F(X'_i, \beta)$…… (10)

If the cumulative probability function is logistic then the logit model takes this form

$$\boldsymbol{Pi = \frac{1}{1 + e^{-Xi\beta}}}$$

Therefore the empirical model for measuring probability that a household is willing to pay for improved water services is expressed as

$Pi = F(WTPi)$…… (11)

Where

Pi is probability function (the probability that an individual is willing to pay)

e represents the base of natural logarithms

Xi represents the ith explanatory variable (vector of observed characteristics of demand, socio-demographic, attitudinal and behavioral variables

β_i is a parameters to be estimated (a vector with corresponding estimated variable) coefficients

ε_i is the error vector consisting of unobservable random variables

The logit model equation sought to inform research question three “To assess factors and households’ willingness to pay for improved water supply conditions due to spring protection”.

The coefficient sign in the model provides information about the effects of the variables to the probability that the dependent variable is one. If the coefficient is positive, an increase in the variable increases the probability of a yes answer in the choice question and an increase in the variable decreases the probability of a yes, if it’s negative. Different non market valuation studies have come up with region specific findings regarding factors that influence WTP. This concept is relatively new in developing countries and has generated varying results regarding the factors that influence WTP.

The study also made few hypotheses in the logistic econometric model and the variables are shown in the Table 1. Income, number of people in the household, educational level, farm size, distance and time were hypothesized to positively influence WTP. Other variables such as membership to group and source of support were also investigated to assess how they influence WTP for environmental benefits associated with spring protection.

Table 1; **Expected sign of various variables in the analysis for WTP model**

Variable	**Description**	**Expected sign**
F1WTPPS (dependant variable)	A dummy indicating whether respondents are willing to pay to get improved services of spring protection. WTP=1 if yes =0 if no.	+/-
A2AGER (years)	Age of the respondent	+/-
A5PRSPR	Respondent position in the household	+
A6EDUR	Respondent level of education	+/-
C7DIST(metres)	Distance respondent walk to the source of water	+/-
C8MEMW	A dummy indicating whether respondents are members of water user groups. MEMW=1 if yes = 0 if no	+/-
C11CONTF(Kshs)	Group contribution fee	+
E1FARSZ (acres)	Household land size holding	+
E10INCOM (Kshs)	Respondent level of income	+
TRNM	A dummy indicating whether respondent was training on management of water facility. TRNM=1 if yes =0 if no	+/-
D4IITIMFE (Minutes)	Time consumed for water collection per day	+/-
C12CONTM (Kshs)	Amount of money contributed towards maintenance of spring	+/-

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1 Challenges and institutions that affect successful water supply

4.1.1 Household socio-economic and demographic results

This information is important in understanding the general background of the respondents. Results showed that 22.5% of those interviewed were male and 77.5% were female. This indicated a higher percentage of female because they are the primary collectors and decision makers of water collection activities.

The respondents' age ranged from 18- 93 with an average age of 46.42 and was categorized into four groups. In terms of distribution 27.5 % of respondents were in the age bracket of 18-35 years old. Another 22% were between 36- 45, 36.5% between 46- 65 while 13.5% had over 65 years.

Majority of respondents were aged between 18-65 years. This group constitutes the productive age group of the population and the implication is that other productive activities will probably be abandoned for fetching water, which will subsequently lead to less productivity, reduced earning power, hunger and possibly poverty (Adamassu et al, 2003).

Majority of respondents (81%) were engaged in farming, while 9%, 2%, 0.5% and 8% were involved in small scale trade /business, teachers, civil service and other activities respectively. This indicated that only 3% of the respondents were engaged in formal employment. These results are supported by the Government of Kenya (2005) Development Plan that gives non-formal employment mainly (agriculture) of the area as being 79.8% of all employments.

Results also revealed that the average land holding of the respondents was 1.53 acres. This value is consistent with the Kenya Integrated Household Budget (KIHB, 2005) that gives the average land size as 1.5 acres (Government of Kenya, 2005). However, this value is below the FAO recommendations that give an average land holding of 3.6 acres per household for subsistence food purposes (FAO, 1999). This indicated scarcity of land that can be attributed to fragmentation of land that is mainly due to high population densities.

Family size ranged between 1- 15 with average number of people living in the household as 5.3. This value is consistent with Government of Kenya (2005) District Strategic Plan, which gives an average number of people living in a household in Vihiga district as 5. In terms of education most of the respondents (67.5%) had completed or had some primary education. Some 8.5% had not attained any formal education, while 1.5% had completed nursery. At least 21% of respondents had some secondary education, and a small percentage (1%) had completed college/university education. Therefore the education level of respondents was generally low as shown in Table 2.

Table 2; **Percentages of respondents on household level of education**

Level of education	**% of respondents(n=200)**
No formal education	8.5
Nursery	1.5
Primary	67.8
Secondary	21.1
College/university	1
Total	100

Source: (Authors survey, 2011)

The total monthly incomes for these households was low with about 53.5% of respondent earning below Kshs 2,000 per month from both formal and informal activities, while 47.5 % earned above Kshs 2,000 per month (Table 3).

Table 3; **Monthly income levels of households in Emuhaya**

Income level (Kshs per month)	**% of responses (n=200)**
0-2,000	53.5
2001 - 5000	19.5
5001 - 10,000	22.0
10,000 - 20,000	3.5
20,000+	1.5
Total	100

Source: (Authors survey, 2011)

In conclusion, these findings indicate that households in the study area have low income and this is mainly due to the fact that the main source of income is generated from non formal employment (mostly farming) which is limited by the small uneconomical land holdings and low levels of formal education.

Crop and livestock activities formed the main source of income in the area. There were varieties of crops grown in the area due to adequate, reliable and well distributed rainfall throughout the year (Kipsat et al, 2001). Most respondents planted maize (30.8%) and beans (29.7%) while 13% grew bananas, 8.8% vegetables, 1.3% groundnuts,0.8% tea,4.2% soybeans,1.9% sugarcane, 4.2 cassava/potato and 5.5% others crops (sorghum, millet, fruits) as shown in Table 4.

Table 4; **Major crops grown by households in the study area**

Crops grown	**% of responses**
Maize	30.8
Beans	29.7
Bananas	13.0
Vegetables	8.8
Groundnuts	1.3
Tea	0.8
Soybeans/peas	4.2
Sugarcane	1.9
Cassava	4.2
Others	5.5
Total	100

Source: (Authors survey, 2011)

The major types of livestock reared by the respondents were cattle (86.3%), poultry (84.8%), goats (13.7%) and (6.1%) sheep. The maximum number of cattle was seven with an average of 2. The number of poultry reared ranged from 0- 47 with the average of 5. Results show that 72.5% of respondents experienced food shortage at times, 9% said they always experienced a shortage while 18.5% indicated they never experienced any shortage.

4.1.2 Independent sample test for household characteristics

To determine the socio-economic variables that were statistically significant between household with protected springs and those with unprotected springs, an independent sample t-test was run. The results are presented in Table 5. Six variables: household size, membership to water user group, membership fee, and time spent fetching water, water quantity and training were found to be statistically different between the two groups. The results showed that households with unprotected springs had slightly more number of people living in the household than those with protected springs. These results were statistically significant at 10%. The results also indicated that mean membership to water user group was higher in households with protected springs than in households with unprotected springs. These results were statistically significant at 1% level. Mean group membership fee for households with protected springs was higher (Ksh 83) than that of their counterparts with unprotected springs (Ksh 11) and this was statistically significant at 1%. Average time spent in fetching water per day was higher in households with unprotected springs than in household with protected springs. These results were also significant at 1% level.

