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Attitude, Socio-Economic factors and Sustainability of Smallholder Irrigation Schemes: A Case of Kuywa Smallholder Irrigation Scheme in Bungoma County, Kenya.

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Abstract

This study investigated factors influencing sustainability of smallholder irrigation projects in Western Kenya, a case of Kuywa scheme in Bungoma County. In all smallholder irrigation schemes, there is always a difference between the irrigation potential and the actual acreage of land put under irrigation. The extent to which this potential is exploited can be used to measure the level of sustainability of the scheme. This research investigated the factors influencing sustainability of Kuywa smallholder irrigation scheme whose exploited irrigation potential was recorded as 13%before the study. This was the level of sustainability was the highest among all the schemes in Bungoma County yet lower than the anticipated national target of 40% according to the NIB Survey of 2011. In this study, the smallholder irrigation farmers' attitude and their socio-economic status were interrogated to determine how these factors influenced sustainability of the scheme. The study used descriptive survey design. The sampling procedure used was the 'census approach' and the data collection method involved questionnaires, interview schedules, observations and document analysis. These instruments were used to collect both qualitative and quantitative data. The data collected on the farmer's attitude and their social economic status was cross tabulated with sustainability which was then measured as low where farmers irrigated land below 0.25acres, moderate for irrigated land between 0.25-0.5 acres and high for irrigated land between 0.5-1.0 acres. This study found out that there were more farmers 60(44.2%) with negative attitude than those with positive attitude 45(33.1%). It was also found that 51.8% of farmers were food poor. Negative attitude and high food poverty among the farmers were some of the factors that led to low sustainability. From this study it was determined that Kuywa irrigation scheme had a sustainability level of 27.8% higher than the 13% recorded by the NIB Survey in 2011. The study therefore concluded that 27.8% was a low level of sustainability occasioned by negative farmer attitude, low farmer participation in operations and maintenance and poor irrigated crop produce marketing among other reasons. This study therefore recommends that project pre-feasibility studies be made mandatory in all such projects; capacity building involving all project beneficiaries be undertaken and formation of a marketing federation be ensured in order to increase sustainability of smallholder irrigation schemes through crop production and not only in Kuywa but also in other similar projects in Western region of Kenya. It is hoped that improved self management of the scheme through farmer participation in operations and management would increase sustainability of the schemes and reduce expenditure incurred by the Exchequer in the rehabilitation of previously funded schemes and in the process increase the irrigated land to the anticipated national target of 40% sustainability.

Keywords: Attitude, Socio-economic factors**,** Smallholder Irrigation Schemes

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1. INTRODUCTION

Smallholder irrigation schemes are government funded projects which are identified for funding by the Exchequer through the Department of Irrigation, Drainage and Water Storage in the Ministry of Water and Irrigation. These projects are found distributed in all the five major water basins in Kenya. The funds for the development of smallholder irrigation schemes are supposed to be disbursed only after detailed feasibility studies and design reports confirm irrigation potential exists and that the famers living there are willing and ready to contribute up to10% of the total cost of construction. The remaining 90% cost of project implementation is funded through the Exchequer upon the signing of the memorandum of understanding on the funding arrangements.

Despite meeting funding conditions, sustainability of smallholder irrigation schemes upon construction and commissioning still remains low (NIB survey, 2011). Out of all the 45 irrigation projects so far funded by the Exchequer in the Western region of Kenya through the Ministry of Water and Irrigation, at the tune of over Ksh.200 million in the last five years, no single scheme was exploiting 30% of its potential(Provincial Irrigation Officer's Inventory, 2011). The average exploited irrigation potential in this part of the country stands at 2.5% compared to the national average of 24.8 %(NIB survey, 2011). As a result of low sustainability, most schemes have since collapsed and the Water User's Associations formed to manage the schemes disintegrated almost immediately the public support was stopped upon the scheme completion (Ong and Orego, 2002).

The majority of smallholder irrigation schemes today require additional funds for rehabilitation in order to increase land under irrigation (Ong and Orego, 2002). Additionally, low sustainability compels the government to fund rehabilitation of existing schemes at the expense of increasing land under irrigation in new sites (Economic Stimulus Programme, 2008). Therefore the fact that such schemes do not self govern as they should even after the development of infrastructure, capacity programmes and availability of water for irrigation is an indication that there are other factors that influence sustainability. The government plan to develop additional 40,000Ha. of land under irrigation each year in order to achieve 40% of the total irrigation potential by the end of 2012 (ESP, 2008). However, unless factors influencing sustainability are identified, isolated, studied and adequately addressed, the government policy to achieve 40% of the irrigation potential by 2012 may not be possible.

