

**IMPACT OF IRRIGATION SCHEME ON FOOD SECURITY: A CASE OF
WEI-WEI IRRIGATION SCHEME IN CENTRAL POKOT
DISTRICT, WEST POKOT COUNTY, KENYA**

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DECLARATION

I, the undersigned, declare that this project is my original work and that it has not been presented in any other university or institution for academic credit.

KAKUKO KAPKAI JOHN Sign..... Date.....

L50/64049/2011

This project has been submitted for examination with my approval as university supervisor.

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DEDICATION

I dedicate this work to my family for their moral support and encouragement throughout my study.

ACKNOWLEDGMENT

For the development and production of this work, I feel a deep sense of gratitude to my supervisor, Mr. Julius Koringura for his guidance and supervision. My profound gratitude to all residents of Pokot County and management of Wei-Wei irrigation scheme who in one way or the other assisted me in completing this research project.

ABSTRACT

The main purpose of the study was to determine the impact of irrigation scheme on food security, a case of Wei-Wei irrigation scheme in Central Pokot District, West Pokot County, Kenya. The specific objectives of the study included: - to establish various kinds of food crops grown and quantities produced at Wei-Wei irrigation scheme, to find out the effects of Wei-Wei irrigation scheme on settlement at Central Pokot District, to find out the influence of Wei-Wei irrigation scheme on businesses at Central Pokot District, to explore the effects of Wei-Wei irrigation scheme on education at Central Pokot District, to find out the contribution of the project to peace and to assess the contribution of the scheme to food security and the standard of living of the people of Central Pokot. The study employed a case study research design. A total population of 245 persons was targeted. Stratified simple random and simple random sampling designs were used to select the sample size. Questionnaires and interview schedules were used as the main data collection instruments. Data was analyzed using both descriptive and inferential statistical techniques with the aid of Statistical Package for Social Science (SPSS) version 19. The study established that cereals are the main food crop grown at Pokot Central as a result of Wei-Wei irrigation scheme. The production of food has increased to an average of 30-50 bags a year. The study established that Wei-Wei irrigation Scheme has enhanced settlement of people whereby structures or buildings are modern and there is no movement of people in search of grass for the animals. In relations to the influence of Wei-Wei irrigation scheme on business at Central Pokot District, the respondents indicated that the scheme has opened business avenues whereby business like hard-wares, shops, car wash, posh-mills and M-Pesa outlets. The respondents indicated that due to irrigation that has ensured food/abundance/security, there has been opening of schools (primary, secondary) and tertiary colleges. People are now getting formal education that will assist to work on the irrigation scheme. Based on the findings and conclusions of the study, the researcher recommended that Wei-Wei irrigation scheme management should foster for Expansion of areas under irrigation, institutional coordination and modernization. This will increase areas under irrigation programme and ensure improved productivity hence improved food security. The study suggests that further study should be carried out on effective utilization of rain water for irrigation purposes alongside maize crop farming like fruits and horticulture.

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LIST OF ACRONYMS

ASAL	Arid and Semi-Arid Lands
CSO	Central Statistics Office
ECS	Education Commission of the States
ESP	Economic Stimulus Programme
FAO	Food and Agricultural Organization
GNI	Gross National Income
KOS	Kingdom of Swaziland
NIB	National Irrigation Board
SNL	Swazi Nation Land
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

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. One among many is seeking for ways of increasing agricultural productivity through irrigated systems, especially under smallholder managed irrigation schemes that mainly produce food products for direct consumption or trading in the rural spot markets. On the other hand, large scale irrigation setups, with more sophisticated technologies concentrate on products for export, processing and/or niche markets. 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. 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. 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).

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. 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) 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 ponds 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. In addition, there is great potential for harvesting runoff water for farming especially in the lowlands and valley-bottoms that store water naturally. 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. 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. 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. Achievement of results normally would be the most reliable way of stimulating growth of irrigation that seems to be stagnating in Kenya.

1.2 Statement of the problem

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 4.7 percent in 2006), Kenya obviously calls for a more drought irrigation policy that enables 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.

Central Pokot County is an arid area where the population has been depending on pastoralism as the main source of earning livelihood. Due to 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). Due the fact that the people living in the county are pastoralists, cases of cattle rustling have been on the rise. However, an irrigation scheme known as Wei-Wei irrigation scheme was initiated by well-wishers to boost food security in the area as well as reduce dependency on donors and government for support. The study therefore sought to determine the effectiveness of this irrigation scheme in ensuring food security in Central Pokot District, West Pokot County, Kenya.

1.3 Purpose of the Study

The main purpose of the study was to investigate the impact of irrigation scheme on food security, a case of Wei-Wei irrigation scheme in Central Pokot District, West Pokot County, Kenya.