Table 5; **Independent sample t-test for household/group characteristics**

Variable	observations	Mean	Std. Dev	t- value	Sig(2 tailed)
Age (years)	200	46.34	16.150	-1.031	0.306
Protected	152	46.65	15.893		
Unprotected	48	48.50	16.926		
Education level	200	2.05	0.778	-1.91	0.236
Protected	152	2.01	0.822		
Unprotected	48	2.15	0.618		
Household size	200	5.30	2.257	-1.737	0.087*
Protected	152	5.12	2.026		
Unprotected	48	5.88	2.795		
Income (Kshs)	200	1.84	1.011	1.095	0.276
Protected	152	1.885	1.050		
Unprotected	48	1.71	0.874		
Distance to spring (metres)	200	317.30	249.906	-0.870	0.388
Protected	152	326.84	221.818		
Unprotected	48	350.42	323.848		
Membership to water user group (dummy variable)	200	0.62	0.487	6.0704	0.000***
Protected	152	0.74	0.442		
Unprotected	48	0.25	0.438		
Group membership fee (Kshs)	200	66.35	161.380	4.623	0.000***
Protected	152	83.24	180.356		
Unprotected	48	11.46	36.084		
Time spent fetching water per day (minutes)	200	2.42	0.739	-7.914	0.000***
Protected	152	2.20	0.623		
Unprotected	48	3.08	0.679		
Average water quantity per day (20 litre jerrican)	200	3.20	0.884	3.107	0.003***
Protected	152	3.30	0.862		
Unprotected	48	2.85	0.875		
Training on use of water facility(dummy variable)	200	0.32	0.468	10.505	0.000***
Protected	152	0.42	0.496		
Unprotected	48	0.00	0.000		

Asterisks denote statistical significance * at 0.1, ** at 0.05 and *** at 0.01, Degrees of freedom (df) 198.
Source: (Authors survey, 2011)

Water consumption per day for households with protected springs was also higher on average than for the households with unprotected springs and this was statistically significant at 1%. Training on the use of water facility is an integral part in spring protection, therefore it can be

inferred that household using protected spring for their water collection activities went through the training exercise unlike their counterparts who did not because their springs are not protected. Results found out that training was highly significant (1%). Munyua (2009) also conducted an independent t test to determine the social- economic variables that were statistically significant. These findings show that households with protected springs have more benefits than those using unprotected springs.

4.1.3 Water sources

Around 76 % of households interviewed in the study area fetch their water from protected springs while the rest fetch from unprotected springs. Distance to the water collection point (spring) ranged from 50 m (very near) to 2000 m (far) and an average of 317m from the respondents households. Although this study did not seek to find out if there was a significant effect of spring protection on distance, a similar study conducted by Kremer et al (2009) revealed that there was no statistically significant effects of spring protection on the average distance households walked to their main drinking water source (the average length was about 10-11 minutes one-way or 20-22 minutes round-trip). However, this study indicated that distance to the protected springs was shorter than the distance to the unprotected springs.

Several organizations were involved in spring protection in the area. The majority of households (60.3%) fetched water from springs protected by SOFDI while a small proportion (3.3%) those protected by Government under CDF fund, 6% by LATIF, 4% by religious organizations and 26.5% by others. This implies that most spring protection is done by NGOs. It also illustrates how NGOs have taken up the mandate of providing and managing water resources especially at village level as this role of NGOs is recognized by the Government of Kenya (KWAHO, 2009).

The study focused on spring protection intervention because it dramatically and quite cheaply result in improved source water quality in a rural African setting, thus reducing contamination by 73% on average (Kremer, 2009).

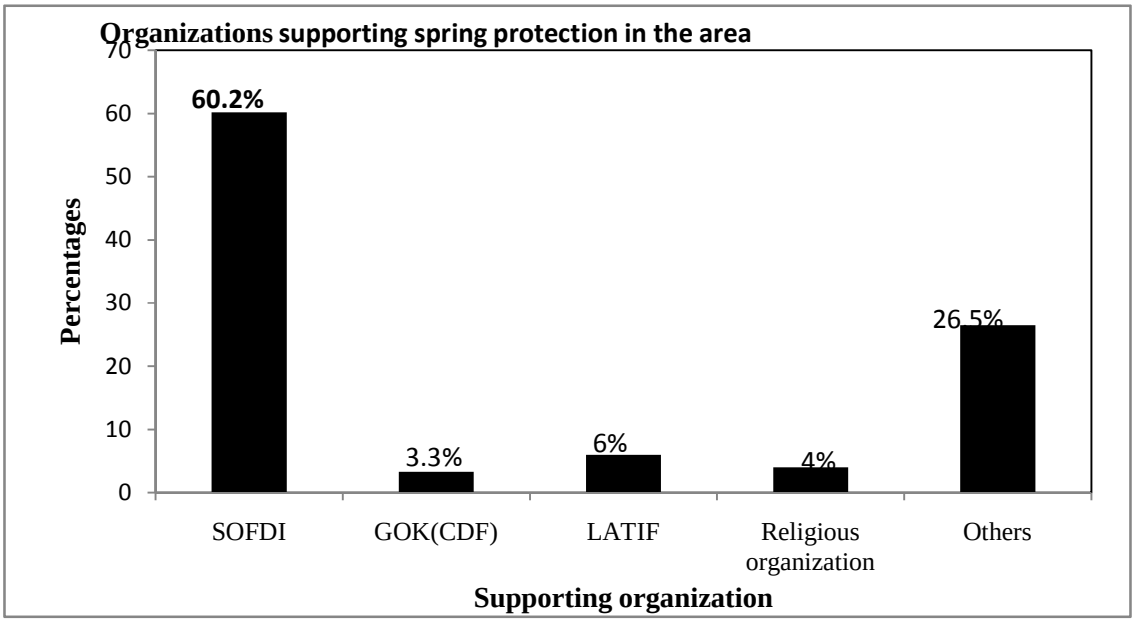

Figure 3: Organizations supporting spring protection as indicated by respondents
Source; (Authors survey, 2011)

4.1.4 Social organization

Most of the households (62.6%) interviewed were members of water user groups while 37.7% were not. For the respondents registered in water user groups, 71.8% were female, 21.0% male, 1.6% joint and 5.6% were either children or parent.

These results were consistent with those of a study by (Were et al, 2006) which revealed that, active participation of women and initiation of water projects was seen as the responsibility of women. High percentage of women in groups reported can be attributed to the fact that women are the ones that bear the brunt of fetching water from distant sources and undertake most if not all domestic and farm work. Moreover, their active participation is important because they play

key roles in the provision and maintenance of water, sanitation and hygiene at the household level.

Research revealed different reasons for joining different water user groups. The most cited reason for group membership was to help in spring protection (50%), some (42.7%) of respondents indicated that it was the need for clean water, 4% of respondents were elderly hence joined the group to offer advice to other group members. A small number indicated other reasons such as to be helped in terms of need, help to reduce poverty, because the group was working well and finally, because they were using water from the spring.

