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Contribution of Perkerra Irrigation Scheme to the Livelihoods of Marigat Sub-county Residents in Baringo County, Kenya

Valentine Jepkemoi Kirui
Ph.D. Student, Department of Development Studies, Moi University, Kenya

Abstract:
Perkerra irrigation scheme in Marigat Sub-County was initiated by well-wishers to boost food security, increase standards of living in the area and reduce dependency on donors and government for support owing to frequent severe droughts. However, to date, the area still experienced food shortages calling into question the effectiveness of the irrigation scheme. The main purpose of the study was to assess the contribution of Perkerra Irrigation Scheme as source of livelihood of residents in Arid and Semi-Arid Areas of Marigat Sub-county. The study therefore aimed at establishing the economic activities engaged by people living in Marigat Sub County and ascertain the contribution of Perkerra irrigation scheme to people's livelihood in Marigat Sub County. This study adopted survey research design in which the target population comprised of 13,000 direct beneficiaries of the scheme and the two project managers of the scheme. Simple random sampling was used to select 388 beneficiaries. The irrigation scheme project managers were purposively selected. Questionnaires and key informant interviews were used as the main data collection instruments in addition to observation. Data was then analyzed using descriptive analysis that is mean mode and standard deviation and presented in tables. Pekerra irrigation scheme contributed greatly to the livelihoods of residents of Marigat Sub-County since it directly constituted or influenced the major livelihood activities in the area such as horticulture, direct employment, and technology transfer. The main economic activities engaged by residents of Marigat Sub-County emanating from the scheme included: horticultural farming, mixed farming, and small scale irrigation for local crop production. Other indirect livelihood activities include apiculture, goat keeping, direct employment and trading with farm products obtained from Pekerra irrigation Scheme. The scheme also contributed to economic empowerment, food security, social, technological and infrastructural development which affects livelihoods of communities. The study therefore recommends that the scheme considers integrating other livelihood activities which although not core to the irrigation component, they could benefit through the infrastructure and systems set up through the scheme.

Keywords: *Contribution, Irrigation, Scheme, livelihoods*

1. Introduction

The World concern on access to adequate and nutritional food for a growing population has triggered the emerging of a number of strategies for different environments and under varied leaderships, programmes and partnerships. Irrigation is the artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and re-vegetation of disturbed soils in dry areas and during periods of inadequate rainfall (WFP, 2009). Additionally, irrigation also has a few other uses in crop production, which include protecting plants against frost (Matu, 2012). Ancient Egyptians practiced Basin irrigation using the flooding of the Nile to inundate land plots which had been surrounded by dykes. The flood water was held until the fertile sediment had settled before the surplus was returned to the watercourse.

In sub-Saharan Africa irrigation reached the Niger River region cultures and civilizations by the first or second millennium BCE and was based on wet season flooding and water harvesting. Terrace irrigation is evidenced in pre-Columbian America, early Syria, India, and China. At the global scale, 2,788,000 km² (689 million acres) of fertile land was equipped with irrigation infrastructure around the year 2000. About 68% of the area equipped for irrigation is located in Asia, 17% in the Americas, 9% in Europe, 5% in Africa and 1% in Oceania (Gitu, 2004). The largest contiguous areas of high irrigation density are found: In Northern India and Pakistan along the Ganges and Indus rivers; In the Hai He, Huang He and Yangtze basins in China; Along the Nile river in Egypt and Sudan; In the Mississippi-Missouri river basin and in parts of California. Smaller irrigation areas are spread across almost all populated parts of the world. Only 8 years later in 2008, the scale of irrigated land increased to an estimated total of 3,245,566 km², what is nearly the size of India (WFP, 2009).

Kenya has been having frequent incidents of droughts that have led to food insecurity and low standard of living in most rural homes especially among small-scale farmers (Matu, 2012). These are mainly dependent on rain fed agriculture and hence their food security is at stake with the frequent incidents of droughts. It should be noted that irrigation is part of MDGs and Vision 2030, particularly when dealing with both the economic and social pillars. Agricultural production is the mainstay of the economy the Kenyan economy

(Gitu, 2004). In 2008, it accounted for 40.2 percent of the GDP and employed 57.8 percent of the labour force. About 80 percent of the population is dependent on agriculture for their livelihood. It is estimated that the livestock sector accounts for 33 percent of national income, rainfed traditional agriculture for 25 percent, irrigated agriculture for 25 percent, rain-fed mechanized agriculture for 12 percent and forestry and fisheries for 5 percent (GOK, 2008).

The Kenya Vision 2030 and the National Food Security and Nutrition Policy (NFSNP) stipulate that the Government of Kenya (GOK) has consistently emphasized on local food production as one of the means of alleviating household food insecurity (GOK, 2008; GOK, 2008b). However, despite the formulation of the strategic plans, food insecurity and thus low standard of living continues to persist since there is marked reliance on relief supplies by the poor, and in Kenya, 53% of the people in rural areas are overall poor while 51% are food poor (GOK, 2008c).

Low standard of living as a result of, among other factors, food insecurity in the country is attributed to factors such as decline in agricultural productivity resulting from continuous land fragmentation. Most of the original large scale farms in Kenya have been sub-divided beyond economically sustainable agricultural production. As a result of the fragmentations, some 89% of the households in Kenya are living in less than 7.5 acres of land while 47 % live on farms less than 1.5 acres (Gitu, 2004). Thus the need for irrigation has become a mainstay for alleviating food insecurity (WFP, 2009).