1.1 Research Objectives

This study was guided by the following objectives:

i. To determine how the attitude of farmers influence sustainability of Kuywa smallholder irrigation scheme in Bungoma County, Kenya.

ii. To establish how social and economic status of farmers influence sustainability of Kuywa smallholder irrigation scheme in Bungoma County, Kenya.

1.1.1 Research Questions.

This study was guided by the following research questions:

i. How does attitude of farmer influence sustainability of Kuywa smallholder irrigation scheme in Bungoma County, Kenya?

ii. How does social and economic status of farmers influence sustainability of Kuywa smallholder irrigation scheme in Bungoma County, Kenya?

2. LITERATURE REVIEW

This section presents a summary of reviewed literature related to the study based on thematic and sub thematic areas in line with the study objectives.

2.1 Sustainability of Kuywa Smallholder Irrigation Scheme

Sustainability has been defined by various organizations in different terms. UN General Assembly opined that sustainability is best explained by the resilience concept, which means the flexibility of a system to dynamic conditions with the features such as the ability to overcome any harsh situations (Barkemeyer, Holt, Preus, & Tsang 2014). The theory of sustainability came about as a result of the work of Thomas Malthus (1766-1834) and David Recardo (1772-1823), the two scholar's first work on environmental limit concepts that was based on an economic viewpoint of how humankind can conduct economically beneficial activities while protecting the natural resources, needs, and quality of life of future generations. In water projects, sustainability means the project can offer the same quantity and quality of water during all weather conditions and remain within the same state, with a capacity of self- reorganizing (Brown & Williams, 2015).

2.2.1 Attitude of farmers and Sustainability of Kuywa Smallholder Irrigation Schemes

Attitude is defined as a predisposition to feel, think or act in a particular way with some degree of consistency (Bentler and Speckart, 1981). Attitude refers to a person's evaluation of any psychological object represented as items of knowledge based on three general classes of information namely, cognitive information, emotional information, and information about past behaviors (Allen *et al*., 2003). There seems to be a relationship between beliefs, value and norms and prople's attitude towards environmental management practices. Attitude is the state of readiness that influences a person to act in a given manner (Rahman *et al*., 2019). It is on the basis of this argument that Muriungi (2015) while investigating the role of project beneficiaries in participatory Monitoring and Evaluation of Ewaso Ng'iro North Development Authority funded projects in Kenya, used descriptive survey design and systematic sampling technique to collect data from 161 project staff and farmers to establish that farmer's approval of projects prior to their implementation was based on their preferences due to previous experiences. Simiarly, Marks, Komives and Davis (2014) also established that when farmers contribute construction materials towards project implementation, they are simply expressing a sense of ownership which is a predisposition of a mental frame. From these review it is apparent that farmer's attitude could influence sustainability of smallholder irrigation projects.

Allen *et al*., 2013 further stated that attitude in agriculture can lead to a more adequate explanation and prediction of their economic behavior. This study has also been used on conservation and environmental related issues focusing on the influence of attitude variables as predictors of conservation behavior (Wotie and Hanaraj, 2013). These two scholars for instance concluded from their research that a significant relationship was found to exist between behavior and the goals and intentions of farmers. This relationship is even stronger when statements on attitudes, social norms and perceived behavioral control are considered (Muriungi, 2015). What this means is that farmers will only take up irrigated agriculture as a means of livelihood improvement if their perceived benefits based on cognitive and emotional information influences positive change in behavior and if this behavioral change supersede what they hold on to as belief system, value or norm towards other forms of farming such as rain fed agriculture. Investigators have taken four different positions concerning causal relationships between attitudes and behaviors: attitudes cause

behaviors; behaviors cause attitudes; attitudes and behavior have mutual causal impact; and attitudes and behaviors are slightly, if at all related (Bentler and Speckart, 1981).

It is therefore important to underscore the central role the belief system that is hugely influenced by what attitude plays not only in decision making on the uptake of irrigation innovations but also on the development of the same for increased sustainability. In general terms, it can also be said that attitude is formed by the excitation of a need in the individual (Bentler & Speckart, 1981). This need may arise within the individual or be triggered by a relevant cue in the environment. To induce attitude change the expression of an old attitude or its anticipated expression must be seen to give satisfaction no longer (Allen *et al*, 2003). This is one way of ensuring that people are open to change of attitudes and opinions (Butto et al, 2007).

