

# **THE INFLUENCE OF WATER PROJECTS ON THE LIVING STANDARDS OF PEOPLE TIGANIA EAST SUB COUNTY IN MERU COUNTY, KENYA**

**Muthoni Kabutia Betty Mwambia**

Master of Arts in Project Planning and Management, University of Nairobi, Kenya

**Prof. Christopher Gakuo**

Odel Campus, University of Nairobi, Kenya

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## **ABSTRACT**

Water is the primary channel through which society, especially the poor, feel the impact of climate change and environmental degradation. The study endeavored to answer the underlying influence of water projects on the living standards for the residents of Tigania east Sub County, Meru County in Kenya. The objectives of the study were: To determine how irrigation, access to domestic water, water selling and the quality of the water influence living standard of the people of Tigania east Sub County. A descriptive survey was used in the study on assessing the influence of water projects on the living standard of the people in Tigania east Sub County. The target population was picked from household heads within Tigania East Sub County. Tigania East has 5 wards and has 39 sub-locations. Each of the sub locations was clustered and based on their population the villages were selected. Data was collected from households in Tigania East Sub County. The following were the major findings made from the results of the study. The Available water to the communities remains unsafe forcing families to incur extra expense to not only pay for water bills but also pay health charges. Water is sold at exorbitant prices this is because of high operations costs as most of the people charged with the responsibilities of water projects are untrained. Another aspect is that most of the water projects are mismanaged and therefore this is pushed to the consumers of water. Presence of middle men/persons or cartels also poses a challenge on the pricing of water thereby in

On management of water projects, especially management of the proceeds from sale of water by the water projects as well as Operations and Maintenance (O&M) remain with people who have not been trained, this increases the chances of mismanagement and affects the water prices. pending on the purchasing power of families and individuals. The study found that all the independent variables had a significant influence on the living standards of the people of Tigania East. The quality of water has an impact on the income and health status of children, families and community members. Individuals spend their meager resources when they fall sick to treat themselves owing to a preventable cause of poor water quality in the community. Inaccessibility of water for domestic use also affects the living standards of the people; distances to water sources are far thereby many households spend several hours looking for the precious commodity. These hours spent would be used to carry out other chores and activities that would increase the income levels of the families. The lack of alternative sources of water during the dry season also affects the community. The families that carry out irrigation have better living standards and higher income levels than those households that do not. The following recommendations were made in order to improve the living standards of people. There is need to train water committees on proper management of water projects and on the importance of provision of good quality water to the community members. The community members also need to be sensitized on the need to put their water project committees to

task over cases of corruption and cartels especially the water projects that collect revenue from the sale of water. This could be done through government efforts of strengthening water Users Associations through implementation of the Water Act 2001. Government of Kenya, through ministry of Water and Irrigation to increase levels of awareness of Rain Water Harvesting as well as develop water infrastructure to reduce the distances to

water sources and to improve of the Quality and accessibility of water at household level. The following areas are suggested for further study: To determine the impact of water scarcity on the household's purchasing power. To determine the impact of training of water project committees on sustainability of water projects.

**Key Words:** *water projects, living standards, Tigania East Sub County, Meru County, Kenya*

## **INTRODUCTION**

In the 21<sup>st</sup> century, climate change and natural resource degradation pose one of the most urgent and unprecedented risks to the global economy (NCE, 2015). Their effect on growth and development is reinforced by patterns of human development, including land use change, industrialization, urbanization, expansion of commercial agriculture and population growth (Vorosmarty et al., 2005). The poor, whose living standard of the peoples in communities often depend on natural resources and ecosystems, are disproportionately affected (Dercon, 2012).

Water will be the primary channel through which society, especially the poor, feels the impacts of climate change and environmental degradation. Water is an essential input for industry, energy production and agriculture, and supports human welfare. However, water also generates risks: droughts, which undermine food security and agricultural production; floods, which devastate infrastructure and destroy lives; waterborne diseases, which affect human health; and scarcity and competition, which can drive conflict, political instability and migration (WWAP, 2012).

Increased investment in rural water supply development in the last decade by both Government and development partners has not resulted in the desired levels of service anticipated. Access to safe water is a basic human need necessary for both the wellbeing and social economic development of populations living in rural Kenya. In spite of efforts to increase access, many rural water supplies completed either have stopped operating or are not operating optimally. This has resulted in loss of service to populations living in the rural areas of Kenya. Many of the dysfunctional water sources are operated and managed by community-based organizations such as Community Water and Sanitation (WASH) Committees, Water User Associations or Women groups.

Water is a basic human need and is important for human survival. A number of reports and policy instruments have given estimates of current access levels to safe water in Kenya. It is estimated that more than 80 per cent of Kenya's population live in the rural areas. According to

the WHO/UNICEF Joint Monitoring Programme Report 2012, only 52 per cent of the population living in rural Kenya had access to improved drinking water sources as compared to 82 per cent of the urban population in 2010. The national average is 59%. The draft National Water Policy (NWP) 2012 puts current rural coverage at below 50 per cent and attributes this low coverage to the type of sources- point sources (hand pumps, springs, wells and small pipe schemes which have complicated stocking requirements for spare parts and repair efforts. On the other hand, The African Ministers Council on Water (AMCOW) Country Status Overviews 2- Regional Synthesis report for 2011 puts coverage in Kenya in 2010 at only 42%.