The rising need for irrigation arises from the apparent inadequacy of soil moisture to support a wide range of crops that are depended upon for food needs and sometimes incomes (Gatu, 2004). It is a common experience to producers to show interest for irrigation facilities even in areas where irrigation was not a necessity up to recent years (FAO, 2000). This scenario is convincingly experienced as a result of global warming manifesting itself through a number of climatic change effects. Such effects as erratic torrential rainfall, wide temperature differentials both on land and water surfaces, speed of wind, unexpected short seasons, increased pests and diseases among others have been witnessed to be responsible for changes in crop yields, reduced soil fertility and increased erosion on farm land (FAO, 2000).

According to WFP (2009), human reactions to these effects has been: searching for technological solutions that can combat the resultant food deficits, change of eating habits, adoption of new techniques, etc. This is however to be accompanied with appropriate technological packages which may be affordable or not, less known to the producers or difficult to comply with. Primarily, irrigation can promote increment of yields of most crops by between 100 and 400 per cent (Mjonono *et al.,* 2009). It is therefore expected that, over the next 30 years, 70 per cent of the grain production will be generated from irrigated land in the world. Food and Agriculture Organization (FAO) (2009) estimates that irrigated land in developing countries will increase by 27 per cent in the next 20 years, but the amount of water expected for agriculture will only increase by a mere 12 per cent if the existing potential for conservation and storage is not adequately exploited.

The potential existing in harvesting runoff water, conservation of valley bottom reservoirs and lowland bonds has been known to supplement crop water requirements without installation of complicated equipment or with only modest investments (FAO, 1997). In Sub-Saharan Africa, only 4% of crop land is irrigated compared to 1.8% for Kenya. However, in many parts of the world, there are large untapped reserves of ground water (Gatu, 2004). In addition, there is great potential for harvesting runoff water for farming especially in the lowlands and valley-bottoms that store water naturally (Smucker & Wisner, 2008). With reasonable investments, this potential could be unleashed for increased food security in this era of food insecurity and deteriorating natural resources and production conditions as a result of climatic changes (FAO, 2000).

The main irrigation schemes in the country are distributed over various agro ecological zones and regions, giving rise to unique opportunities for diversification, crop disease and pest control, low product market competition or gluts and less competition for water resources (GOK, 2008). According to the World Bank report, (2008), Kenya's irrigated land as a percentage of Cropland is quite low and has stagnated at 1.6% since the year 2000 and rising marginally to 1.8% in 2003. The main irrigated crops are rice, maize, sugarcane, vegetables, bananas, citrus, coffee, tea, cotton and flowers. Some of these crops like maize, sugarcane, coffee, tea and cotton, technically, require large scales of operation for economic returns to be realized.

As the Economic Stimulus Programme (ESP) initiatives are being implemented care will have to be taken to guide the smallholders on the right crop for prevailing production systems (Smucker & Wisner, 2008). In this case, the implementation of ESP should go hand in hand with provision of adequate and focused extension, land use management, water use efficiency and environmental conservation in order to realize the anticipated results (Mulupi, 2008). Achievement of results normally would be the most reliable way of stimulating growth of irrigation that seems to be stagnating in Kenya (Gatu, 2004).

Perkerra Irrigation Scheme was started in 1954 and was incorporated into NIB upon its formation in 1966 through an Act of Parliament Cap 347, Laws of Kenya. The Scheme is located 100 Km North of Nakuru town in Marigat District, Baringo County. The scheme was intended to cover a total area of 2,350ha, while the area developed is 800ha. However due to irrigation water shortages, only 607ha is cropped (irrigated) annually out of the 810ha developed for gravity furrow irrigation system (http://www.nib.or.ke/). The water flow in the river (at the catchment outlet) has been reducing over the years and at times all the water in the river is diverted to the canal at the headwork to Perkerra Irrigation Scheme leaving no environmental flows into Lake Baringo. Critical water shortage in Perkerra irrigation scheme began in 1987 with the launching of greater Nakuru water project, upstream of Perkerra River. Another factor attributed to the flow decrease is destruction of the forests and general watershed degradation especially in the upper catchment (Kipkorir *et al.,* 2002). It derived its name from the River Perkerra, which is the source of Irrigation Water, and the only permanent river in the District.

Due to the fact that poverty in Kenya is deepening in many places while at the same time the Gross Domestic Product (GDP) is growing by 5.4 percent in 2014 (KNBS, 2014), Kenya obviously calls for a more drought irrigation polices that enable the whole population to benefit from this technology. Kenya is also known for its growing environmental problems due to overuse of lands and

increasingly also due to effects of climate change. The task is therefore to formulate the new irrigation policy in such a way as to ensure that it has both a positive impact on reducing poverty and on ecological sustainability. The construction of the Scheme started in 1954 after several feasibility studies, which showed that the Ilchamus flats (Plains) were suitable for Irrigation. It benefits directly, approximately 13,000 people. It also, indirectly, benefits the larger Baringo and including parts of Nakuru counties. The Scheme lies in a semi-arid climate condition with an annual average rainfall of 630mm with great seasonal and annual fluctuations.

Maximum and minimum temperatures average at 36^0C and 16^0C. It has high evaporation rates of up to 6mm and low percentage relative humidity. Soils are light silt to clay loam and are modestly alkaline with an average PH of 7.5 and little organic matter. It is well rich in calcium phosphate. The Scheme has an area developed for irrigation on an inclined plane layout. It is gravity fed through furrow irrigation. It is a major source of Bulb Onions, Dried Chilies and Watermelons. Other crops introduced as diversification measure in the late 1980s included Pawpaw's for Papaya Wine making by KWAL Ltd and Cotton. Farmers abandoned production of the above crops due to marketing problems. In 1996 the Scheme farmers started planting Seed Maize crops. While studies have been done on the wider natural resource management and its influence on food security (Gatu, 2004; GOK, 2008), little has been done on the specific water resource through irrigation for the people of Marigat who are currently food insecure and yet have Perkerra Irrigation Scheme in their backyard. This study hopes to find out the contribution of Perkerra irrigation scheme to livelihood in Marigat Sub-county poverty Baringo County.