Attitudinal change or opinion change is a type of change in which the change agent exercises social influence (Bentler and Speckart, 1981). This social influence can be a very superficial thing where the subject merely says what he thinks the change-agent would like to hear or it may be profound where the subject endorses and takes as his own the attitudes of the change-agent. Since an opinion is an expressed attitude, his remarks on opinion change have relevance to modifications in attitude (Bentler and Speckart1981). Identification can be said to occur when an individual adopts behavior derived from another person or a group because this behavior is associated with a satisfying self-defining relationship to this person or group (Barghouti, Garbus, and, 1992)). In the case of sustainable irrigation, as a system for producing foods and cash crops, more knowledge - intensive than input intensive reasons are required in the up take of irrigation innovations (Cho and Boland, 2004).

To transfer knowledge and skills it is necessary to generate desirable changes in the attitudes of farmers as a first step (Bentler and Speckart, 1981). These researchers further established that assessing attitudes in connection with the principles and concepts of sustainable agriculture gives a standard of existing status on which basis, planning could be made to achieve desirable change. Leeuwis, (2023) in his study found out that farmers' attitude toward sustainable irrigated agriculture among older farmers with more experience in agricultural activities, family size and more land is lower than younger farmers with less land and higher knowledge. In addition farmers with high level of literacy and participation in agricultural extension courses have better entry behavior towards this type of agriculture (Leeuwis, 2000).

According a study by Kulkarni and Tyagi (2015), the factors that have positive correlation with farmer's attitude such as literacy, off-farm income, farmers' knowledge, use of sustainable farming methods can cause farmers to have a positive attitude towards sustainable agriculture. Based on this finding, Cho and Boland (2004) established that attitude towards irrigated agriculture had a direct impact on sustainable development of smallholder irrigation schemes. This finding is further confirmed by Devarajulu and Chandrasekaran (2009) who used the concept farmers' "willing to pay for irrigation water" as a measure of sustainability of smallholder irrigation schemes. From the foregoing it is right to state that farmers' decision to participate or not to participate in an irrigation scheme is informed by attitude based on perception and understanding of the anticipated benefits (Thompson, 2001). This perception is what determines the response to new ideas or technologies that farmers are confronted with. Whether a new idea is relevant and therefore should be received and adopted will largely be determined by the level of

acceptance. It is on the basis of these reviews that the study adopted descriptive research design to determine how smallholder farmers attitude influence sustainability of Kuywa irrigation scheme in Bungoma County, Kenya.

2.2.2 Socio-economic status of farmers and Sustainability of Smallholder Irrigation Schemes.

Economic and social progress is important underlying factors of sustainable development (Ministry of Agriculture, 2003). Sustainability is evaluated in terms of welfare and measured as willingness to pay for goods and services consumed (Munasinghe, 2007). In this way the cost of irrigation development affects sustainability. In Kenya today for instance the development of a hectare of irrigated land is estimated at between Ksh. 280,000-500,000/= depending on the preferred irrigation technology (Ministry of Agriculture, 2003). The continuing weakening of the Kenya Shilling against the hard currencies has affected the costs of irrigation materials and equipments procured from outside the country such as sprinkler heads and drip kits. Lack of adequate funding for irrigation development by the Exchequer can be explained by simple fact that most funding comes from public sector investment programmes whose reduced public funding means the government also has to address financial needs of other economic sectors in its annual budgetary allocations based on economic priorities (Ministry of Agriculture, 2005). In cases where adequate funding has been available the situation hasn't been any better. That is why Thompson in (2011) highlights the fact that potential financiers seem to lose confidence in financing irrigation development initiatives due to cost and time overruns in irrigation projects.

the fact that economic considerations in the form of financial constraints (both by government and the smallholder farmers) can cause delays in the implementation of irrigation project, as farmers struggle to purchase necessary inputs, such as seeds of high value crops and irrigation equipment besides meeting their other obligations as the members of an irrigation scheme. Conversely, smallholder farmers with logistic and financial clout face strong incentives to start the cropping season early so that they can benefit from high market prices for an early crop (Hussain *et al.*, 2002). The social impact of this scenario is reduced participation by those less endowed economically (Ostrom, 2003). Together, these constraints and incentives make coordination of the cropping calendar all but impossible considering that not all farmers in the scheme are on the same economic level (Keita 2003). Like most projects, irrigation has a wide range of beneficial and harmful effects on the environment (Biswas, 1996; Muriungi (2015). The beneficial effects are often reflected in the welfare gains by farmers due to increased crop output and multiplier effect on national incomes and food security (Ministry of Agriculture, 2005). In the assessment of the smallholder irrigation sub-sector in Zimbabwe for instance, Munasinghe (2007) established that smallholder irrigation has brought many successes to farmers such as: growing of high value crops both for local and export markets thus engaging the rural poor in the mainstream economic activity. However Kisumbi and Nassiuma, (2017) while undertaking a study on the role of farmer participation on the basis oof perceived socio-economic benefits used a mixed method approach with a sample size of 168 drawn from a population of 4,423 using systematic sampling technique to show that community participation based on socio-economic considerations making has no influence on sustainability but instead the incentives tied to the water projects support. This means that other factor come into play even where the social and economic benefits are considered.