The Millennium Development Goals for water and sanitation targets halving the population without access to safe water by 2015(MDG Report, 2008). Yet, the MDG Report for 2012 has reported that Kenya is already not on course for achieving the MDG goals for water and sanitation. According to the draft National Water Policy (NWP) 2012, “most of the rural water services systems are still not sustainable because of inadequate operation by communities leading to breakdown of facilities and low access rate, poor water quality and increased disputes”(NWP 2012). Disparities in access to safe water are even more severe in the ASAL areas where there is insufficient densification of water points (NWP 2012).

Demombynes and Trommlerova (2012) reported Kenya’s rate of post neonatal deaths per 1000 live births fell by more than half over a five- year period, dropping from 47 to 22, as measured using data from 2003 and the 2008-09 Kenya Demographic Health Surveys. Among the possible causes of the decline are various targeted public health initiatives including improved access to water and sanitation.

One of the main interventions that have always been considered is ensuring availability and accessibility of water for the inhabitants. Tigania West Sub County, which is located in Meru County in the larger Meru region in Eastern part of Kenya, is one of the regions that have been targeted for community water projects by the Kenyan government and non-governmental organizations. These initiatives have been supported by the broad government policy interventions with the intentions of ensuring proper management of water resources in the country. Initiating projects to ease accessibility to water in the ASALs is seen as a noble cause. However, without proper planning and integrated approach that ensures sustainability of the water sources and its accessibility, such projects may not have lasting impacts.

Groundwater provides the only realistic water supply option for meeting dispersed rural demand as alternative water resources can be unreliable and expensive to develop (Foster, 2000; MacDonald, 2005). However many projects spend large amounts of money installing water sources without trying to understand the groundwater resources on which these sources depend. As a result, many supplies are unsuccessful or perform poorly (Robins 2006). Arid areas where groundwater recharges are limited and erratic. According to Gleitsmann (2007) in a qualitative assessment of the participatory water management strategies implemented at the conformity level in rural Mali through a water supply project-The West Africa Water Initiative (WAWI)-

community-based rural water supply was found to be a positive step in responding to the needs of rural Malians. However, the assessment noted that the installation of such water projects with limited consultative participatory approaches and limited extension services do not necessarily proffer sustainable rural water supply. Furthermore, since the United Nations Conference on Environment and Development (UNCED) of 2002, the international community has made considerable effort to raise awareness about water resources concerns and management.

Non-governmental organizations, farmers, local authorities, the scientific and technological community, business and industry, trade unions, indigenous people, children and youth and women, have become an integral part of the sustainable development and management of water resources at the international, national and local levels. Many non-governmental organizations have been more successful in building community awareness and local capacity than in providing technical support for water assessments, water supply and sanitation. Attempts to encourage the transfer of operation and maintenance to water-user associations have had mixed results, since the generally low economic returns on irrigated agriculture and uncertain land tenure provide little incentive for farmers to make long-term capital investments. It is against this background the study investigate influence of water projects on the living standards for the residents of Tigania east Sub County.

## **STATEMENT OF THE PROBLEM**

It is important for the organizations or agencies, governmental and non - governmental, who are involved in water services provision for populations living in rural Kenya to achieve their objectives of improving access to safe water for needy populations. In spite of the improved policy, legislative and funding environment, access to safe water for populations in rural Kenya remains low translating to poor social indicators- 46 per cent below the poverty line, high infant mortality and morbidity and high incidence of water borne diseases among these populations. The Ministry of Water and Irrigation in Kenya has been implementing the water sector reforms since the enactment of the Water Act 2002 to improve sector efficiency and overall performance but more importantly created new decentralized institutional framework to among others accelerate water service provision. However, it has become evident that increasing coverage does not equate to increased access due to a high failure rate of water facilities. There is now recognition that while development of new systems is important, it is not enough to provide sustainable services in it. Consequently, National governments and development partners have begun to recognize the scale of the problems associated with poor sustainability of rural water facilities (IRC, 2015). According to an IRC Triple-S 2010 study, despite relative success in the provision of new rural water infrastructure in the last two to three decades, studies in many countries show between 30 to 40 per cent of facilities either do not function or are operating below capacity. In Kenya, about 25 to 30 per cent of the recently completed community managed rural water supply facilities will become dysfunctional in the first three years following completion. For instance, Tigania east Sub County is one of the areas, which fall within the Meru

County that faces perennial drought and limited water resources. The region receives mean annual rainfall of 500- 600mm. This situation has led to challenges in accessing clean and reliable water in arid and semi-arid areas. This has necessitated government and non-governmental agencies to develop interventions to support communities in these areas to establish water projects. However, there is lack of sustainability of most of the water projects initiated by government and non-governmental organizations as demonstrated by annual serious water shortages in these dry areas during droughts. There is therefore a need to understand why there are numerous water projects being implemented while water shortages. It is against this background the study endeavored to answer the underlying influence of water projects on the living standards for the residents of Tigania east Sub County, Meru County in Kenya. In this context, whether or not water continues to flow over time. However, the manifestation of these factors in the Kenyan context and their contribution to project failure has not been adequately understood in the sector.