1.1. Statement of the Problem

Baringo County and particularly, Marigat, is an arid area where the population has been depending on pastoralism as the main source of earning livelihood. Due to successive drought, there has been hunger which has resulted to death; the locals have become destitute and depended on donations from the government and Non-governmental Organizations (relief food). However, an irrigation scheme known as Perkerra irrigation scheme was initiated by well-wishers to boost food security and increase standard of living in the area as well as reduce dependency on donors and government for support and yet the residents' low poverty standards and food insecurity persists in the area, calling into question the effectiveness of the irrigation scheme to alleviate hunger in the area so far.

The scheme was designed to put 2,350ha under irrigation, while the area developed was 800ha. Further, due to irrigation water shortages, only 607ha out of the 810ha have been cropped from gravity furrow irrigation system. This raises questions on whether the scheme has indeed been effective in addressing the objectives it was intended. While studies have been done on the wider natural resource management and its influence on food security, little has been done on the Perkerra irrigation scheme in poverty alleviation in Marigat Sub County. The study therefore sought to analyze Perkerra irrigation scheme in poverty alleviation in Marigat Sub County. The study would help Perkerra irrigation scheme management and Baringo County government to assess whether the project has attained its objective of enhancing food security and socio-economic empowerment through the creation of employment opportunities. Secondly, the residents and community in Baringo County and particularly those of Marigat District would find the study beneficial as they will be enlightened on the importance of the project.

2. Literature Review

2.1. The Irrigation Status in Kenya

Recent policy guidelines bringing on board various water management and user associations under the Ministry of Water and Irrigation are expected to improved water use efficiency to enable farmer put more land under irrigation. Even though, research institutions and other irrigation promoting agencies need to explore and introduce to the farmers yield improving technologies particularly in relation to improved seed, cultivation, harvesting and post-harvest handling equipment. The present practices lack harvest equipment, yields achieved are low, postharvest losses are high and water supply is insufficient. Expansion by 4000 acres in Mwea scheme has been reported but production is done in rotational turns posing challenges of inability of NIB taking up critical issues as priority before expanding to other areas where the same constraints are likely to be realized soon after setting up costly systems. The water user and management associations have not been innovative enough to be able to tap the water resource from seasonal runoffs by way of storage and appropriate exploitation of the aquifer. Recurrent food insecurity among Kenyans has made scholars and institutions to look for solutions to alleviate the problem in the country. The issue of increasing cultivable land comes foremost since out of the 576,000km² only 17% is a high rainfall zone, receiving more than 1000 mm of rainfall annually and is arable enough to support farming without irrigation (GoK, 2010).

The existing irrigation and drainage potential of 1.3 million and 600,000 ha respectively are within the second production zone that is characterized by medium rainfall of 750-1000 mm per year occupying between 30 -35 percent of the country's land area. Hitherto, 114,600 hectares are under irrigation and 30,000 ha drained. It is believed that out of the potential 17 hectarage, 540,000 ha can be developed with the available water resources while the rest will require harvested and stored water.

The land mainly under private smallholder irrigation is devoted to production of vegetables and fruits for export and the local market. These include Asian vegetables, Tomatoes, Spinach, Kales, brinjals, melons, corgets and chillies. Fruits include Mangoes, paw paws, bananas, custard apple and citrus. The returns from the commodities are relatively high and productivity is satisfactory. They are clustered along and around water sources which may have been developed with support from either the government or NGOs. The land parcels are commonly individually owned or rented. A number of these schemes have been produce collection points by exporter companies under various agreements but other producers are free to deliver their vegetables direct to major market like the Wakulima and Kongowea in Nairobi and Mombasa respectively. Those who are not in cluster agreements, do sell their produce at farm gate but

even with marketing costs adding onto the produce price, they still make attractive margins which motivate them to continue production (Gregory, Ingram and Brkrlacich, 2005).

Although, this has been a popular organizational model of a number of privately operated schemes in the country, it has had some challenges including the environmental factors and climatic changes especially the water scarcity and lack of farmer capacity to handle the technological advancement in the enterprises. Quality control also has not been easy except where individual exporter companies have developed supervision and extension provision arrangements to be able to achieve the standards required for export farm products (Ngigi, 2002).

Water use management and maintenance of water delivery structures is done by the cluster management committees who also pay part of their proceeds at agreed rates to the regional based water users' association under the Ministry of Water and Irrigation. These category of irrigators experience very little influence from government quarters since scheme expansion is spontaneous depending on water availability. At times the irrigating farmers reduce irrigation activities to be able to attend to their rain-fed land parcels where they grow maize, beans, sweet potatoes, green grams, cassava and pigeon peas. This is their strategy of ensuring food security. Examples of these schemes can be seen in most districts of Kieni (Central province), Kajiado and Oloitoktok (Rift Valley), and Yatta, Kibwezi, Mtito Andie (Eastern province), Msambweni and Kaloleni (Coast Province) The large scale category of irrigators is individual or company owned with massive production for export and the local market. Their main market outlets are export companies, super markets chains, and deliveries to the market directly or through proxies (Ngigi, 2002).

The farms are normally under no obligation to produce any crop that is not their choice. The farms provide significant employment in terms of casual labour especially those involved in vegetable and flower production. Some of the farms operate mixed production systems which depend on ground or river water or both. Examples these farms can be seen in Laikipia and Naivasha, Yalla, Thika, etc. These category has no constraints of extension service because they employ own personnel and procure any equipment deem necessary as long as economic returns are foreseeable the rate collapsing of this (FAO, 2009).