Smallholder irrigation development has made it possible for other rural infrastructure such as, telephones, schools and clinics to develop in Egypt (IWMI, 2002). In Kenya, smallholder irrigators have developed a commercial mentality and their crops yield increase and farm income go up many folds (Ong and Orego, 2002). Nyakwaka, Muronga, and Muvumbi (2018) indicates that irrigation is associated with increased intensification through greater use of fertility-improving technologies such as fertilizer and manure, and other purchased inputs such as improved seed and pesticides and mechanized labour. That is why Munasinghe (2007) indicates that irrigation ensures year round food security while off-farm employment during part of the year is a common practice to obtain extra money for the smallholder. Cai, McKinney, and Rosegrant (2001) indicate that, in areas where irrigation is the dominant water user, sustainability in irrigation water management is ensured through water supply system reliability and vulnerability, environmental system integrity, equity in water sharing, and economic acceptability. That is why Wotie and Hanaraj (2013) suggests several ways to improve physical and economic efficiency at the farm level such as agronomic practices of improved crop husbandry and cropping strategies; technical options like installing advanced irrigation system; managerial practices like adopting demand-driven irrigation scheduling systems and better maintained equipment and institutional frameworks where economic water pricing and improving the legal environment are some of the key pillars of sustainable smallholder scheme. That is why Devarajulu and Chandrasekaran (2009) showed that higher agricultural productivity delivered both absolute and relative gains to the rural poor in India. A share of these gains is through the growth component or wages and lower food prices rather than improved distribution of economic opportunities.

it is important to acknowledge that poverty has both economic and social dimensions in sustainable irrigation (Food and Agriculture Organization, 1997).The poor are defined as those members of society who are unable to afford minimum basic needs, comprising food, shelter and clothing (Poverty Reduction Strategy Paper Report, 2001). According to the government of Kenya blue print poverty can be classified into material poverty or relative poverty. Poverty can also be classified into food poverty and overall poverty. According to the government of Kenya welfare monitoring surveys, the level of poverty in Bungoma County stands at 53% of people categorized as overall poor while 51% as food poor(PRSP Report, 2001). This report explains that the rural small scale farmers are poor because they lack education, are discriminated against, and because of negative attitudes towards them especially by the able bodied in the society and lack of advocacy mechanism among other reasons.

There is evidence for instance how children from cash-crop growing homes are poorly fed in comparison with those coming from the so called “traditional farms” producing a diversity of staple crops due to education on nutritional opportunities available in traditional crops (Nkambule and Dlamini, 2013). In many developing countries, smallholder irrigation is one of the world’s most ambitious poverty reduction initiatives (Mintesinot, 2002). It is designed to enable 2 million poor households a year to take a major step on the path out of poverty. This initiative is expected to benefit 60 million poor by 2025 and should bring 1 million hectares of land under irrigated cultivation (Hussain *et al.*, 2002). In this way, investment in irrigation and other agricultural water management projects can be effective in reaching the poor. From the foregoing review, it is apparent that agricultural water investments should be done with the needs and capabilities of the poor in mind.

Promoting irrigation technologies and services tailored for smallholders is likely to have greater impact on poverty reduction for the rural populations (Nkambule and Dlamini, 2013). Such technologies include gravity systems with open canals and money-maker water pumps where appropriate; watershed management approaches, training and technical advisory services specifically for smallholders are designed. Lack of capital, relevant skills and appropriate technologies has been found to contribute to high poverty levels (FAO, 2022). The report further states that cost recovery from poor farmers for operation and maintenance of irrigation systems is controversial as subsidizing these services and providing irrigation water far below cost due to poverty is financially unsustainable. Pricing water is important not only for generating revenues for running the smallholder schemes, but also for promoting efficient use of water resource (Ndou, (2012). Similarly, Hussain *et al.* (2002) observed that a free or very low water charge encourages overuse, reduces the incentive for farmers to cooperate or participate in irrigation and may result in low system productivity and poor conservation.