## **PURPOSE OF THE STUDY**

The study aimed at assessing the influence of water projects on the living standards of people of Tigania east Sub County, Meru County, Kenya.

## **OBJECTIVES OF THE STUDY**

1. To determine how irrigation influences the living standards of the people of Tigania east Sub County.
2. To determine the extent to which extent access to domestic water influences the living standards of the people of Tigania east Sub County.
3. To assess how water selling influences living standard of the people of Tigania east Sub County.
4. To find out how the quality of water affects the living standards of the people.

## **LITERATURE REVIEW**

### **Irrigation using water and the living standard of the people**

A study conducted by a team of international and Kenyan professionals on Irrigation and Drainage Sector Institutional Reform support services, (Consultants, 2009) defined “support services” as including all those activities related directly to the irrigated agriculture production systems. These included: Physical services, e.g., construction and repair of irrigation facilities; Agricultural services, e.g., land development, provision of agricultural inputs (seeds, fertilizers, pesticides, herbicides etc.); Institutional services, which includes agricultural extension, irrigation management extension, financing, marketing, training, regulating and auditing, water rights, and conflict resolution; and Provision of equipment and services, for example pumps, drip

irrigation systems, greenhouses, etc. Further, they explained that the provision of such support services was essential for developing a prosperous, efficient and sustainable irrigated agricultural sector; and their provision should be the core business of specific institutions (Commission, 2001). Support services related to irrigate agriculture production therefore included rehabilitation/ improvement of systems and some assistance for their operation and maintenance (Aagaard, 2005). This study also noted that other agricultural production-related services such as supply and marketing facilities, cooperatives for purchasing inputs, and marketing outputs were not well coordinated among the related agencies. Institutional support for either strengthening existing organizations or providing foundations for the establishment of new organizations was also limited (Poulton & Kanyinga, 2013).

The Consultant acknowledged a Kenyan use of the term “support services” to refer to the necessary infrastructure such as roads, cold chain facilities, and communication and market infrastructure. The Consultant considered these as necessary conditions for a prosperous market-oriented agriculture, whether irrigated or not, and that these conditions were absolutely essential. An important gap related to irrigation management extension i.e. including irrigation agronomy (advice on water management techniques for specific crops), management of water deliveries to farmers on irrigation schemes, achieving high crop productivity and profitability per unit of water and integration of crop production with livestock and fish production were identified in this study. The MoALF extension staff that should offer advice on crop management were often absent from irrigation schemes. MoALF still had extension staff members with irrigation agronomy training who worked largely on farm-level rainwater harvesting; but they often did not have specialized training for irrigation water management. The Consultant therefore established that provision of effective extension services on irrigation schemes was currently a serious gap.

According to the United Nations Economic and Social Council (2001), financial commitments to water projects have to a large extent remained unfulfilled. Even though some developing countries such as Kenya have increased public spending in the sector, the gap between the levels of investment needed to achieve full water coverage and the levels of investment actually made is considerable. The Council further estimates that governments in developing countries spend some US\$ 10-25 billion annually on water supply and sanitation, with a major portion being spent on higher-level services in urban centers.

### **Access to domestic water and the living standard of the people**

Domestic water supplies are one of the fundamental requirements for human life. Without water, life cannot be sustained beyond a few days and the lack of access to adequate water supplies leads to the spread of disease. Children bear the greatest health burden associated with poor water and sanitation. Diarrhea diseases attributed to poor water supply, sanitation and hygiene account for 1.73 million deaths each year and contribute over 54 million.

Disability Adjusted Life Years, a total equivalent to 3.7% of the global burden of disease (WHO, 2002). This places diarrhea disease due to unsafe water, sanitation and hygiene as the 6th highest burden of disease on a global scale, a health burden that is largely preventable (WHO, 2002). Other diseases are related to poor water, sanitation and hygiene such as trachoma, schistosomiasis, ascariasis, trichuriasis, hookworm disease, malaria and Japanese encephalitis and contribute to an additional burden of disease.

As of 2000 it was estimated that one-sixth of humanity (1.1 billion people) lacked access to any form of improved water supply within 1 kilometer of their home (WHO and UNICEF, 2000). Lack of access to safe and adequate water supplies contributes to ongoing poverty both through the economic costs of poor health and in the high proportion of household expenditure on water supplies in many poor communities, arising from the need to purchase water and/or time and energy expended in collection. Access to water services forms a key component in the UNDP Human Poverty Index for developing countries (UNDP, 2009).

The importance of adequate water quantity for human health has been recognized for many years and there has been an extensive debate about the relative importance of water quantity, water quality, sanitation and hygiene in protecting and improving health (Esrey et al., 2001). Despite this debate, international guidelines or norms for minimum water quantities that domestic water supplies should provide remain largely lacking. For instance, whilst the Millennium Declaration Goals include a target to 'halve the proportion of people who are unable to reach or to afford safe drinking water by 2015' (UN,2000) it does not specify in what quantity such water should be supplied. The WHO/UNICEF Joint Monitoring Programme, which produces the Global Assessment of Water Supply and Sanitation data, describe reasonable access as being 'the availability of at least 20 liters per person per day from a source within one kilometer of the users dwelling' (WHO and UNICEF, 2000). However, it should be noted that this definition relates to primarily to access and should not necessarily be taken as evidence that 20 liters per capita per day is a recommended quantity of water for domestic use.