The irrigation schemes that are government managed through the NIB include: - Mwea, Perkkera, Bura, Hola, Ahero, West Kano and Bunyala. The schemes work under a relatively closed management by the National Irrigation Board (NIB) and are traditional rice growers with little or no rotation. They have a long history of management failures and a myriad of other problems that stem from the inabilities to self-governance. They have not been able to exploit the available land fully at any one time and plans on what do next are all dependent on the NIB's board decisions (Abebe Musoke and Wambura 2007).

Whereas expansion of land under irrigation is thought to be one of the solutions to the food insecurity in the country (Agricultural Sector Development Strategy (ASDS) 2010-2020), the apparent inadequacy of water, location of the potentials land and/or water, lack of independence in decision making by the operators and the scales of operation of individual producers may curtail realization of the dream. This is because about 40 per cent of the irrigated land belongs to private large farms that do not necessarily produce food stuffs for direct consumption, 42 per cent belong to smallholder farmers who are in own vegetable production business, and 18 per cent, government managed schemes. The fraction under government influence is too small to make significant contribution to the food security requirements given the challenges outlined above. More so, yields obtained from the public supported schemes are not optimal enough to sustain continued production in long term basis (GoK, 2003).

An attempt to compare the income margins from other crops that can compete well with the resources devoted to rice revealed that the majority of the crops require low investment costs in terms of variable costs and generates better incomes compared to rice. This is the most critical consideration in business which NIB should consider if the land and water resources have to be put to rational use. Farm production practices also insist on aspects of crop rotation and fertility management not to mention the benefits of crop diversification especially in risk management (NIB, 2002).

2.2. Empirical Review of Contribution of Irrigations Schemes towards Standard of Living

Literature that examines the impact of irrigation on agricultural performance, household income and poverty is mixed. While few studies have found no linkage between irrigation and standard of living, many others have found irrigation to be of great significance for standard of living. Most studies have used poverty as an indicator of standard of living. Jen *et al.,* (2002) also did not find a link between irrigation and the total factor productivity growth of any major grain crop in China between 1981 and 1995. In Tigray region, Ethiopia, Berhanu and Pender (2002) showed that the impacts of irrigation development on input use and the productivity of farming practices controlling all other factors were insignificant. In line with irrigation and poverty linkage, there are a number of studies in different countries which show that irrigation has served as the key driver behind growth in agricultural productivity and in increasing household income and alleviating rural poverty.

Lipton *et al.,* (2004) state that irrigation can reduce poverty, through increasing production and income, and reduction of food price. This helps very poor households meet the basic needs associated with improvements in household overall economic welfare, protection against risks of crop loss due to erratic, unreliable or insufficient rainwater supplies, promotion of greater use of yield enhancing farm inputs and creation of additional employment, which together, enable people to move out of the poverty cycle.

Narayanamoorthy (2001) points out that besides increasing cropping intensity and productivity of crops, the intensive cultivation of crops due to timely access to irrigation, increase the demand for agricultural labourers and hence wage rates for those who lived below the poverty line in India. He concluded that improvement in access to irrigation and investing in human capital development, are the two most important factors for agricultural growth and rural poverty reduction in India. Moreover, a study carried out by Fan*et al.,* (1999) examining the linkages between government spending, growth and poverty in rural India, using state level data from 1970 to 1993, showed that government spending on productivity enhancing investments, such as irrigation, research and development in agriculture, rural infrastructure (including roads, electricity, and education) which target the rural poor, have all contributed directly to

the reduction of rural poverty. They found that irrigation development, in addition to raising agricultural productivity, also encourages private investment in these regions.

Empirical evidence from Australia shows that a dollar worth of output generated in irrigated agriculture generates more than five dollars' worth of value to the regional economy, which suggested irrigation development has a strong multiplier effect on other sectors of the economy (Ali and Pernia 2003). Shah and Singh (2004) found in India that more irrigation means fewer people below the poverty line. Moreover, Fan *et al.,* (2000), in their study on the role of public investment on growth and poverty, noted that government expenditure on productivity enhancing investment which includes investment in irrigation, has played a significant role in poverty reduction and enhancing productivity in rural China.

Bhandari *et al.,* (2006) using farm-level data collected from 324 households in Nepal, also indicated that shallow well tub wells irrigation has generated a significant positive effect in increasing rice yields and overall farmers' incomes. An average yield of shallow tube well irrigation owners was increased by 86 percent when compared to that of rainfed farmers. The net income of shallow tube well irrigation owners exceed that of the rainfed farmers by $69 per hectare, which has an obvious effect on the .ability of the farmers to reduce poverty and sustain their livelihood strategies.

Moreover, Hussain and Hanjra (2002, 2004), also found that the productivity of irrigated lands were twice that of non-irrigated reference areas, the net productivity benefits defined as the difference in net output values between irrigated and non-irrigated lands varied widely across settings from US$23 to US$600 per hectare. Lire (2005), in eight public managed micro dams and 29 surrounding villages in Tigray, Ethiopia showed that agricultural yield and farm profit have significantly increased in villages with closer proximity to the dams than in those farther away from the dam water resource. According to the study, the overall evidence suggests that carefully designed irrigation dams could significantly improve agricultural production and overall food security.

Empirical results on the determinants of poverty in Tigray reported by Hagos and Holden (2003), indicate that physical asset endowment, in terms of access to irrigation, farm size and livestock holding, were reported to have a positively significant effect in improving standard of living and food security status. Irrigation, not only contributes to increased crop production but, may also reduce variability in production through improved control of the crop environment. In this respect, an empirical study carried out in Nigeria showed that the proportions of population of irrigation beneficiaries that experienced crop failure and poor harvest dramatically declined in comparison to the pre-irrigation status (Babatunde 2006).