Willingness to pay (WTP) is an economic concept, which aims at determining the amount of money a consumer is willing to pay for the supply of water. Consumers' WTP is becoming increasingly popular and is one of the standard approaches used by market researchers and economists to place a value on goods or services for which no market-based pricing mechanism exists (Keita, Lidon, Raes, and Jamin, 2007). Stepped tariffs in which the basic need like water is provided almost free to poor people may work in the case of domestic water but is difficult to implement for irrigation water because of the commercial nature of irrigation enterprises. Therefore through direct and indirect effects, adoption of agricultural technologies through irrigated agriculture can help to reduce poverty and malnutrition. it is on the basis of this revelation that Denison *et al.,* (2007) reveals that many of the smallholder irrigation schemes the world over have collapsed or still remain non-functional despite more funding being poured into these investments.

The poor resource base of the farmers, fragmented and small size of land holdings, unsecured or lack of land titles and high interest rates as highlighted by FAO, 2003).still holds today and goes further to explain farmers' limited economic ability and why they fail to apply for credit from funding institutions despite opportunities in irrigation. Adopters of irrigation innovations directly gain higher yields and incomes from the new technology, whilst indirect gains are derived from adoption by others leading to lower food prices, employment creation, and growth linkages between sectors of the economy (Wotie and Hanaraj, 2013). The impact of irrigation on poverty may vary depending on the dimensions of poverty and how it is measured. Poverty can be measured by absolute concepts to define a threshold fixed in real terms (Denison and Manona, 2007). For purposes of this study, an income of one dollar per day spent on food per person was used as a level to determine absolute poverty and in turn a given as a standard of living or welfare.

Indicators of poverty levels in this case include: income levels at the household level, consumption per person per day and proportion of disposable income spend on food. Irrigation projects are expected to impact on these indicators (e.g. income versus higher yields, income versus food security). It is also important to note that irrigation may have both positive and negative influence on poverty (Denison and Manona, 2007). Brown, & Williams (2015) presented the social relationships between individual farmers and the scheme management as "a promising platform for water users' organization while Vandersypen *et al*. (2007) proposed didactic tools for participatory water management that could support smallholder farmers in coping with their responsibilities after the withdrawal

of the external funding support. In many instances however, the farmers experiences a myriad of challenges which can easily impede sustainability. The extend to which the scheme beneficiaries work as a team in planning, implementation, monitoring and evaluation of the scheme programmes depend on whether or not the scheme members feel they are part of the bigger picture that manages the affairs of the irrigation scheme (Devarajulu and Chandrasekaran, 2009). In cases where sustainability is low, most likely the farmers don't see the schemes as theirs, and they assume that the system is owned by the government, in which case they assume that they should be maintained by the government. It is on the basis of this understanding that Kolavalli and Kerr (2002) argued that meaningful beneficiary participation in projects was limited to projects implemented by NGOs due to funding preconditions while Marks and Davis (2012) observed that low sustainability of smallholder irrigation schemes occurred when farmer participation at project control phase was low due to their low involvement during implementation stage.

This top-down perception to development often leaves the smallholder farmers with limited influence over their own prospects (Ounvichit, *et al.,* 2008). In a sustainable scheme, institutions must be well designed and accepted by farmers, the right incentives put in place and the necessary social capital available developed (Snellen *et al.* 2004). Ounvichit *et al*., (2008) presents the social relationships between individual farmers and their communities as a promising scaffold for farmer's organization within the scheme while Vandersypen *et al*., (2007) proposes didactic tools for participatory water management that could support smallholders in coping with their responsibilities after the withdrawal of State support. This means that resolving the conflict between the various competing goals, and involves the simultaneous pursuit of economic prosperity, environmental quality and social equity. Ostrom (1993) identified several basic principles of self-organized irrigation systems, as: 1) clearly defined boundaries of the service area and clearly specified water rights; 2) relating the rules of water allocation to the rules of cost distribution; 3) including all individuals affected by the rules for water usage in the group that creates these rules; 4) water monitoring and sanctioning to be performed by the water users or individuals accountable to them; 5) a low-cost local conflicts resolution mechanism to be available and 6) the water users' rights to devise institutions not to be challenged by external government authorities.