Norms for quantities of water to be supplied have been proposed for certain specific conditions. For instance the SPHERE project sets out 15 liters of water used per capita per day as being a key indicator in meeting minimum standards for disaster relief (SPHERE, 2008). In their guidance manual prepared for the Department for International Development (UK), WELL (2008) suggested that a minimum criterion for water supply should be 20 liters per capita per day, whilst noting the importance of reducing distance and encouraging household connection. A similar figure has been suggested by other researchers (Carter et al., 2007). Gleick (2006) suggested that the international community adopt a figure of 50 liters per capita per day as a basic water requirement for domestic water supply.

In their study, Cazcarro et al., (2015) observed the funding of water projects by Autonomous Communities (A.C) governments led to the expedited implementation of water projects resulting to improved agricultural productivity in these devolved governance levels in Spain. Further, they

note this had significantly improved agricultural incomes earned by rural farmers leading to their economic empowerment (Cazcarro et al., 2015). Similar evidence Shygonskyj and Shygonska, (2016) who observed the availability of financial resources did significantly influence the implementation of water projects by Oblasts in Ukraine. They noted that this was important in the reduction of reported cases of water borne diseases in public hospitals under the management of these devolved units of governance (Shygonskyj and Shygonska, 2016).

Study by Bemspang and Segerstrom (2009) found evidence failure to fund water projects by regional governments adversely influenced access to safe drinking and clean water in these devolved units of governance in Tanzania. They observed this resulted to an increase in reported cases of water borne diseases and adversely influenced income levels among women as they spend most of their time fetching water (Bemspang and Segerstrom, 2009). In their study, Kiprono and Wanyoike (2016) noted a county government had funded the implementation of water projects. Further, they observed these projects did improve agricultural productivity in the county resulting to the economic empowerment of its residents (Kiprono and Wanyoike, 2016).

According to UN-Water, (2007) attribute water scarcity often creates a question of water quality, this result from environmental pollution and using un-protected water points. The report further asserts that water and health are intimately interlinked. Water conveys pathogens to people and provide the habitat for vector and intermediate hosts of pathogens. Shortage of water and inadequate sanitation may limit the ability of families to cope with some threats that may lead to infection and illnesses. Disease associated with water affect the poor with greater margins as compared to rich nations with a burden of ill health that creates a vicious cycle of poverty and sickness, UN-Water, (2007). Such families and communities may not be able to carry out their tasks effectively due to several hours or even days supporting sick people or relatives.

This limits their socio-economic productivity. Vulnerable communities are disproportionately affected by poor water quality. These communities include those that live near water ways of compromised quality. In order to mitigate on the risks of diseases suffered by communities, families and communities can mobilize towards improved drinking water facilities UN-Water, (2007).

### **Water sale and the living standard of the people**

Several different types of municipal water demand and benefit models have been estimated over the last several years. These studies have typically evaluated the effect of price and income on water use or the effect of different levels of finished water quality on water supply benefits as measured by willingness to pay. Willingness to pay estimates has generally ranged from about \$7 to \$16 per household per month. Water supply models have also been estimated which estimate the impact of water quality on water treatment costs and price. The models have used several different price variables, various seasonal adjustment variables, different classes of water use, cross-sectional and time series data, and aggregate data over the United States, site specific

data, different functional forms, and different econometric techniques. Of 124 studies reviewed by Espey et al. (2007), 86 used a log-linear functional form.

Almost all of the demand models have estimated the price elasticity of demand to be negative and inelastic and the income elasticity to be positive and inelastic. This general result has occurred regardless of the region where the study was conducted or the modeling technique used (Espey et al., 2007). One notable exception is a study by Hewitt and Hanemann (2005) which presented the results for a discrete/continuous choice model of residential water demand with block rate pricing and based on individual June through August data for Denton, Texas. The discrete/continuous choice model produced price elasticities ranging from  $-1.57$  to  $-1.63$ , which is much more elastic than presented in other water demand studies. This type of model cannot be used with aggregated data.

Even though the majority of municipal and industrial water demand studies have estimated water demand to be price inelastic, the negative sign for the price coefficient indicates price can be used as a policy instrument to reduce municipal water demand. The results of the Hewitt and Hanemann (2005) study indicate that price could be a very effective water use policy instrument under certain conditions. Variables other than price and income have been found to be important in explaining variations in water use. Some of these variables include the season of the year, rainfall amounts and/or evapotranspiration rate, temperature, household size or some other measure of water need, region for which data was obtained, and type of use (such as residential, commercial, or industrial).

Early water demand studies (Gottlieb, 2003; Wong, 1972) used fairly simple linear econometric modeling techniques, average price as the independent water price variable, total water use per year or per month as the dependent quantity variable, household income as the independent income variable, and occasionally temperature or rainfall data as additional explanatory variables. These studies used both site specific time-series data and aggregated cross-sectional data. The price elasticity of demand for residential water supplies in these early studies was relatively price inelastic, generally ranging from  $-0.25$  to  $-0.80$ .