The group also offered some services; the major ones were to coordinate protection (32.3%) and mobilization for spring protection (39.5%). Some 11.3 % of respondents indicated that it helped them in making rules and regulations to govern the running of the group. Another 7.3% stated that it helped them in farming and 6.5% of respondents said that groups offered advice services while 1.6% cited merry go round services and 0.8% of respondents indicated that groups offered loans for businesses and help in times of need for each one of them.

In a related study conducted by Schusler and Decker (2003) indicated that groups evolve in their understanding of issues relevant facts, problems, opportunities, areas of agreement and disagreement. Moreover, operations and daily deliberations of activities in the water projects are more so coordinated by committee and group members'. Hence, collective action resulting to improved economic, physical and social wellbeing of the group members.

The results agree also with a study conducted by Leino (2007) which revealed those user committees were often springboards for other economic activities: for instance, they may band together for income generating activities to cover maintenance expenses for the spring and distribute extra profits among themselves. In addition, the user committees might also become

rotating savings and credit associations (ROSCAs) and tangible benefits to individual members from collective efforts of supply and distribution of water acted as incentives to continued cooperation.

4.1.5 Challenges experienced in water user groups

Challenges are inevitable in any social organization/group, therefore respondents indicated some challenges presented in the Table 6. Some 45.2% of the respondents in groups indicated that lack of cooperation was the major problem hindering major developments in the group. Some 18.5% indicated lack of enough funds while 12.1% cited lack of frequent meetings. Another 14.5% said it was low contributions while 8.5% indicated failure to contribute and 0.8% blamed the leaders for not working well. More so our investigation revealed that lack of enough funds/ failure to contribute were the main challenge especially by the water user group members because some members still regarded water services as an entitlement to them that should be provided by the government. In a related study conducted by Admassu et al (2003), it was reported that insufficient community partnership with the management, lack of adequate skills with financial management for water sources and lack of gender sensitivity were key weaknesses. These challenges are correlated because they all address low commitment on the part of the beneficiary members. Management implication of these findings is that if these challenges are solved they could contribute meaningfully to maintenance and enhance sustainability of spring protection and other environmental protection activities.

Table 6; **Group challenges experienced during protection of springs and other developmental activities**

Challenge	**% of respondents (n=124)**
Failure to contribute	8.1
Failure/ no frequent meetings	12.1
Lack of cooperation	45.2
Lack of enough funds	18.5
Leaders not working well	0.8
Low contributions	14.5
No challenge	0.8
Total	100

Source: (Authors survey, 2011)

In their respective groups, respondents indicated certain activities that were carried out as a group. Most respondents (92.7%) joined groups to obtain good water services and the activities performed compliment the reason as shown in Table 7.

A similar study conducted by Admassu et al (2003) revealed that, 76.7 % respondents out of all users of protected water sources had made contributions either in cash or in kind needed for water development. This is consistent with this study where every member had to contribute either labour or funds towards spring protection. Although Meshack (2003) reported that, monitoring forest and attending community meetings that decide on various implementation activities were major activities. This study revealed that carrying sand and stones were the major activities. The main reason of this difference is the nature of the resource being protected. Adamassu et al (2003) noted that community participation in spring development was important because of the type and volume of work in spring protection which is labour intensive.

Table 7; **Percentages of responses as scored by different group activities during protection of springs**

Activity	% of responses
Carrying sand and stones	49.7
Cleaning the spring site	13.4
Cooking for masons	10.7
Planting crops/ flowers/trees	6.0
Contributions(money and materials)	14.8
Coordinate meetings/registration	2.7
Mobilize funds	2.0
Security	0.7
Total	100

Source: (Authors survey, 2011)

Results also revealed that majority of respondents (56.2%) using protected springs had not received training on the use of a protected facility while only 43.8% had received some training. Most of the people who received training were fetching water from protected springs.

4.1.6 Leadership and group membership

Majority of the respondents (64.4%) belonging to water user groups indicated that most of decisions made in their groups was through consultation of leaders and members, 23.1% of respondents said that they were made by leaders only, while 9.4% said through members consensus and only 3.1% of respondents indicated that they were imposed from outside. The results show that members were involved in decision making which is important because it leads into ownership of ideas. This is shown in figure 4.

Past studies indicated that water user groups should have leaders who are responsible for water related activities. Abdullaev et al (2010) reported that in most case studies of informal water user groups, the leader was initiator of formation of the group and that strong ownership of land

where the spring was located was also an important feature. Moreover, the type of leadership and members who participate also play a significant role in group productivity.

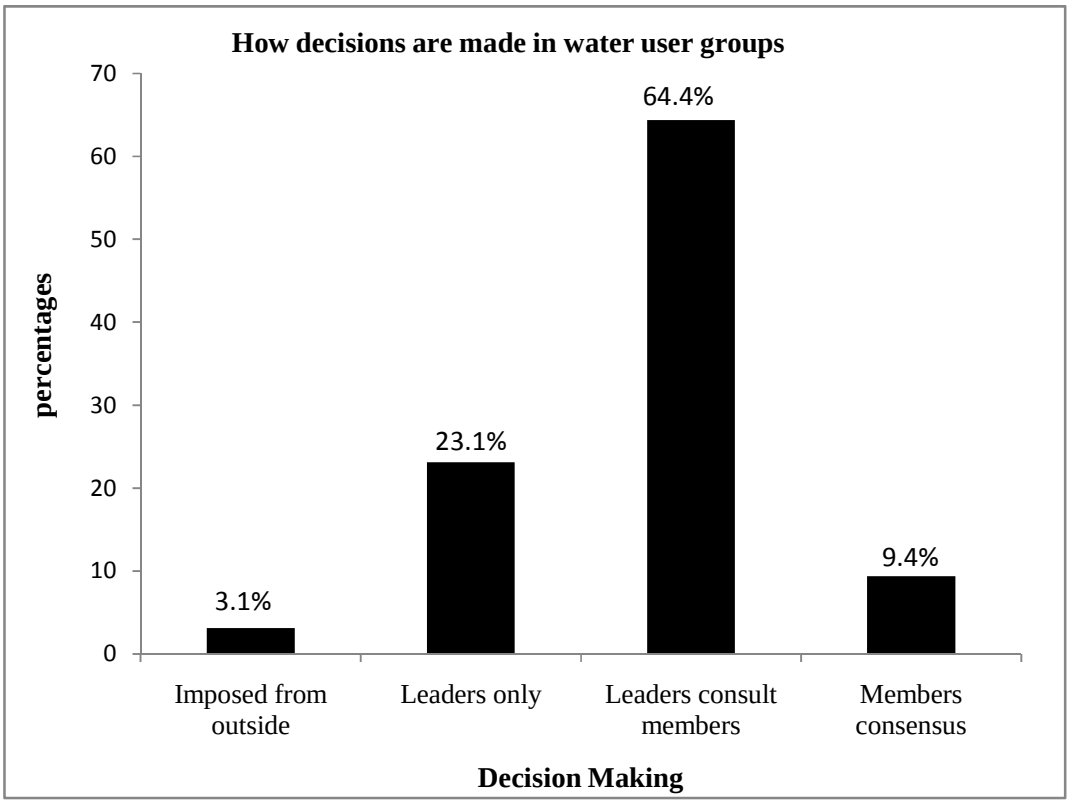

Figure 4: Frequencies of how decisions are made in the water user groups
Source: (Authors survey, 2011)

About 82.5% of respondents were satisfied with leadership while only 18.7% were not satisfied. For effective running of the water user groups, an institution that governs the usage and operation of the group/ water facility is important. Majority of respondents (92%) in groups had formulated rules and bylaws to be followed by members and only 8% had not. Out of 92.2% of the respondents, 9.9% had very good knowledge of the rules, 76.5% had good knowledge while 10.5% and 3.1% their knowledge was poor and very poor, respectively. Majority of the respondents (60%) indicated that the rules/bylaws were relevant, 20% perceived that they were somewhat relevant and 20% very relevant.