While poverty has both social and economic dimensions (FAO, 1997), economic and social status of smallholder farmers will determine the type of on-farm infrastructure they can invest in depending on their ability to afford (Denison and Manona, 2007). This ability also influences the types and amount of input applied in a cropping season as well as the area put under irrigation which in the end has a bearing on income levels and sustainability of the smallholder scheme (Denison and Manona, 2007). In fact, the total socioeconomic environment of the smallholder farmer has a composite effect on their participation in irrigation management (FAO (2002). For purposes of this study therefore, sustainability referred to the of area of land put under irrigation by smallholder farmers as a percentage of the total irrigation potential of the scheme. It is as a result of the foregoing reviews that the study adopted descriptive research design to determine how smallholder farmers' socio-economic status influence sustainability of Kuywa irrigation scheme in Bungoma County, Kenya.

3. METHODOLOGY

The study adopted descriptive research design survey in order to describe characteristics of occurrences of the phenomena in the population with respect to the variables under study as outlined in the objectives (Kerlinger, 1986). "Census approach" sampling technique was used where all the 129 elements in the population were sampled because according to Emory and Cooper (1995) this technique is ideal where the total number of elements is less than 150 and there is a strong measure of diversity within the population under study. In Kuywa smallholder irrigation scheme farmer population was highly variable socio-economically in terms of income levels, education level, age, family size and ultimately the choice of irrigation technology used. Considering that the study was restricted only to one irrigation scheme, the adoption of census approach was therefore more appropriate. Questionnaire was the main tool for quantitative data collection and analysis in which closed ended Likert type questions was used. Qualitative data was gathered using interview guide through focused group discussion and observation schedule. Data was also collected from the 15 members of the irrigation scheme management committee through focus group discussions to generate qualitative data. In addition, document analysis was also done by reviewing all the Kuywa project documents available.

The reliability of the instruments was ensured by using test-retest method. The instruments were piloted twice to the same respondents during a span of two week interval to determine if the responses were consistent. The results of the data collected was then used to calculate reliability coefficient. Pearson Product Moment Correlation coefficient was used to measure the strength and direction of influence of the first set of results against the second set using the model shown here below;

$$r : r = \frac{n(\sum(XY) - (\sum X)(\sum Y)}{\sqrt{[n\sum X^2 - (\sum X)^2\,][n\sum Y^2 - (\sum Y)^2]}}$$

Where r = Pearson product moment correlation coefficient,

$\sum Y$ = sum of indicators of sustainability of smallholder irrigation scheme during the first test,

$\sum X$ = sum of indicators of sustainability of smallholder irrigation scheme during the second test,

$\sum Y^2$ = sum of squares of indicators of sustainability of smallholder irrigation scheme during the first test,

$\sum X^2$ = sum of squares of indicators of sustainability of smallholder irrigation scheme during the second test,

$\sum XY$ = sum of product of indicators of indicators of sustainability of smallholder irrigation scheme during the first and the second tests,

n = sample size.

A Pearson Product Moment Correlation coefficient of +0.84 was obtained when the indicators of both the first and second tests were correlated. Based on this result the questionnaire was deemed to be reliable (Mugenda and Mugenda, 1999).

Descriptive statistics such as mean, median, mode, frequency and percentages were used to express factors that influence sustainability of smallholder irrigation schemes. Frequencies, percentages, mean scores and standard deviations were analyzed and presented in tables for the variables under study to determine how farmers' attitude and socio-economic status

influence sustainability of Kuywa smallholder irrigation scheme. Secondary data and data from the focused group discussions was analyzed and interpreted using the following three steps: key thematic areas in line with the objectives of the study; daily briefs and finally the briefs were described and expanded to incorporate additional insights from observations made in the field by the researcher and from the scheme documents through content analysis.

4. RESULTS AND ANALYSIS

With regard to the first objective on the influence of farmer's attitude on sustainability of Kuywa irrigation scheme, descriptive statistical analysis was adopted in which frequencies and percentages was used to analyze sustainability of Kuywa irrigation scheme in Bungoma County, Kenya. The influence of smallholder farmer's attitude on sustainability of Kuywa irrigation scheme was cross tabulated and is presented in in Table 4.1.