A study conducted by Madhusuda *et al.,* (2002) in India, indicated that availability and access to irrigation infrastructure, coupled with the availability and access to new technologies- high yielding varieties and fertilizers, were major underlying factors for the success of the green revolution in India. They noted that better access to irrigation has facilitated intensification of cropping practices and inputs used, and contributed to the "modernisation" of the agricultural sector.

By creating more secure and stable rural communities, access to irrigation water can also help stop migration to already overcrowded cities and slums (van Hofwegen and Svendsen 2000; Chambers 1988). This is supported by Hussein *et al.,* (2002) that, labour employment per hectare and wage rate were found to be significantly higher in irrigated settings than in non-irrigated settings in Sri Lanka and Pakistan. Furthermore, a study conducted by Hussein and Hanjra (2003) in South and South-east Asia, found that higher labour employment and wage rates were reported in irrigated than rain-fed areas, and they concluded that this change in wage was a direct result of irrigation development. Furthermore, they provide evidence on the significant contribution of irrigation to employment generation in agriculture. They noted that the annual labour work per hectare in the Ganges-Kobadak irrigation system of Bangladesh was around 100 days more than that in nearby non-irrigated areas. This additional labour demand creates better full time employment opportunities for farm family members and also create employment opportunities for hired labour. Moreover, they indicted that hired labour used in irrigated settings was double compared to that of nearby non-irrigated areas and the wage rate was 15 percent higher in the former than in the latter areas.

Qiuqiong *et al.,* (2005) argues that the green revolution in Asia would not have happened without massive irrigation development. Without continuous irrigation, many countries would have been unable to achieve the agricultural and economic growth rates required to achieve food security and reduce poverty. They state that, irrigation has been tremendously effective in generating a variety of benefits such as improvements in productivity, employment, wages, incomes and consumption expenditures which directly has an effect in reducing poverty within the irrigated perimeter. Van Koppen (1998) states that, small-scale irrigation schemes given their dispersed nature, and relatively small size, suitability for households under resource-poor conditions, small-scale water harvesting, are not likely to attract significant external support, although small-scale irrigation schemes do offer considerable potential for poverty eradication and equitable resource access.

Frequent drought and adverse economic conditions are the major problems faced by the irrigation sector in semi-arid areas of sub-Saharan Africa. To reduce risks associated with rainfall variability and increase yields of food crops, more public investments in yield-enhancing technologies such as small-scale irrigation and irrigation management systems have been recommended as one important rural development and poverty reduction strategy (Pinstrup-Andersen and Pandya-Lorch 2001). Irrigation farming is one of the most important rural development investments that can have both direct and indirect impacts on poverty and food security in semi-arid tropical countries (IFPRI 2002; Bhattarai and Narayanamoorthy, 2004).

Stephen (2004) indicates that in many Asian countries, irrigation would continue to play a major role in poverty alleviation by providing food security, protection against famine and expanding employment opportunities. However, access to irrigation has only been possible where there are adequate developed water resources. Postel *et al.,* (2001) noted that, with affordable drip systems, small farmers can shift from subsistence production to production for the market. This doubles their income and greatly enhances household food security.

However, though water harvesting and supplemental irrigation technologies have greater promise for increasing crop yields; their adoption by farmers has been extremely limited, as the risk and costs seem to have outweighed the benefits.
Francois *et al.,* (2003) indicted that 4 micro dams and 2 river diversions irrigation projects in Tigray have been successful in enabling farmers obtain a certain amount of wealth suggesting that farmers involved in irrigation schemes have shown significant improvement in their livelihoods, and earn higher incomes than non- irrigation users. Beneficiary households were able to produce enough for the year round household consumption, build household assets such as different livestock, and better improved houses which directly mitigate vulnerability to shocks. They also stated that irrigation offers the rural population an alternative source of employment and income. While such studies have been done, little has been done for Perkerra irrigation Scheme and its contribution to improving standard of living of its direct beneficiaries.

3. Methodology

The study adopted a descriptive research design in the collection analysis and presentation of data. Descriptive research design is used to describe a behavior or type of subject not to look for any specific relationships, nor to correlate to or more variables. The current study fitted into this design since it sought to find out how Pekerra Irrigation Scheme has contributed to the livelihoods of adjacent communities of Marigat Sub County. Data obtained from the study was summarized using descriptive statistics to quantify the opinions of beneficiaries on how the scheme has contributed to their livelihoods. Finally, discussions, conclusions and recommendations were made.
The study targeted 13,000 direct beneficiaries of the scheme (Perkerra Irrigation Scheme Report, 2012), the 2 project managers of the scheme and the Baringo County executive secretary for trade and industrialization. Simple random sampling technique was used to select the direct beneficiaries of the irrigation scheme from Marigat Sub County. The sample size for the study was calculated according to the formula by Mugenda & Mugenda (2003) as shown below:

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

Where,
n = the size of sample if the target population is greater than 10,000
Z = the standard normal deviate at the required confidence is the study population (1.96)
p = the proportion in the target population estimated to have characteristics being measured (50%)
q = 1-p
d = the level of statistical significance set (0.05)
Therefore upon substitution, the sample size for this study was:

$$n = \frac{1.96^2 * 0.5 * 0.5}{0.05^2}$$

n = 384 beneficiaries

The irrigation scheme project managers and county officer were purposively selected as they were more exposed to the irrigation scheme and as such would offer expert information necessary for the study.
In order to collect information for this study, the researcher used questionnaires, focused group discussions and content analysis. The questionnaire was designed using likert scale with questions about demographic information, crops grown, the economic activities of the people around the scheme, its productivity, challenges and how the scheme contributed to poverty alleviation. This was administered to residents and beneficiaries. An interview schedule to elicit in depth responses that were relevant for the study was employed on the 2 project managers and the county officer. The managers offered in-depth information necessary and relevant to the research objectives.
Based on the data evaluation instruments, qualitative data analytical techniques were utilized; In order to come up with consistent presentation of collected data, analysis was be done through the editing, coding and tabulation. Editing was be done by the researcher to improve the quality of data. Tabulation was also done classifying data and putting it in form of tables by use of a computer. Descriptive analysis was employed in data analysis. Descriptive analysis used to describe the results was in the form of means, standard deviation, frequencies and percentages. The statistical package of social sciences (SPSS) will be used to aid in the analysis. To analyse the livelihood activities, statistical means and standard deviations were used. further the most common livelihood activities were identified using the principal axis component factor analysis technique. To establish the effect of Pekerra irrigation scheme on livelihoods, statistical means and standard deviations were computed on the various aspects of impact. To establish the challenges, qualitative data from the questionnaires and interview schedules were analyzed based on themes drawn from the research objectives. For observation, livelihood activities pictorial profile was done by capturing and grouping the livelihood activities engaged in by the residents.

4. Results

4.1. Benefit from Pekerra Irrigation

The study explores the specific livelihood activities residents of Marigat Sub –County engage in owing to the existence of the scheme and how they have generally impacted on the livelihood of the residents. Pekerra scheme has been of benefit to the larger community of Marigat Sub-County since majority of the residents (88.2%) cited that they have derived some benefit from the scheme before.

	Frequency	Percent
Yes	307	88.2
No	41	11.8
Total	**348**	**100.0**

Table 1: Ever benefitted from Pekerra irrigation

4.2. Livelihood Activities engaged by Residents of Marigat Sub-County

Residents of Pekerra irrigation scheme identified the livelihood activities they engaged based on how intensive they were practiced. This was measured on a five point likert scale. Table 2 presents the descriptive analysis of the livelihood activities. The findings show that horticulture was the most cited livelihood activity by residents of Marigat Sub-County rated at (Mean =3.94, σ = 0.98). This was done through own small scale irrigation (Mean =3.64, σ = 1.19). Bee keeping, goat keeping were also cited as key activities. Residents also derived through employment in the scheme and by buying and selling produce from Pekerra irrigation scheme.

Livelihood Activities	Mean	Std. Deviation
Horticultural farming	3.94	0.98
Mixed farming	3.89	0.68
Own small scale irrigation	3.64	1.19
Bee keeping	3.46	1.07
Goat keeping	3.42	0.93
Employment at Pekerra	3.3	0.93
Buy and sell from Pekerra irrigation scheme	2.95	1.35
Seed production	2.74	1.28
Rice production	2.65	1.11
Employed outside Pekerra irrigation scheme	2.63	1.35
Sale produce to Pekerra	2.62	1.31
Dairy farming	2.32	1.02
Poultry farming	2.04	0.99
Small scale business	2.01	0.94
Supplies to Pekerra	1.97	1.18
Charcoal burning	1.55	0.83

Table 2: Descriptive Statistics on the Livelihood Activities, CI = 95%

The findings indicate that Pekerra irrigation scheme contributed greatly to the livelihoods of residents of Marigat Sub-County since it directly constituted or influenced the major livelihood activities in the area such as horticulture, direct employment, and technology transfer to ownership and operation of small scale irrigation facilities. This corroborated with a study by (ILO, 2007) in sub-Saharan Africa, which revealed that two thirds of the working population still made their living from agriculture, especially commercial agriculture. Haile (2008) also identified four interrelated mechanisms by which irrigated agriculture can reduce poverty, that is through: increasing production and income, and reduction of food prices, that helps very poor households meet the basic needs and associated with improvements in household overall economic welfare, protecting against risks of crop loss due to erratic, unreliable or insufficient rainwater supplies, promoting greater use of yield enhancing farm inputs and creation of additional employment, which together enables people to move out of the poverty cycle. These ultimately contribute to improvement of the livelihood status of residents.

4.3. Contribution of Pekerra Irrigation Scheme to Livelihoods

In assessing how Pekerra irrigation scheme has impacted on the livelihoods of the residents of Marigat Sub-County, the study focused on the impact on social impact, economic impact, impact on infrastructural and technological developments and food security in the area which are key dimensions of livelihoods. Regarding the impact of Pekerra irrigation scheme on the social lives of the residents of Marigat Sub-County, the study found out that the scheme has played a key role in helped the community to shun negative cultural practices such as cattle rustling and negative ethnicity witnessed in parts of Baringo County (Mean =3.96, σ = 0.80). Secondly, the scheme has also enhanced food sufficiency to feed the local community (Mean =3.52, σ = 0.96). The food is also sufficient and nutritious (Mean = 3.83, σ = 1.18).

Further, as a result of the scheme, residents have been able to raise fees to educate their children (Mean =3.49, σ = 1.35) therefore improving the education standards in the region. The scheme has also contributed to the livelihood of residents in many other ways including: enabling residents to afford the basics such as clothing for their children from the earnings, ability to access affordable health care services, construction of permanent hosing structures for their families, access to clean drinking water, drainage, and sanitary facilities such as toilets. The findings are presented on Table 3.