These results are consistent with a study done by Were et al (2006) whose results indicated that all of the members interviewed and some of their wives were aware of the group's bylaws and that sanctions were also in place to deal with defaulters. It was also revealed that all groups should be organized into smaller units and should have its own set of rules or norms that regulate behavior.

There was some relationship between knowledge of the rules and perception of the relevance of the rules such that those people who had very good knowledge indicated that the rules were either relevant or highly relevant. At least, 26.5% of respondents showed that on average the members fully adhered to the rules while 61.7% indicated that members at times adhered and some 11.7% indicated that members rarely adhered to the rules. These results are presented in Figure 5. Out of 119 respondents who indicated that at times/rarely do members adhere to rules cited some reasons why members found it difficult to adhere. These reasons included ignorance to the rules (46.2%) and 19.3% of respondents indicated lack of custodian/caretaker to monitor the rules and ensure that the rules are followed. Another 6.7% said that some members were not familiar with the rules, 5.9% indicated that some members despised the leaders hence did not follow the rules, while 3.4% said it was because some members did not attend the meeting, and the rest said they did not know why it was difficult for some members to adhere.

Admassu et al (2003) study suggested the need to have guards and trained personnel to undertake maintenance works, increasing the capacity of water sources through spring collection boxes and faucets. Ignorance, poverty coupled with lack of strong community commitment was also revealed to degrade the immediate environment contributing decisively to the sustained transmission of communicable diseases. This implies that rules/bylaws and commitment are important for sustainable management of water resources.

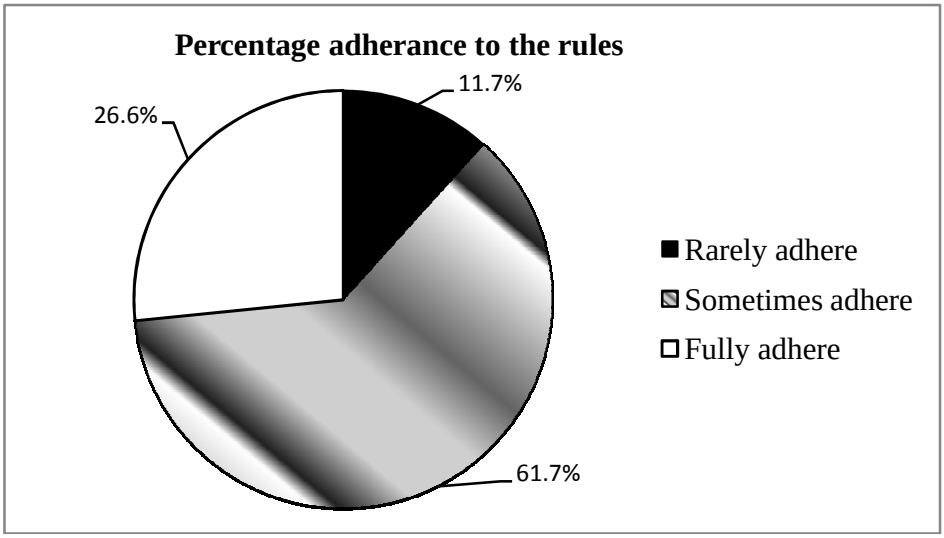

Figure 5: Household members' percentage adherence to the rules in protected springs management Source; (Authors survey, 2011)

4.2 Socio-economic and environmental benefits of spring protection

Households with protected springs recorded a reduction in time spent in fetching water with majority (52%) using time interval of 15-30 minutes compared to before, where majority (59.3%) spent 30-60 minutes (Table 8).

Table 8; **Household time used for collection of water per day before and after spring protection**

Time interval (minutes)	% of respondents before (n=200)	% of respondents after (n=200)
NA	0	24.2
<15	1	5.6
15-30	12.6	52
30-60	59.3	15.2
>60	27.1	3
	100	100

Source: (Authors survey, 2011)

Majority of respondents spent less time in filling the jerrican after the spring protection with 62.5% of respondents spent less than 15 minutes while 12.0% and 1.2% of respondents spending 15-30 minutes and 30-60 minutes, respectively (Table 9). These results are consistent with

Adamassu et al (2003) who indicated that majority of respondents (64.9%) used the time interval of 15- 30 minutes to fill their jerrican in the existing water conditions.

Table 9; Household time used for filling 20-litre jerrican before and after spring protection

Time interval (minutes)	**% of respondents before (n=200)**	**% of respondents after (n=200)**
NA	0	24.0
<15	8.0	62.5
15-30	66.5	12.0
30-60	25.5	1.5
>60	0	0
	100	100

Source: (Authors survey, 2011)

Water is said to be adequate when it is supplied in the right quantity to meet all the uses it is meant for (Gleick, 1996). Households with protected springs reported an increase in water consumption since majority (39.2%) of the households used more than six 20- litre jerricans per day compared to before spring protection when most respondents (40.4%) used between three to four jerricans. This could be partly because they spent less time fetching water and less time filling the jerrican and also less fatigue because they did not have to scoop water from the spring using a jar (Table 10). Inferences that can be drawn from this finding is the main behavioral change that results from spring protection is an increase in the use of the protected springs for drinking water (Kremer et al, 2009).

Similar study conducted by Aderibigbe et al (2008) produced similar results where more than half of the respondents (64.8%) used less than 140 litres of water per day for all purposes.

Table 10; **Household water consumption before and after spring protection**

Water quantity (in terms of 20litres) per day	% of respondents before (n=200)	% of respondents after (n=200)
NA	0	24.1
1-2	9.1	3.5
3-4	40.4	9.5
5-6	38.9	23.6
>6	11.1	39.2
	100	100

Source: (Authors survey, 2011)

Households with protected springs also provided their perception of water quality as being better after protection as compared to before protection. Majority said the water quality was good (40.4%) and very good (32.8%) while only 2.5% reported that it was poor. Majority of respondents (96.4%) indicated that the water quality was poor/very poor before protection. These results are presented in Table 11.

Table 11; **Water quality perception of household before and after protection of springs**

Water quality	% of respondents before(n=200)	% of respondents after (n=200)
NA	0	24.2
Very poor	30.6	0
Poor	65.8	2.5
Good	3.6	40.4
Very good	0	32.8
	100	100

Source: (Authors survey, 2011)

Results in the Table 12 indicate activities respondents 'preferred doing with the time they saved from water collection activities. They spent most of the saved time (81.3%) working on the farm while a small fraction of the time (18.7%) on other activities. This is because farming was the major occupation of the majority of respondents and constitutes a larger percentage of their income.