Later water demand studies (Lyman, 2002; Martin and Wilder, 2002; Hewitt and Hanemann, 2005; Renwick and Archibald, 2008) used more sophisticated econometric techniques and marginal prices that attempted to account for various block rate schedules. These later studies have greatly improved the reliability of the price and income elasticity estimates and have identified several additional factors, which affect domestic water demand. Some important factors, which have been evaluated in more recent studies, are discussed below. However, it is interesting to note that with the exception of the Hewitt and Hanemann (2005) study mentioned above, the later studies produced price and income elasticities similar to the early studies.

The more recent studies have added to the understanding of the differences in demand between regions, the impact of different pricing structures on demand, differences between short-run and long-run demands and elasticities, and differences between peak and off-peak demands. A study

by Lyman (2002) indicated price elasticity of demand during peak use periods is actually very elastic while the price elasticity of demand is inelastic during off-peak periods of use. A study by Martin and Wilder (2002) indicated the price elasticity of demand is higher for urban households than for suburban households, but that both are price inelastic. The Martin and Wilder study indicated the mean marginal price for the utilities in the study sample was about 39% higher for the suburban water users than for the urban water users and the mean average price was 37% higher for the suburban water users. Typically the quantity of a good or service demanded is more responsive to a change in price at higher prices. There appears to be a legitimate difference in water demand between urban and suburban water users.

Nieswiadomy (2002) included a variable representing public education efforts to encourage people to use less water. The public education variable was statistically significant only for water users in the western United States when average price was used as the price variable. The results do not indicate a strong correlation between public educations about water conservation and reduced household water use.

The equity of imposing increased water rates to reduce water usage and the potential for other policy instruments to reduce water demand were evaluated by Renwick and Archibald (2008). The results indicated that lower income households, \$20,000 or less per household, had a much higher price elasticity of demand ( $-0.53$ ) than other higher income households ( $-0.11$  to  $-0.22$ ). Their findings indicate that a uniform increase in water rates to reduce water use would result in reduced water use by lower income households but water use by high-income households would change very little. One implication of the study was that to achieve water use reductions in an equitable fashion, regional water demands need to be disaggregated based on income levels and other relevant variables and separate markets need to be identified so each category of user is treated fairly.

A study by Schneider and Whit latch (2001) estimated elasticities for different categories of use, including residential, commercial, industrial, government, and school users. The results showed that the long-run and short-run price elasticities of demand for commercial, government, and school uses were much higher than for residential or industrial users. This indicates relatively greater need for water by residential and industrial activities.

Several studies have also been completed which estimate the willingness to pay of households for improved water quality of domestic water supplies. Positive willingness to pay implies household water use will generally increase as water quality improves. A 2002 poll of business leaders in the north-central United States indicated an average willingness to pay of about \$7.00 per users per month (Dahl, 2002). The poll also indicated that only 13% of the respondents were not willing to pay anything to ensure good quality water. A study of willingness to pay for residential water quality improvements in Georgia showed a mean willingness to pay of \$10.07 to \$16.06 per month depending on the source of water, individual wells or a municipal supply, and the type of model estimated (Jordan and Elnagheeb, 2003). The Jordan and Elnagheeb study

also indicated knowledge of water quality problems was significant in explaining willingness to pay.

A contingent valuation survey assessing household willingness to pay for protecting the quality of drinking water supplies in four Massachusetts towns estimated an average willingness to pay to protect water quality ranged from about \$64 to \$125 per household per year (Powell and Allee, 2000). Two of the study area towns had experienced water supply contamination problems. Those who had experienced contamination problems were willing to pay more than those who had not experienced any problems previously. A similar study in Dover, New Hampshire indicated a mean willingness to pay for protecting groundwater quality of \$129 per year and a median willingness to pay of \$40 per year (Schultz and Lindsay, 2000). Recognition of groundwater quality problems was a statistically significant variable in explaining willingness to pay in the Schultz and Lindsay study.

The literature indicates that the cost (price) of water has a significant impact on the quantity of water demanded by households and that raw water quality can have a significant impact on the cost of water treatment and therefore on price. Although the impact of water quality on water use and treatment costs has been shown to be relatively “inelastic,” the significance of the relationship indicates that changes in raw water quality has significant welfare impacts as related to municipal water supplies. As a result, the policy implications of water quality regulations on municipal water supply benefits are important. Putting together the consumer demand and water supply aspects in one system provides important information for policy makers to evaluate the benefits from water quality improvements on municipal water supplies.