Table 4.1: Farmers' Attitude and Sustainability of Kuywa irrigation scheme

Attitude	**Sustainability**					
	Low (0-0.25acres)		Moderate (0.25-0.5acres)		High (0.5-1.0 acres)	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
20-59 Negative	60	44.2%	0	0%	0	0%
60 Neutral	0	0%	31	22.7%	0	0%
60-100 Positive	0	0%	0	0%	45	33.1%
Total	**60**	**44.2%**	**31**	**22.7%**	**45**	**33.1%**

Out of 136 respondents who participated in the study it was established that more farmers with a negative attitude 60(44.2%) cultivated less than 0.25 acres of land a level considered to be of low sustainability as compared to 45(33.1%) farmers with a positive attitude who cultivated between 0.5-1 acres or land sizes of high sustainability. The study also found that 31(22.7%) farmers with a neutral attitude cultivated 0.25-0.5 acres a level considered to be of moderate sustainability. Since there were more farmers irrigating unsustainable land sizes due to a negative attitude than those cultivating sustainable land sizes as a result of a positive attitude, the study established that Kuywa scheme was operating at a low sustainability. The study concluded that negative farmer attitude lad to low sustainability; neutral attitude was the result of moderate sustainability while positive attitude led to high sustainability. In Kuywa smallholder irrigation scheme however, there were more farmers with a negative attitude than those with a positive attitude. This led to low sustainability of Kuywa irrigation scheme.

With regard to the second objective, socio-economic status of smallholder farmers was analyzed using three dimensions of socio-economic factors, namely; family size, education level and income levels. Descriptive analysis in which frequencies and percentages was used to determine the influence of socio-economic factors on sustainability of Kuywa irrigation scheme in Bungoma County, Kenya. Analysis with respect to influence of farmer's individual family size and sustainability of Kuywa irrigation scheme was cross tabulated and is presented in Table 4.2.

Table 4.2: Influence of family size on sustainability of Kuywa Irrigation Scheme

Family size	**Sustainability**					
	Low (0-0.25acres)		Moderate (0.25-0.5acres)		High (0.5-1.0 acres)	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Less than 2	55	40.4%	0	0%	0	0%
Between 2-6	0	0%	43	31.6%	0	0%
More than 6	0	0%	0	0%	38	27.9%
Total	**55**	**40.4%**	**43**	**31.6%**	**38**	**27.9%**

A total of 55(40.4%) households with less than two members cultivated less than 0.25 acres under irrigation, 43 (31.6%) households with between 2-6 members cultivated between 0.25 -0.5 acres of land under irrigation, while 38(27.9%) households with more than 7 members cultivated between 0.5-1 acres under irrigation. What this meant was that the higher the number of members of a household the more likely was the acreage of land a household put under irrigation. The more the family members in a household the higher was the labour availability and therefore the more was the land put under irrigated agriculture. From these observations it was clear that the size of the family influenced positively the sustainability of an irrigation scheme. These observations agreed with what van de Fliert and Braun (2002) observed that the increased irrigated enterprises in an irrigation scheme resulted from higher household labour among the rural poor.

Farmer's education Level and Sustainability of Kuywa irrigation scheme

Analysis with respect to influence of farmer's education level and sustainability of Kuywa irrigation scheme was cross tabulated and is presented in Table 4.3.

Farmers' Education level on Sustainability of Kuywa Irrigation Scheme

Highest education level	**sustainability**					
	Low (0-0.25acres)		Moderate (0.25-0.5acres)		High (0.5-1.0 acres)	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Primary(KCPE/CPE)	57	42.3%	0	0	0	0%
Secondary (KCSE/	16	11.9%	56	41.6%	1	0.7%
Certificate/Diploma	2	1.4%	2	1.4%	0	0%
University education	0	0	0	0	1	0.7%
Total	**75**	**55.6%**	**58**	**42.5%**	**2**	**1.4%**

It was observed that out of 73(53.7%) of smallholder farmers with secondary school education 56(41.1%) cultivated between 0.25-0.5 acres, 16(11.9%) farmers cultivated below 0.25 acres under irrigation, while 1(0.7%) cultivated0.5-1acre. All the 57(42.3%) farmers with primary education cultivated between 0-0.25 acres while out of the 4(2.8%) farmers with tertiary education, 2(1.4%) cultivated below 0.25acres and 2(1.4%) cultivated between 0.25-0.5 acres. The only 1(0.7%) farmers with university education cultivated between 0.5-1.0acres under irrigation. What these statistics showed was that majority 57(42.3%) farmers with basic education cultivate acreages below 0.25 acres considered to be of low sustainability, 56(41.1%) farmers with secondary education cultivated between 0.25-0.5 acres under irrigation considered as moderate sustainability, while 1(0.7%) farmer with university education cultivated between 0.5-1 acre an area considered to be of high sustainability. This meant that the higher the level of education of the smallholder farmer, the more likely the farmer cultivated more land under irrigation, lending credence to the fact that literacy level influenced the acreage put under irrigation. Low levels of literacy

coupled with the fact that only about 1/3 of the farmers participated in all the capacity building programs organized by the DIO during scheme development explains farmers' low involvement in the scheme management and the small uneconomical acreages of land put under irrigation(MoA, 2003). These findings confirmed the argument by Ostrom (2003) that acquired knowledge is only built on existing knowledge pool if this knowledge can be put to immediate use by the farmer.