Similar study conducted by Were et al (2006) revealed that time for relaxation, visiting friends and relatives, men spending more time doing casual work and increased cohesion between wives and husbands were the main activities done with the time saved. Consequently, most of the time saved was reported to be used on working in the farm. This could be partly because there are more women in the area as compared to men and spent most of their time farming which is their main livelihood strategy.

Table 12; Activities done in the time saved from water collection

Activity	**% of responses (n= 152)**
Work in the farm	81.3
Looking after livestock	1.9
Trade in the market	5.0
Attend women's meetings	2.5
Cleaning	6.9
Other activities	2.5
Total	100

Source: (Authors survey, 2011)

The five major water uses reported include washing, human consumption, bathing, livestock consumption and kitchen gardening with 22.1%, 21.5%, 19.4%, 18.7% and 14.1% respectively (Table 13). Households with protected springs and those who reported to know agricultural benefits associated with water were subjected to some questions regarding the same. Increased vegetable production was the major benefit reported by 26.2% of respondents, increase in milk supply reported by 22.2% of respondents, increase in livestock numbers (20.2%) and production of napier grass 16.8%. Other benefits included less diseases due to frequent spraying, increased seedling production, 4.4% and 9.9% respectively (Table 13). Similar studies conducted by (Were et al, 2006) indicated that increased supply of indigenous vegetables was reported by 80% of households; increased milk production reported by 67% and increased production of tea

seedlings reported by 50% of households. These findings may be accounted for by small parcels of land owned by the people in the area forcing them to revert to vegetable production.

Table 13; **Major household water uses and benefits associated with spring protection**

		% of responses
Major water uses	Washing	22.1
	Kitchen gardening	14.1
	Human consumption	21.5
	Livestock consumption	18.7
	Bathing	19.4
	Seedling irrigation	4.0
	Others	0.1
	Total	100
Agricultural Benefits	Increase in livestock	20.2
	Production of Napier	16.8
	Increased milk supply	22.2
	Increased vegetable production	26.2
	Increased seedling production	9.9
	Less diseases due to frequent spraying	4.4
	Others	0.2
	Total	100
Health benefits	Less waterborne diseases	31.5
	More washing of clothes	17.1
	More bathing	14.8
	More washing of utensils	11.1
	No need to boil and filter water	16.7
	No discolored clothes/utensils	8.6
	Others	0.2
	Total	100
Environmental benefits	Planting trees	31.0
	Planting grass	51.6
	Planting flowers	13.6
	Fencing the surrounding area	3.3
	Others	0.5
	Total	100

Source: (Authors survey, 2011)

Households with protected springs also provided some perception of the health benefits associated with improved water supplies. Results show that most households (31.5%) reported a reduction in waterborne diseases, 17.1% reported more washing of clothes, 16.7% said there was no need to boil or filter water, while 14.8%, 11.1% and 8.6% reported more bathing, more washing of utensils and no discolored clothes/utensils respectively (Table 13).

These results are consistent with other such studies. A study done by Were et al (2006) indicated that majority of respondents 80% reported reduction of incidences of waterborne diseases. Similarly, Admassu et al (2003) indicated that accessing safe water for better health, bringing community awareness on hygiene, understanding the need of water source attendants, reducing the problem of water leaches and fencing were opportunities. Clasen et al (2007) also found out that water and sanitation interventions had the potential to reduce waterborne infections and the associated disease burden by as much as 50%.

Protection of the spring also had influence on the environment. Most households indicated a positive effect on the environment (71.8%) while a negligible percentage (2.7%) indicated negative effect, while 25.5% of respondents had not experienced any effect. Major positive effect reported was planting of grass (51.6%), planting of trees (31%), planting flowers (13.6%) and fencing the surrounding (3.3%). Most of the trees planted were eucalyptus. Table 13 shows the major water uses and benefits.

Similar studies revealed that on average, there seemed to be some improvement in maintenance outcomes and maintenance quality at water sources where the committee received a grant. In conclusion, time saving, health improvement, provision of privacy, and environmental protections are some of the desirable impacts of water and sanitation programs in developing countries (Carter et al, 1999).

Results indicated that respondents were also familiar with water- borne, water- based and water-related diseases and their symptoms. It was noted that most of the people (29.2%) knew about typhoid, 18.5% diarrhea/stomachache, 15.3% cholera, 13% malaria. Another 13% cited coughing and sneezing, 1.0% dermatitis, 9.4% cold/fever and 0.6% bilharzia.

Majority of the respondents (86.7%) indicated that they had experienced the adverse effects of the waterborne diseases/symptoms they mentioned while 13.3% had not experienced though they had knowledge about waterborne diseases.

Table 14; **waterborne diseases/symptoms**

Disease	**Percent of responses**
Diarrhea/stomachache	18.5
Cholera	15.3
Typhoid	29.2
Malaria	13.0
Coughing and sneezing	13.0
Skin disease	1.0
Cold/fever	9.4
Bilharzia (Schistosomiasis)	0.6
Total	100

Source: (Authors survey, 2011)

4.3 Factors and households willingness to pay for improved water supply conditions due to spring protection

4.3.1 Willingness to pay

Majority of respondents (93%) were willing to pay to receive satisfactory spring protection services while only 7% were not willing to pay anything. The mean willingness to pay for maintenance of springs to both households with protected and those with unprotected springs were Ksh 111.25, with a standard deviation of 58.55. The WTP value was encouraging due to the fact that a higher percentage of the respondents earned an income of not more than Ksh 5,000 per month. Some 6.5% of respondents were not willing to pay anything, while 23.5% were willing to pay Ksh 50, 27.5% were willing to pay Ksh100, 26.0 and 16.5% were willing to pay Ksh150

and Ksh 200 per month, respectively. Average willingness to pay for households with unprotected springs was slightly higher than for those with protected springs that is, Ksh 116.67 and 109.54 respectively.

The percentage of people not willing to pay was slightly lower than that of study conducted by Moffat where 15.2% of respondents expressed reservations because they regarded water services as an entitlement to them that should be provided by the government. Not willing to pay in this case was attributed to the fact that people were getting water as a social service/entitlement. However, due to the problem of sustainability of considered services, it is vital that people view water as an economic good and establishment of a fund to improve the reliability of supply is necessary. In consistency with other studies, households in this study appear to be more likely to be willing to pay. Adekunle also found out that 77% of the respondents were willing to pay various amounts ranging from 5 Nigerian Naira – 1000 Nigerian Naira monthly. Mehrara, (2009) also revealed that 69.2% of the respondents were willing to pay to get drinking tap water connections.

Results indicated that the main reason for paying/ motivation factor was that most respondents really needed improved water services (65.6%) and (22.3%) were concerned about the health risks of existing water supply system. Some 3.1% cited other reasons among them environmental issues (Table 15). Ahtiainen (2007) also sought to understand why people at Gulf of Finland were willing to pay. The main reason was that they wanted to maintain the Gulf of Finland clean for the future generations (80.2%) and to protect the nature in the Gulf of Finland (71.0%). Similarly, Samdin (2008) also revealed that higher percentage (65.1%) wanted to conserve and preserve Taman Negara National Park for the future generations. The answers in these studies

were used in order to distinguish between those who truly place a value of zero on the good, and those who responded zero for some other reason (Bateman et al. 2002).