The water cost and water use models are estimated simultaneously in this analysis to represent the supply and demand relationships within a water market. Evaluating both of these relationships allows for a more complete analysis of the domestic water supply benefits associated with improvements in raw water quality or the costs from degraded raw water supplies. The two models presented in this analysis provide a framework, which can be used by federal, state, and local water agencies to evaluate the economic effects of changes in water quality on water suppliers and households. The impact of changes in raw water quality on water suppliers and the impact of finished water quality on domestic water use are evaluated as a system. As expected, the water cost model estimated in this analysis indicates factors such as the source of raw water, the need for groundwater treatment, the overall size of the water supply system, the region of the utility, and water quality as measured by hardness all significantly affect the cost per unit of water delivered. Poor water quality results in higher treatment costs and higher water rates. The water use model indicates water demand is influenced significantly by household income, household size, temperature, precipitation, the price of water, and finished water quality. Improved water quality (lower levels of hardness) results in an increase in the quantity of water demanded within a project area. Combining the results of the models allows an analyst to evaluate the full impacts of water quality benefits on municipal water supplies as a system.

The modeling results and estimates of the potential benefits to water users from improved water quality (reduced water hardness) indicate water quality improvements may need to be quite large before substantial domestic water supply benefits can be obtained. However, it is likely that the costs of improving water quality will increase at an increasing rate. It should be noted that the application of this methodology to a smaller area using individual household data would likely produce better results because a more site specific measure of water quality could be used in the water cost (supply) model and marginal water prices could be used in the water use model. In addition, this analysis does not consider the costs associated with improving raw water supply quality and future studies could include this cost component to build upon the results in the analysis.

### **Quality of water and Living standards of the people**

“Water is essential to sustain life and a satisfactory (adequate, safe and accessible) supply must be available to all. Improving access to safe drinking water can result in tangible benefits to health. Every effort should be made to achieve a drinking water quality as safe as practicable” (WHO Guidelines for Drinking water quality, 1997). Water quality has been the subject to many recent studies (Mangesh and Chandrasekr2013), mainly because of water scarcity and poor water distribution. Many countries are beginning to experience difficulties with water supply because of increased demand for water by agriculture and industry, coupled with poor management or a lack of management of water resources (Kharaz et al, 2012). Pollution from industrial activities, urban areas and cattle farms has promoted deterioration in water quality (UNEP, 2008).

Over 286 million Americans get water from community water systems. 8% of community water systems provide water to 82% of the US population. Disability Adjusted Life Years, a total equivalent to 3.7% of the global burden of disease (WHO, 2002). This place diarrhea disease due to unsafe water, sanitation and hygiene as the 6th highest burden of disease on a global scale, a health burden that is largely preventable (WHO, 2002). Other diseases are related to poor water, sanitation and hygiene such as trachoma, schistosomiasis, ascariasis, trichuriasis, hookworm disease, malaria and Japanese encephalitis and contribute to an additional burden of disease.

Lack of access to safe and adequate water supplies contributes to ongoing poverty both through the economic costs of poor health and in the high proportion of household expenditure on water supplies in many poor communities, arising from the need to purchase water and/or time and energy expended in collection. Access to water services forms a key component in the UNDP Human Poverty Index for developing countries (UNDP, 2009). The problem of water pollution and quality degradation in developing countries is becoming a threat to natural water resources. This phenomenon is attributed to the increasing quests of these countries to achieve industrialization status and diversification of the National development goals and Kenya is no exception to this phenomenon (Kithiia, S.M and Khroda, G.O, 2011).

Water resources are increasingly being polluted by organic, inorganic and microbial matter (Kiithia 1992 & 1997). The impact of pollution on water resources is manifested by water of poor quality, which gives rise to water toxicity to mammals and aquatic life: loss of aesthetic value by becoming unsuitable for recreational activities, high cost of water supply as polluted water is expensive to treat, eutrophication, oxygenation and rain and habitat modification.

## **THEORETICAL FRAMEWORK**

### **The Theory of Socialization**

Culture is defined as social heritage. The ideas, techniques and habits passed from generation to generation. Emile Durkheim and Talcott Parsons played a great role in developing the idea behind culture and socialization. Socialization is defined as the process of acquiring social characteristics and learning ways of thoughts and behaviors considered appropriate as well as inappropriate in society. This process in the early stages is informal, unintended and a product of social interaction, close physical and emotional contacts. Societal norms and values are internalized through this process and societal sanctions are designed to ensure compliance (Bilton et al 1987).

This learning process is done through observation and experience for example men and women are taught how society expects them to behave, the roles society expects them to undertake and pressure for conformity is ensured through societal sanctions including stereotyping and labeling. This process commences at birth and terminates upon death. This theory has been used to explain how water roles are designated in the rural semi-arid areas following the principles of gender division of labor. Women are designated the role of ensuring enough water reserves for household use. It automatically is understood that they are therefore responsible for fetching water and managing how water is used at the household level. Men dig the wells, they are responsible for water harvesting, and they own the wells owing to patriarchal landownership structures in society. Men own more resources than women owing to patriarchy therefore, they may have more resources to invest in water fetching implements. This means that male-headed households may have an advantage in accessing enough water for their households as compared to the female-headed households.