Farmer's income level and sustainability of Kuywa irrigation scheme

Analysis with respect to influence of farmer's level of income and sustainability of Kuywa irrigation scheme was cross tabulated and is presented in Table 4.4.

Table 4.4: Farmer's Income Levels and Sustainability of Kuywa Irrigation Scheme

Income levels	**sustainability**					
	Low (0-0.25acres)		Moderate (0.25-0.5acres)		High (0.5-1.0 acres)	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Less than Ksh.30,000/-	91	67.6%	28	20.5%	0	0%
Ksh.30,000-50,000/-	0	0%	13	9.5%	0	0%
Ksh.50,000-70,000/-	0	0%	2	1.4%	0	0%
More than Ksh.70,000/-	0	0%	0	0%	1	0.7%
Total	**91**	**67.6%**	**43**	**31.4%**	**1**	**0.7%**

It was observed that 91 (67.6%) farmers who earned less than Ksh. 30,000/- cultivated less than 0.25 acres, while 28(20.4%) who earned the same amount irrigated 0.25-0.5 acres of land. It was also observed that13(9.5%) of farmers who earned between Ksh. 30,000-50,000/- irrigated 0.25-0.5 acres, 2(1.4%) farmers who earned Ksh.50,000-70,000/- irrigated 0.25-0.5acres and 1(0.7%) farmer who earned over Ksh. 70,000/- irrigated 0.5-1.0 acre. These observations revealed that the majority 119(88%) of farmers who earned less than Ksh. 30,000/- during the irrigation season cultivated less than 0.5acres under irrigation, an area of land considered moderate and low sustainability. Low household earnings therefore corresponded with low acreages in irrigated agriculture. This confirms the observation made by Munasinghe (2007) that if returns to investment in irrigated agriculture are low then the willingness to pay for operations and maintenance of irrigation infrastructure by farmers in smallholder scheme diminishes. Similarly, van de Fliert and Braun(2002) observed that, higher wages outside the irrigated enterprises increases the opportunity cost of labour and therefore reduces the incentive to participate in the irrigation schemes

5. CONCLUSIONS AND RECOMMENDATIONS

With respect to the first objective it was concluded that farmers generally had a low attitude towards irrigation. The low attitude impacted on the extent to which the irrigation scheme was managed leading to low sustainability. In order to improve acreage of land under irrigation and therefore and increase the level of sustainability of Kuywa irrigation scheme it is recommended that the following bottlenecks should be addressed: low farmer attitude, low family labour, short length of time spend in practicing irrigated agriculture, and inaccessible crop produce markets. It is further recommended that farmers' negative attitude be addressed through systematic capacity building programmes to raise their level of understanding of available opportunities through irrigated agriculture compared to other economic opportunities available at the farm level. It is also strongly recommended that Smallholder irrigation scheme implementation guidelines developed by the Ministry of

Water and Irrigation be strictly adhered to during such scheme development supported by other available smallholder irrigation implementation manuals. Capacity development manuals developed by renowned institutions such as the International Water Management Institute could also come in handy.

With respect to the second objective it was concluded that family labour positively influenced sustainability. Low household labour led to low acreage put under irrigation while more household labour available led to increase in the area of land put under irrigation. The study also concluded that formal education of the smallholder farmer also positively influenced the area of land irrigated. The higher the level of education attained by the smallholder farmer, then the more likely the higher was the area of land put under irrigation by that farmer. The study also concluded that family income from whichever source positively influenced irrigated agriculture. The study concluded that food poverty influenced the area of land put under irrigation negatively. The higher the level of food poverty at a household level, the more likely that household irrigated less land. It is therefore recommended that all new irrigation projects be identified with the concurrence of the project beneficiaries to avoid making it look like the project has been forced on the farmers. Building on existing farmer knowledge should be the basis of needs assessment for the scheme holders training. Project beneficiaries should be categorized according to their level of awareness and formal education acquired if possible before the necessary capacity building programme is undertaken. This study therefore recommends that sustainability in Kuywa and any other irrigation scheme in the Western region of Kenya could be improved by undertaking a thorough pre-feasibility study as a pre condition for identifying factors that cause low sustainability and develop ways of addressing them. In Kuywa this study was unfortunately never undertaken. All factors that may influence sustainability of smallholder irrigation scheme should be identified, known and addressed during the project implementation stage.

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