Table 15 ; Motivation factors for households willing to pay

Reason	**% of responses**
Fee is not high	9.0
Want improved water services	65.6
Worried about health risks of existing water supply system	22.3
Others	3.1
Total	100

Source; (Authors survey, 2011)

Table 16; **Frequencies of WTP values for households using protected and unprotected springs**

Willingness to pay(Ksh)	Frequencies of respondents		Total
	Protected	Unprotected	
0	11	2	13
50	35	12	47
100	43	12	55
150	40	12	52
200	23	10	33
	152	48	200

Source: (Authors survey, 2011)

Apart from paying monthly rates for maintenance and major repair works, households with unprotected springs were also willing to pay subscription fee which is paid once. Only 4.2% of respondents using unprotected springs were not willing to pay subscription fee while 43.8% were willing to pay Ksh 100, 33.3% of respondents were willing to pay Ksh 150 and only 18.8% were willing to pay Ksh 200. The average subscription fee that households with unprotected springs were willing to pay was Ksh 131.25 which is slighter higher than the maintenance fee because it is only paid once. Respondents' willingness to pay implied that they acknowledged importance of water for it is the main natural resource that is vital for improving life and fundamental to healthy and productive society (GOK, 2006).

4.3.2 Factors affecting households willingness to pay

The WTP for spring protection was regressed on respondent's age, education, household size, source of support and distance to the spring, membership to water user group, farm size, income and time. Table 17 presents the estimated coefficients. The Pseudo R^2 was 0.230, implying that the listed variables jointly explained 23.0% of the total factors that affect WTP. In a related study on WTP, Munyua (2009) found R^2 to be 0.40 which is slightly higher than this. P values indicated that four variables; support, membership to group, farm size and time were significant in explaining the variations in the WTP for spring protection (Table 17).

The following specific inferences were drawn from the Table 17. First WTP was determined by the source of support in spring protection for there was significance at 10%. Results indicated that farm size influenced WTP and there was a direct relationship between the two at 5%. The positive sign suggested that households with a larger farm were found to be more willing to pay. This could be attributed to the fact that those with large farm sizes may be using water for some irrigation purposes. The coefficient of farm size can be interpreted as follow, holding everything else constant; a unit increase in farm size will result in P1.235 increase in WTP.

Membership to water user group, a dummy variable was found to influence WTP negatively at 10%. According to the model, this variable explains WTP in that households belonging to water user group were less willing to pay. This might be attributed to the fact that those belonging to the group had already contributed some amount of money towards developmental activities hence less willing to pay unlike their counterparts who have never contributed.

Results also showed that time used in fetching water per day influenced WTP negatively at 10%. This implied that households who spent more time in fetching water were not willing to pay. This was an interesting result but the reasons for this are still unclear. The estimation

coefficient of time used for fetching water suggests that a unit increase in time would reduce WTP by P 1.188.

Average distance walked to the spring, income, education and household size which were expected to have significant influence on WTP were found to be insignificant. Age was found to have the expected negative sign even though it was insignificant. According to this model, the variable did not explain WTP. The negative sign was expected to imply that the older the person the less he/ she was willing to pay for improved water supply. Education level had the negative sign and was not significant in explaining WTP. This is contrary to expectations. Distance to the spring site had a negative sign and was also insignificant in explaining WTP. The variable did not explain WTP and this was also contrary to expectation. Household size which was also expected to be significant was found to be insignificant with a positive sign.

Some of the variables in this study were not consistent with findings in other studies (Mehrara, 2009) study indicated that WTP for connections increased with the difficulty of drinking water provision. This implied that the longer it took to collect water (more distance, more number of trips to collect water and time takes to reach tank), the more the consumers were willing to pay for connections.

Even though income was shown to be insignificant, it was highly expected to have a positive significant influence on WTP. There has been mixed results in the previous studies. Mehrara et al (2009), Adekunle et al (2006), Samdin and Aziz (2010), Wang et al (2006) and Ahtiainen (2007) found the level of income being significant and having a positive influence on environmental WTP**.** Chen and Chern (2002) found out that income had a significant and negative effect on WTP while Adesope et al (2010) found out that income had no significant effect on WTP.

However, Fujita et al (2005) study on WTP was consistent with the result of this study. The results found out that the lower the current water usage volume or the shorter the water availability time, the higher the WTP. They therefore considered that water supply volume restricted by limited water availability time resulted in the higher WTP. The analysis of the social determinants of the willingness to pay can also be used to give insights concerning other issues such as designing health policy and tariff construction (Abou-Ali and Carlsson, 2004).

Table 17; **Logit regression analysis for the WTP**

	Dependent variable			**WTP**
Explanatory Variable s	**coefficient**	**Std. error**	**Z**	**P>|Z|**
Age	-0.011	0.027	-0.41	0.685
Education	-0.064	0.482	-0.13	0.894
Household size	0.158	0.199	0.79	0.428
Support	0.539	0.292	1.85	0.065*
Distance	-0.001	0.002	-0.73	0.468
Membership to group	-2.266	1.352	-1.68	0.094*
Farm size	1.235	0.608	2.03	0.042**
Income	-0.171	0.429	-0.40	0.690
Time	-1.188	0.645	-1.84	0.066*
Constant	5.998	3.518	1.70	0.088*

R^2 =0.230 n= 150 asterisks denote statistical significance * at 0.1 and ** at 0.05.
Source: (Authors survey, 2011)

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study sought to evaluate the benefits of protected springs on the lives of the community members. The study then determined the economic valuation of improvement in spring protection and factors that influence WTP.

Most of the respondents in the study were female, whose education was not beyond primary level. Majority of them were aged between 46-65 years, earning less than Kshs 2,000 per month and farming was their major occupation. The average number of people living in a household was five and the average land size holding was 1.5 acres. However, households using protected springs were slightly younger, had fewer members in a household and the distance covered to a spring was shorter.

Majority of respondents fetched their water from protected springs and were able to indicate some of the benefits associated with this. Given the importance of spring protection in organizing people into social groups 63% of respondents indicated that they belonged to water user groups and majority (93%) indicated that the main motive of joining the group was the need for clean water and participation in spring protection activities. Furthermore most of them stated that they were satisfied with their group leadership because most leaders consulted members in decision making. To prevent illegal activities at the spring site and ensure sustainability of the resource, most of the respondents indicated that they had rules governing the use of the protected facility and majority had sufficient knowledge about them.

Most of the respondents using protected springs recorded a reduction of time in filling the 20 litre jerrican and overall reduction of time in fetching water per day. They used the time saved for several activities and since the main activity of most respondents was farming, they spent most of the time saved working on the farm. Similarly, majority of respondents using protected springs indicated that water quality and sanitation was better than before protection.

Households with protected springs indicated to have experienced some benefits not enjoyed by those using unprotected springs. On agricultural benefits majority of respondents indicated an increase in vegetable production and increased milk production which might be attributed to increase in Napier grass production. Also there were health benefits experienced and they include reduction in waterborne diseases, more frequent washing of clothes and no need to boil water and filter clothes. Similarly the project had environmental benefits at the site which included planting of grass and trees.