### **The Rational Choice Theory**

The conception of society as made up of individuals acting rationally has been most explicitly developed by economists, in the view behind a free market. Competition operating in the laws of supply and demand is adjusted by choices and preferences of the buyers. According to economist Adam Smith (in Ian Craib 1992), the stability is as a result of 'hidden hand' or 'unintended consequences'. Rational choice theory assumes that an individual's desires and beliefs are the reasons for their actions. Further the theory accentuates that there are also causes for the

individuals' actions. Alan Carling first introduced the notion of scarcity and choice into the Rational Choice Theory in 1986 (Ian Craib 1992 p.73). From scarcity and choice, we can develop a very elementary theory that rationality is at work 'indirectly' in the choice of prioritizing access to and provision of scarce resources. This theory has been used to explain why cost of water is very high in the semi-arid areas especially because of its scarcity. Scarcity increases the opportunity cost of bringing water to the household because of the long distances traveled. Water becomes expensive as a result. The willing buyers do not have many options from which to choose. It is either they travel to overcome the long distance to the water source or buy water from water vendors at very exaggerated prices. This in turn affects access, which subsequently affects household water provision.

## **RESEARCH METHODOLOGY**

### **Research Design**

A descriptive survey was used in the study on assessing the influence of water projects on the living standard of the people in Tigania east Sub County. Mugenda and Mugenda, (2003) contend that the purpose of a descriptive research is to describe behavior and characteristics. For the purposes of obtaining adequate and relevant information in a short time, the study used survey to collect the data. Best and Khan, (2009) agreed with other scholars who argued that descriptive surveys describes and interprets phenomena and are concerned with conditions or relationships that exists, opinions that are held, processes that are going on, and effects that are evident or trend that are developing. Therefore, the study will use the design in order to analyze the phenomena of irrigation, access to domestic water, water selling and the quality of the water in relation to improving living standard of the people. Isaac and Michael, (1995) say that in order to describe facts and characteristic of a given population or an area of interest, factually and accurately, the best model or design is descriptive research design. The study also used qualitative methodology through use of focus group discussion. Cooper and Schindler (2001) agreed that focus groups are panels, facilitated by a moderator who meets with the audience for a specified period to exchange perspectives, knowledge and opinions on a topic. The focus groups were able to explore new or unexpected information that was not anticipated and the researcher observed reactions to the research questions in an open forum.

### **Target Population**

The target population was picked from household heads within Tigania East Sub County has five wards and has 39 sub-locations. Each of the sub-locations was clustered and based on their population the villages were selected. One water group was randomly selected among five Water Users Associations. Key informant Interviews were carried out with District Water Officer - Tigania east Sub County and Public Health Officer- Tigania east Sub County. The area has 7546 households and 196 household heads will be interviewed.

## **Sample Size and Selection**

According to Mugenda and Mugenda, (1999) where there is time and resources, a researcher may take a bigger sample. This means that there would be a higher level of confidence. They further add that if the target population is less than 10,000 the sample size would be calculated as follows:

$$n = Z^2 pq/d^2 = \{(1.96)^2(0.5) (0.5)\} / (0.07)^2 = 196$$

Where: n= the desired sample size; z= the standard normal deviate at the required confidence level of 95%.; p= the proportion in the target population estimated to have characteristics being measured; q= 1-p; d= the level of statistical significance set (confidence interval) of 7%.

This sample size is close to the sample size proposed by Yamane, (1967) of 196 for a population of 7546 with precision levels of + 7%. Therefore, a sample of 196 was selected for the study. This was carried out through cluster sampling of sub locations and randomly selected villages. Systematic sampling was carried out for all the households in each of the villages. Probability sampling was used to collect data. Castillo, (2009) said that probability samplings a sampling technique where the samples are gathered in a process that gives all the individuals in a population equal chances of being selected. Probability sampling allows subjects in a population to be randomly selected, so that each one of the stands an equal chance of being included in the study. The study selected one water user group for focus group discussion of the five existing water groups.

## **Data Collection Instruments**

The following are the data collection instruments that were used to carry out the data collection. Data was collected using questionnaires, interviews and focus group discussions. Data was collected from households in Tigania East Sub County. Primary data was collected using structured questionnaires with both open and closed questions. The questionnaire was administered to the literate respondents by the researcher with the help of four research assistants who were part of the chiefs and ward administrators. The data collection used a questionnaire because of it is a typical method through which descriptive data can be collected, Gay, (1981). Key Informant Interviews was carried out with Meru County Government, Ministries of Water and Irrigation and Public Health. This gave the report a technical look at issues influencing of water projects on the living standards of people. Focus group discussion is another method that was used to collect data from groups those were selected. This is because the groups have information that is important in addressing influence of water projects on the living standards of people. Focus group discussions have been found helpful in assessing needs, developing plans, testing new ideas or improving existing programmes, Krueger, (1988); Babbie, (1992). Focus

group guides were developed to be used in the focus group discussion. A group of 5 (2 female and 3 male) committee members were interviewed.

### **Data Collection Procedures**

Before carrying out the research, proper documentation and printing of copies was done early enough. This ensured that the assignment moved as planned. The materials included; letter of introduction will be given to the leaders of the villages sampled, letter of permission to carry out the research and questionnaires and other materials. A pilot test was carried out to check on validity and reliability of the instruments. Once this process was done, the tools were modified to fit the context and preparation for the exercise commenced. Leaders were mobilized based on the dates for the data collection so that they inform the groups and communities. Letters were sent to the groups that were selected informing them of the time they would be interviewed. The data collection schedule included the household survey and key informant interviews. After the data collection, the data was verified to check whether all the sections were dully filled as well as ascertain the number of questionnaires submitted. This was done to ensure quality data collected. Later the data was keyed in Statistical Programme for Social Sciences (SPSS).