	Min	Max	Mean	Std. Deviation
The scheme has enabled residents to raise fees to educate their children	1.00	5.00	3.49	1.35
Since the onset of Pekerra Irrigation there is plenty of affordable nutritious food in the area	1.00	5.00	3.83	1.18
The scheme has supplemented a balanced diet for my family	1.00	5.00	3.34	1.13
The scheme has enabled residents to afford clothing for their children from the earnings from Pekerra Irrigation scheme	1.00	5.00	3.28	1.25
Pekerra irrigation scheme has enabled the residents of Marigat Sub county to gain access to affordable health care services	1.00	5.00	2.45	1.30
The food produced in Pekerra irrigation scheme is enough to feed the local community	2.00	5.00	3.52	0.96
The Scheme has helped the community in shunning negative cultural practices	2.00	5.00	3.96	0.80

Table 3: Socio Development, CI = 95%

The high rating by the residents of Marigat Sub-County on the impact of the project on the social development reveals that the project has had a significant contribution to the livelihoods of the residents of Marigat – Sub - County. These findings also collaborate with findings by Chazovachii (2012) during an impact evaluation of small scale irrigation schemes on rural livelihoods in Panganai irrigation scheme Bikita District Zimbabwe which also revealed that the scheme provided income alternative income to the residents which enabled them to send children to school, buy groceries and even to pay a visit to distant places therefore contributing to the social development of communities living around the scheme.

With regards to the role of Pekerra irrigation scheme on infrastructural development in Marigat Sub-County, majority of the respondents concur that onset of scheme has led to enhanced supply of clean drinking water in Marigat Sub county (Mean =4.12, σ = 0.89). Further, residents agree that there has been an improvement in the state of roads and road networks in the area (Mean =4.07, σ = 0.99) as a result the scheme. However, residents revealed very low level of contribution of the scheme in enhancing electricity distribution, construction and equipment of hospitals in Marigat Sub-County and the construction on new schools which are instrumental in enhancing the livelihoods of marginalized communities. The findings on Table 4 shows that although the project has been a success in its core objectives of water supply and food security, it has overlooked other essential livelihood components that build on or enhance the success and sustainability of livelihood projects such as education, and health.

	N	Min	Max	Mean	Std. Deviation
The onset of Pekerra irrigation has improved the state of roads in our area	348	2.00	5.00	4.07	0.99
The scheme has enhanced electricity distribution in Marigat Sub-county	348	1.00	5.00	1.81	0.98
Pekerra Irrigation scheme has enhanced water supply in Marigat Sub county	348	1.00	5.00	4.12	0.89
Pekerra irrigation scheme has led to construction and equipment of hospitals in Marigat Sub county	348	1.00	3.00	1.57	0.72
The scheme has led to construction on new schools in the area therefore improving the quality of education	348	1.00	4.00	1.61	1.03

Table 4: Infrastructural Development, CI = 95%

Pekerra irrigation scheme was also ranked fairly well by the residents in contributing to technological changes that are instrumental in the livelihoods of residents. First the scheme was ranked high in providing training to residents of adjacent communities on irrigation technology (Mean =4.15, σ = 0.79). This has resulted to irrigation technology transfer since majority of the residents of Marigat Sub-County cited that based on the skills gained they have also developed their own local irrigation equipments borrowing from the knowledge learnt from Pekerra scheme (Mean =4.04, σ = 0.83).

Evidence from the findings also shows that, the scheme has made irrigation technology available to the residents of Marigat Sub County. By involving the local community in the project this has enabled the diffusion of irrigation technology in the region. The scheme enlightens residents on emerging development and technological changes in the field of irrigation which also informs innovation. However, there is minimal sponsorship to residents to acquire their own irrigation equipments through the project (Mean =2.81, σ = 1.40). Table 5 shows the distribution of responses on the technological impacts of Pekerra irrigation schemes to the livelihoods of Marigat Sub-County.

	Min	Max	Mean	Std. Deviation
The scheme has made irrigation technology available to the residents of Marigat Sub County	1.00	5.00	3.75	1.00
Pekerra irrigation trains residents of adjacent communities on irrigation technology	3.00	5.00	4.15	0.79
Involvement of the local community in the project has enabled the diffusion of irrigation technology	1.00	5.00	3.64	0.87
The scheme sponsors residents to acquire their own irrigation equipments	1.00	5.00	2.81	1.40
Residents of Marigat sub county have also developed their own local irrigation equipments borrowing from the knowledge learnt from Pekerra scheme	2.00	5.00	4.04	0.83
The scheme enlightens residents on technological changes in the field of irrigation	1.00	5.00	3.70	1.28

Table 5: Technological Development, CI = 95%

From the findings, it is evident that the scheme has introduced new irrigation technology in the area and owing to the design and implementation of the project, there is tangible impact in irrigation technology diffusion and transfer. Based on knowledge, skills and experiences gained from the scheme, this has changed the livelihoods of surrounding communities who have also developed their own irrigation facilities and are engaged in food production.

Regarding the contribution of Pekerra irrigation scheme to food security in Marigat Sub-County, overall the findings revealed that the scheme has largely contributed to food production in the area therefore addressing food security concerns. This was attested by the residents as shown on the findings in Table 6. Most of the residents concurred that the scheme has enhanced food production in Marigat Sub County (Mean =4.36, σ = 0.62). As a result, residents of have access to a wide variety of food items from the scheme (Mean =4.23, σ = 0.65). Further residents identified that the supply of food items from Pekerra irrigation scheme was adequate to meet the needs of both children and adults in the Sub-County (Mean =4.17, σ = 0.89). Surplus foods produced were sold out to external buyers (Mean =4.11, σ = 1.20) therefore generating income for the residents. According to the resident, the scheme has also ensured that the supply of food items in Marigat Sub-County was no longer affected by rainfall patterns since the Pekerra Irrigation scheme utilized even dry spells for food production. This was also cited by a large number of respondents (Mean =4.09, σ = 1.11). However residents doubted the reliability of the project in the future since majority cited that the supply of food commodities from Pekerra irrigation scheme was not reliable (Mean = 2.88, σ = 1.10).