Most respondents were willing to pay for the improvement of springs and their maintenance. The mean WTP was with respondents in unprotected springs willing to pay slightly higher than those already using protected springs, mainly because the water quality and quantity in their springs was low and they had not paid anything before.

Results revealed that source of support, membership to water user group; farm size and time used for collecting water per day were some of the factors that influenced WTP. While source of support and farm size influenced WTP positively, membership to water user group and time influenced WTP negatively. However, the study found out that income had no significant effect on WTP. Those using less time to collect water could be more willing to pay than those using more time because they value time and may have engaged themselves in other productive

activities. Empirically, it was found that there is interest among households involved in using springs to participate in spring protection activities.

5.2 Recommendations

1) Training is required for community because as individuals become aware of need to conserve the water resources they should be equipped with knowledge. They should be assisted with information, implementation and demonstration of the benefits associated with spring protection. This is because information is a major input in sustainable resource development and use especially at the micro level.

2) Results of the study showed that some respondents did not adhere to the rules regarding the use of the protected springs. It is recommended that custodians be recruited to take care of the protected facility in order to ensure sustainability. Moreover the community should work hand in hand with the local administration in order to minimize damages caused to the protected facility by reporting any person not abiding by the rules. Effective communication will reduce illegal activities at the protected spring site.

3) From the findings it is clear that the community play an important role in water supply because they are the major beneficiaries. Therefore conscious efforts should be made to involve the community in the whole planning process of spring protection and cost recovery because they are the ones who know the problems they face and which springs should be protected.

4) The results of the study clearly indicate that only a few of the sampled protected springs do have trees. Therefore it is recommended that community awareness on fencing off the upper part of the spring and planting appropriate tree species to conserve the source be intensified.

5) Further studies should be done in order to quantify impact of time saved as a result of spring protection on agricultural productivity. Studies also on water quality of the springs.

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APPENDICES

Questionnaire

Questionnaire no

SPRING PROTECTION IN EMUHAYA DISTRICT: ASSESSMENT OF IMPACT AND WILLINGNESS OF THE USER COMMUNITY TO PAY FOR IMPROVED WATER SERVICES.

Most of the questions in this survey are related to your opinion and attitude. There are no right or wrong others. The interview is confidential and your name will never be associated with your answers.

A. IDENTITY

Interviewer …… Interview date ……

A1. Name of the respondent ……

A2. Age (years) ……

A3 Sex [ ] 1= male 2= female

A 4. Marital status [ ] **codes** 1=single 2= married 3 = separated 4= divorced 5= widow

A5. Respondent position in the household ……

1=HH 2= spouse 3= son/daughter 4= parent 5= grandchild 6= other(s) specify……

A6. Level of education (years spent in school) [ ]

A7. Occupation [ ] 1= farming 2= trader 3= civil servant 4 = teacher 5= others (specify)

A8. i .Division …… ii Location ……

iii. Sub location …… iv. Village …… v. Clan …….

B. HOUSEHOLD COMPOSITION

B1. How many people constantly live, eat and cook at this household (HHS size) …….

Including the household head and spouse, please list the number of household members in each category

B2	B3	B4		B5	B6	B7	B8
Age in years	Gender 1=male 2=female	Number male/female		Level of education	Completed 1=yes 0= no	If not, years completed	occupation
0– 5							
6– 12							
13 –17							
18- 35							
36- 45							
46- 65							
65+							

Codes for level of education

1=Nursery 2=primary 3= secondary 4= college 5= university

C. WATER FACILITY, SOCIAL ORGANIZATION AND INSTITUTIONS

C1. Is your main source of water a spring? 1= Yes 0= No [ ]

C2 (*If yes*, specify) 1= Protected 2= Unprotected [ ]

C3. What is the name of the spring? ……..

C4. Who supported the spring protection intervention? [ ]

1= SOF-DI 2= GOK (CDF) 3= Religious Organization 4= other(s) specify……

C5. Tenure security of land where spring is protected [ ]

1= Freehold 2= Tenancy 3= communally owned 4= State owned

C6. When was the spring protected? ……

C7. What is the distance from the source in kms? ……

C8. Are you or a member of the household a member of water user group? 1= Yes 0= No [ ]

If yes fill the table below

C8.1	Who is registered	
C8.2	What is the name of the group	
C8.3	Your position (status) in the group	
C8.4	When did you join (year)	
C8.5	Reason why you became a member	
C8.6	What services do the group offer	
C8.7	What activities do you participate in	
C8.9	What challenges do you face as a group	

C9. If *no,* explain? ……

C10. As a member of water user group, how did you contribute towards the protection of the spring? .....

C11.How much did you contribute as a group membership fee? .....

C12. How much do you contribute per year towards the maintenance of the springs……
C13. How are decisions made in the group? **Codes [ ]**

1= Imposed from outside. 2= By leaders only. 3= Leaders consult members. 4= Members' consensus 5= other(s) specify……

C14. How often do you attend to group meetings? **Codes [ ]**

1=Always 2= Sometimes 3= Never
C15. To what extent are you satisfied with the leadership of your group?
1= Very satisfied 2= Satisfied 4= Dissatisfied 5= Very unsatisfied.
C16. Why are you satisfied/ unsatisfied? …….
C17. Have you received any training in managing the protected spring facility? 1= Yes 0=No [ ]
If yes, how did you find the training **Codes** [ ]
1=Not useful 2=Useful 3=Very useful

C18. Does your water use group/committee have rules and bylaws to be followed regarding the use of the protected springs? 1. Yes [ ] 0. No [ ].

C19. How do you rate your knowledge of the rules and bylaws [ ]

1= Very poor 2= Poor 3= Good 4= Very good

C20. What is your perception of the relevance of these rules [ ]

1= Somehow relevant 2= Relevant 3= Highly relevant

C21. On average what is the percentage adherence to these rules? [ ]

1= Fully adhere 2= Sometimes adhere 3= Rarely adhere

C22. Why do members find it difficult to adhere to the rules? ……..

D. SPRINGS PROTECTION BENEFITS

D1.What was the source of water before the protection of the spring? .....

D2.Who is the main active users of water? .....

D3.How many are reliable……

		Before spring development	After spring development
D4	Time spent in fetching water per day.		
D5	Time used to fill 20ltr jerrican		
D6	Average Water quantity used per day (in terms of 20 lts jerrican)		
D7	Sanitation and hygiene		
D8	Water quality		

Codes for time 1= < 15mins 2= 15 min – 30min 3= 30min -1 hr. 4 > 1 hr
Codes for water quantity (litres) 1= 1-2 2= 3-4 3= 4- 5 4= > 6
Sanitation 1= Very poor 2= Poor 3= Good 4= Very good

D9. What do you do with the time you save from the collection of water?

1= Work in the farm 2= Looking after/water livestock 3= Trade in the market 4=Attend women's meetings 5= Cleaning 6= others (specify)…….