### **Data Analysis Techniques**

Anderson and Poole, (2001) says that the researcher must be able to interpret the data reliably, once it has been collected. The data was collected and analyzed using descriptive statistics such as percentages, means scores, mode, and standard deviation. Both qualitative and quantitative data was analyzed and interpreted using descriptive statistics in order to address the research objectives. Data was keyed in Statistical Programme for Social Sciences (SPSS Version 24.0). Results were presented in tables using percentages and a frequency to facilitate comparisons. Excel worksheet was used for data analysis.

## **RESEARCH RESULTS**

With the income that the community members earn from irrigation and other sources, it is difficult to meet family needs. An example would be a family of 4 persons requires 60 liters per person per day, which translates to 240 liters at Kshs 2, will require Kshs 480 per day, which translates to 14, 400 to meet water costs, which may not happen because the family has other requirements. This makes the family to resort to other cheap water sources, which may compromise water quality as well health of the household, thereby, increasing their chances of vulnerability.

Available water to the communities remains unsafe forcing families to incur extra expense to not only pay for water bills but also pay health charges. This coupled with several families living below Kshs 5000 monthly may make them susceptible to other forms of behavior that may

negate morality and modernization. A low target of households harvesting rainwater still is a challenge as most communities have not appreciated harvesting run offs for agriculture.

Most of the water in unprotected pans is shared with domestic animals and wild animals. Piped water into dwelling was at 2.6% compared to 7.6% for the country Kenya National Human Development Report KNHD), (2006). This is far much below and resources need to be harnessed to improve on the findings

Water quality has an impact on rural livelihoods. Water sources impede on the health status of households thereby limits their opportunities in meeting their daily opportunities and income when they fall sick after consuming water of poor quality. Of great concern is the percentage of community members suffering from diseases that can be prevented by using safe water. Bartam, 2005 and Pruss-Ustan (2008) agrees with this fact. UNDP, (2006) report also concurs with the findings that diarrhea remains the killer diseases and is associated with unsafe water.

Water is sold at exorbitant prices this, is because of high operations costs as most of the people charged with the responsibilities of water projects are untrained. Another aspect is that most of the water projects are mismanaged and therefore this is pushed to the consumers of water. Presence of middle men/persons or cartels also poses a challenge on the pricing of water thereby impeding on the purchasing power of families and individuals.

On access to water for domestic use, the study found out that women walk for long distances to look for water, especially during the dry season considering the area is a considered to be among the ASAL's .The women and girls usually carry water in their backs and therefore may need to make more trips to access the commodity. An example would be a woman needs about 100 liters for the household; this may force her to make five trips each day translating to five hours spent. This compares favorably with what UN, (2000) found out. This imparts on the livelihoods because the hours spent would otherwise be used to do more constructive things to improve on their livelihoods.

On management of water projects, especially management of the proceeds from sale of water by the water projects as well as Operations and Maintenance (O&M) remain with people who have not been trained, this increases the chances of mismanagement and affects the water prices. Community participation needs to be improved to check on accountability of the assigned persons to take care of the community interests without affecting their lives. This finding concurs with UNDP-World Bank, (2008).

In order to cope with water scarcity, households may sell their assets to offset pending water bills. This may limit their assets within the household level and render them vulnerable. With reference to Table 4.5 on income levels, majority of the respondents earning less than Kshs 5000 per month may not afford the water and therefore resort into water of poor quality.

## **CONCLUSIONS**

The purpose of this study was to assess the influence of water projects on the living standards of people in Tigania east Sub County. The following conclusions were made from the results of the study. The quality of water has an impact on the income and health status of children, families and community members. Individuals spend their meager resources when they fall sick to treat themselves owing to a preventable cause of poor water quality in the community. Access to water especially during the dry season is a challenge; therefore, many households spend several hours looking for the precious commodity. These hours spent would be used to carry out other chores and activities that would increase on the income levels of the families and consequently improve their living standards.

## **RECOMMENDATIONS**

There is need to train water committees on proper management of water projects. The community members also need to be sensitized on the need to put their water project committees to task over cases of corruption and cartels. This can be done through government efforts of strengthening water Users Associations through implementation of the Water Act 2014.

Government of Kenya, through ministry of Water and Irrigation to increase levels of awareness of Rain Water Harvesting to Improve of the Quality of water as well as Increase accessibility of this scarce resource at household level.

The Ministry of Water and Irrigation, The County Government of Meru and other partners to put measures in place to ensure alternative sources of water for communities especially those living in Arid and Semi-Arid Areas in the County

The County Government should also ensure they train community members and water project committees on effective operations and maintenance of water projects to reduce misappropriation of funds as well as to improve sustainability of the existing projects.

The Ministry of Agriculture in conjunction with the County Government of Meru- Department of Agriculture should carry out trainings, field shows and capacity building on the importance of irrigation and on the most effective methods that save on water usage.

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