	Min	Max	Mean	Std. Deviation
The scheme has enhanced food production in Marigat Sub County	3.00	5.00	4.36	0.62
The supply of food items from Pekerra irrigation scheme is adequate to meet the needs of both children and adults	2.00	5.00	4.17	0.89
Supply of food commodities from Pekerra irrigation scheme is reliable	1.00	5.00	2.88	1.10
Supply of food items in Marigat Sub-County is no longer affected by rainfall patterns since the Pekerra Irrigation scheme	1.00	5.00	4.09	1.11
Residents of Marigat Sub County have access a wide variety of food items from Pekerra irrigation scheme	3.00	5.00	4.23	0.65
Surplus foods produced from Pekerra irrigation scheme are sold out to external buyers	1.00	5.00	4.11	1.20

Table 6: Food Security, CI = 95%

The high rating by the residents on the contribution of Pekerra irrigation scheme in enhancing food production in Marigat Sub-County confirms the success of the project in addressing food security concerns in the area which is a key livelihood aspect in human life. However, residents have expressed doubts on its reliability therefore raising a red flag on the sustainability project in the future should the project manager the national irrigation board exit. The findings corroborate to the findings of a study conducted by FAO (2002) evaluating the social economic impact of ten irrigation schemes in Zimbabwe. The schemes were found to act as sources of food security for the participants and the surrounding communities. Schemes with high production levels, such as Chitora, Murara, Principe and Wenimbi, provided more food security than the low producing schemes.

The design and integration of Pekerra Irrigation Scheme however shows weaknesses in reliability of food supply owing perennial shortages reported. According Graciana (2011) while evaluating the impact of small scale irrigation schemes on household food security in Swaziland also revealed that small holder irrigation schemes which are well planned and focused at household level and to the fields around the home where food crops are grown can contributes to improved food security through physical and economic access. This explains weaknesses in the design of the scheme which could be attributed to the reliability of food supply in the area.

Finally on the contribution of Pekerra irrigation scheme to the livelihoods of the residents of Marigat Sub-County, the study investigated how project affected the economic status of the residents. The findings on Table 8 reveals that the scheme has had impact spread outside the project site since majority of the residents cited that residents who have learnt irrigation from Pekerra irrigation scheme have been able to create their own employment through small scale irrigation investments (Mean = 4.17, σ = 0.90). Further, the scheme provides direct employment for the locals as supported by the finding that the scheme puts residents of Marigat Sub

County on employment priority (Mean =3.21, σ = 1.09). The scheme was however ranked low in imparting skills to the locals to enabled them gain employment in other organizations (Mean =2.34, σ = 1.49), allowing residents from Marigat sub county to supply inputs to the scheme (Mean =1.97, σ = 0.77). It was also ranked low in providing special pay rates for residents of Marigat employed (Mean =1.49, σ = 0.81) and in attracting private investors into Marigat Sub-County (Mean =1.75, σ = 1.15).

	Min	Max	Mean	Std. Deviation
The scheme puts residents of Marigat Sub County on employment priority therefore creating jobs to indigenous people	1.00	5.00	3.21	1.09
Pekerra Irrigation scheme allows residents from Marigat sub county to supply inputs and services	1.00	3.00	1.97	0.77
The scheme provides favorable pay rates for residents of Marigat employed	1.00	4.00	1.49	0.81
Residents of Marigat Sub county have also gained skills from the scheme which has enabled them get jobs elsewhere	1.00	5.00	2.34	1.49
Residents who have learnt irrigation from Pekerra irrigation scheme have been able to create their own employment through small scale irrigation investments	2.00	5.00	4.17	0.90
Pekerra Irrigation scheme has attracted private investors into Marigat Sub county	1.00	5.00	1.75	1.15

Table 7: Economic Empowerment, CI = 95%.

Based on the findings, it is evident that the scheme has had impact in the region by enabling technology transfer that has in turn enabled the residents to design their own small scale irrigation projects at house hold level. This is the largest noticeable impact of the project on the economic livelihood of the residents. The project has also contributed in employment creation which provides income to the residents although not in a sustainable way. The project has performed poorly in other economic empowerment aspects.

5. Conclusion

The Pekerra Irrigation Scheme had residents of Marigat Sub County engaged in various economic activities. The main economic activities engaged by residents of Marigat Sub-County emanating from the scheme included: horticultural farming, mixed farming, and small scale irrigation for local crop production. Other indirect livelihood activities include apiculture, goat keeping, direct employment and trading with farm products obtained from Pekerra irrigation Scheme.

Pekerra irrigation scheme contributed greatly to the livelihoods of residents of Marigat Sub-County since it directly constituted or influenced the major livelihood activities in the area such as horticulture, direct employment, and technology transfer to ownership and operation of small scale irrigation facilities. Indigenous livelihood practices such as bee keeping and goat keeping played a lesser role which implies that the scheme was key to livelihood of residents. The scheme also contributed to economic empowerment, food security, social, technological and infrastructural development which affects livelihoods of communities.

6. Recommendations

The study therefore recommends the following actions:

(i) Some of the main local livelihood activities identified were apiculture and goat keeping however they have not been factored in Pekerra irrigation scheme. The study therefore recommends that the scheme considers integrating other livelihood activities which although not core to the irrigation component, they could benefit through the infrastructure and systems set up through the scheme.

(ii) The residents of Marigat Sub County have demonstrated their ability and willingness to adapt irrigation technology which is key in enhancing the project impact. The management of Pekerra irrigation scheme in collaboration with likeminded partners should therefore set up a financial and technical support to help nature innovations emanating from the project.

(iii) There is need for enhanced cooperation by the county government of Baringo in expanding the project to adjacent areas since the project has proven to be viable in enhancing people's livelihoods in the area which has otherwise been food insecure.

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