D10. What are the major uses of water in your household? **Codes** start with most important [ ] [ ] [ ][ ][ ][ ][ ]

1. Washing 2.Kitchen gardening 3. Human consumption and cooking 4.livestock consumption 5.bathing 6.seedling irrigation 7. Other(s) specify……

D11. What are the benefits of agricultural production and sale associated with improved water supplies? **Codes** start with most important [ ] [ ] [ ] [ ][ ][ ][ ]

1. Increase in livestock 2.Production of Napier 3.Increased milk supply 4. Increased vegetable production 5. Increased seedling production 6. (Less diseases) due to frequent spraying 7.Others (specify)

D12. What are the health/sanitation benefits associated with improved water supplies? Codes start with most important [ ][ ][ ][ ][ ][ ][ ]

1.Less water borne diseases 2. More washing of clothes 3. More Bathing 4. More washing of utensils 5. No need to boil and filter water 6. No discolored clothes/utensils 7. Others (specify)....

D13. To what extent are you satisfied with spring protection interventions put in place to address the water /sanitation and hygiene needs? [ ]
1= Highly dissatisfied 2= Dissatisfied 3= Satisfied 4= Highly satisfied

D14. Can you mention any 2 water and sanitation related symptoms/diseases you know?

(i)
(ii)

D15. Has anyone in your household had any adverse effects on health as a result of the above mentioned symptoms/diseases? 1= Yes 0= No [ ]

D16. *If yes*, was it before spring development interventions or after? 1= Before 2 After [ ]

D17. Rank the rates of sickness in your household before and after the spring protection. Using the scale of 1= Low 2=Medium 3= High 4= Don't know
Before intervention.[ ]
After [ ]

D18. How has the project affected the environment on site? [ ] 1= Positive 2= Negative. *If negative go to D24*

D19.*If positive* state how [ ][ ][ ][ ]

codes 1= Planting of trees 2= Planting of grass 3= Planting of flowers 4= Fencing the surrounding area 5=Other(s) specify……..

D20. As an individual have you been involved in tree planting at the spring site and in your homestead? 1= Yes 0= No [ ]

D21. If yes what type of trees have you planted? ……

D22. In your opinion, do you think spring protection intervention (concrete structure, outlet pipe, and drainage area and site modification) will last for future use? 1= Yes 0= No [ ]

D23.*If no*, suggest other ways on how to make the intervention long lasting?

D24. Why negative? ……..

E. RESOURCE BASED LIVELIHOOD AND ACTIVITIES

E1. What is your farm size in acres [ ] Total agricultural cultivated land [ ]
Total grazing land [ ]

E2. How many animals do you have in these categories?

Type	Number owned	Who owns them
Goat		
Sheep		
Cattle		
Poultry		
Others(specify		

E3. Did the improvements in the spring lead to decrease or increase in livestock? [ ]
1=Increase 2 = Decrease

E4. Give reasons……

E5. What crops are grown on the farm? .....

E6. How often was food shortage before the spring protection intervention? [ ]

1= Rarely 2= Sometimes 3= Always

E7. Have you experienced food shortage since the development of the springs? 1= Yes 0= No [ ]

E8. *If yes* what do you think was the problem and yet supply of water is reliable? ……..

E9. *If no* how has the intervention facilitated this? ……..

E10. In which of the following categories do you estimate your total monthly household income, from all activities, working members, business income, pension and others [ ]

1= <2000 3= 5000 – 10,000 5= > 20,000 2=2000- 5000 4= 10,000- 20,000

E11. Who controls the above mentioned income [ ] Livestock [ ] milk sale [ ] vegetables

[ ] **codes** 1=Male 2= Female 3=Joint

F. VALUING THE BENEFITS OF SPRING PROTECTION INTERVENTION.

Household with protected springs

You are satisfied with the current water supply system because the springs are protected. However, the springs need to be properly managed and maintained for you to receive satisfactory water supply and sanitation.

F1. If you were to receive these satisfactory services will you be willing to pay for these services 1.Yes 0. No [ ] *If no go to F6*

F2. *If yes,* will you be willing to pay a maximum of Ksh 50 per month? 1. Yes 0. No [ ]

F3. How sure are you of your decision? **Codes [ ]**

F4. *If no* how much are you willing to pay for the above services? ..... *If not* willing to pay at all *go to F6*

F5. Could you please explain to me the main reasons of you paying X amount of money.

1. The fee is not high
2. I really want the improved water supply system.
3. I worried about the health risks of existing water system
4. Others (specify)

F6. Could you please explain to me the main reasons of you not paying? [ ]

1. I cannot afford, the amount is too high
2. I don't want improved water system
3. I am not worried about health risks
4. Others (specify)……

Households with unprotected springs

F7. Your household currently does not receive improved water service.If you were to receive "satisfactory water and sanitation services" as we explained, would you be willing to pay for these services? 1. Yes 0. No [ ] *If no go to QF13*

F8. *If yes* will you be willing to pay a maximum of Kshs 100 once as a membership/ subscription fee. 1. Yes 0. No [ ]

F9. Are you willing to pay Kshs 50 per month to cater for maintenance or towards major repair works when it occurs? 1. Yes 0. No [ ]

F10. How sure are you of your decision? **Codes. [ ]**

F11. *If no* how much are you willing to pay for the above services? ..... If not willing to pay at all *go to QF13*

F12. Could you please explain to me the main reasons of you paying X amount of money. [ ]

1. The fee is not high
2. I really want the improved water supply system.
3. I worried about the health risks of existing water system
4. Others (specify)……..

F13. Could you please explain to me the main reasons of you not paying? [ ]

1. I cannot afford, the amount is too high
2. I don't want improved water system
3. I am not worried about health risks
4. Others (specify)……

Codes for the *Q62 and Q6* 1= Totally sure 2= Somewhat sure 3= Equally sure or unsure 4= Somewhat unsure 5 =Totally unsure

Logistic Regression

Logistic regression

Number of obs = 150
LR chi2(13) = 18.05
Prob > chi2 = 0.1556
Log likelihood = -30.300856
Pseudo R2 = 0.2295

F1WTPPS	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
A2AGER	-.0107661	.0265808	-0.41	0.685	-.0628635	.0413313
A5RSPR	-.7835582	.6818157	-1.15	0.250	-2.119892	.552776
A6EDUR	-.0640102	.4823412	-0.13	0.894	-1.009382	.8813612
B1HHSZ	.1580255	.199452	0.79	0.428	-.2328933	.5489443
C4SUPP	.5393105	.2917964	1.85	0.065	-.0325998	1.111221
C7DISTS	-.001187	.0016364	-0.73	0.468	-.0043944	.0020203
C8MEMW	-2.266482	1.352294	-1.68	0.094	-4.916929	.3839651
C11CONTF	.0042842	.0060744	0.71	0.481	-.0076214	.0161898
E1FARSZ	1.23529	.6078854	2.03	0.042	.0438564	2.426724
E10INCOM	-.1710414	.4285606	-0.40	0.690	-1.011005	.6689219
C17TRNM	-.0645035	.8450653	-0.08	0.939	-1.720801	1.591794
D4IITIMFE	-1.187735	.6454029	-1.84	0.066	-2.452702	.0772313
C12CONTM	.0054254	.007037	0.77	0.441	-.0083668	.0192177
_cons	5.998083	3.517996	1.70	0.088	-.8970633	12.89323

Map showing distribution of protected and unprotected springs