1.4 Research Objectives

The study was guided by the following research objectives

- 1) To establish various kinds of food crops grown and quantities produced at Wei-Wei irrigation scheme.
- 2) To establish the effects of Wei-Wei irrigation scheme on settlement at Central Pokot District
- 3) To find out the influence of Wei-Wei irrigation scheme on trade at Central Pokot District
- 4) To explore the effects of Wei-Wei irrigation scheme on education at Central Pokot District
- 5) To assess the contribution of the scheme to food security, peace and the standard of living of the people of Central Pokot.

1.5 Research Question

The study sought to answer the following research questions

- 1) What are the various kinds of food crops grown and quantities produced at Wei-Wei irrigation scheme?
- 2) What are the effects of Wei-Wei irrigation scheme on settlement at Central Pokot District?
- 3) What is the influence of Wei-Wei irrigation scheme on trade at Central Pokot District?
- 4) What are the effects of Wei-Wei irrigation scheme on education at Central Pokot District?

- 5) What is the contribution of the scheme to food security, peace and the standard of living of the people of Central Pokot?

1.6 Significance of the Study

The study will help Wei-Wei irrigation scheme management and West Pokot 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.

The residents and community in West Pokot County will find the study beneficial as they will be enlightened on the importance of the project. Their participation in crop growing, cattle rearing and employment/man-power will help the project flourish and bring positive results to the county which has been known for food insecurity and drought.

1.7 Basic Assumptions of the Study

The study was guided by the following assumptions

- a) The sample size was a true representative of the target population.
- b) The respondents were willing to elicit information requested by the researcher.
- c) The study was carried out within the allocated time using allocated resources

1.8 Limitations of the Study

Some respondents were not open or sincere in responding to the questionnaires, most of them answered the questionnaires after asking the researcher several questions. The participant's interactions were also hindered by other factors such as culture and fear of

participants being victimized. The study overcame this limitation by presenting a letter of authority from university which stated that the study was for academic purposes only.

1.9 Delimitations of the Study

The study basically sought to investigate the impact of irrigation scheme on food security, a case of Wei-Wei irrigation scheme in Central Pokot District, West Pokot County, Kenya. The study was carried in West Pokot County in the month of June using a case study research design

1.10 Definition of Significance Terms

Education	Learning institutions like schools and technical colleges that have come up to support increasing demand for basic and higher education due to irrigation scheme
Food Security	Sufficient supply of food through irrigation schemes
Impact	Outcome or end results
Irrigation	Use of water resources to support farming activities.
Poverty Eradication	Improving people's living standard through provision of adequate food and employment provided by irrigation scheme for people to work on the farms
Settlement	The number of people living in the area supported by irrigation related activities

Trade

This involves conduct of business activities that set up due to initiation of the water project

1.11 The Organization of the Study

This chapter forms the basis of the study. The chapter highlights the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, and significance of the study, the scope and limitations, definition of significant terms. The other chapters of the work include chapter two which dealt with literature review related to the topic under study, chapter three which dealt with research design and methodology used in conducting the study, chapter four which discussed data analysis, presentation and interpretation and finally chapter five which presented the summary of the findings, conclusions, recommendations and suggestions for further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of the previous studies related to the current study. The aspects covered in this chapter include: the relationship between irrigation schemes and food security

2.2 Literature Related to food security and irrigation

In the 1996 Rome Declaration on World Food Security, food security is food that is available at all times, to which all persons have means of access, that is nutritionally adequate in terms of quantity, quality and variety, and is acceptable within the given culture.” Further, the FAO speaks of food security on household basis when all members of a household can be supplied with sufficient and adequate food, whether through their own production or through buying of food.

As Lankford (2003) argues there must be a positive balance of benefits against risks and costs of irrigation. A more secure and increased crop productivity, improved planning and timing of start of the cropping season and extended harvest season, raised number of jobs and income are some knock-on effects that show how irrigation facilitates economic transactions and improves livelihoods and the wealth and infrastructure of whole villages (Lankford, 2003).

2.3 Literature Related to Irrigation Schemes

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 household welfare, many others have found irrigation to be of great significance for household welfare. Most studies have used poverty as an indicator of household welfare. 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 that 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 rain-fed farmers. The net income of shallow tube well irrigation owners exceed that of the rain-fed 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 household welfare 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 creates 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) indicated 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.

2.4 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

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, Perkera, 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 inability 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).

In Kenya irrigation may be seen as both a major cause of and an important solution to the country's increasing water scarcity and water insecurity. On the one hand, irrigated agriculture in Kenya accounts for 76 percent of the water resources used (WRI 2003), and thus irrigation itself is aggravating water scarcity. On the other hand, expanding irrigation is one of the most important ways out of this situation, because in many locations rain-fed agriculture is no longer able to generate adequate yields.

Apart from the traditional small scale irrigation practices that have been ongoing in some areas in Kenya for the past 400 years, large scale irrigation schemes have also been in existence from the time of the colonial era. Farmers were forced to work in these large irrigation schemes, first as slaves in the 19th century and then as unpaid laborers during World War II. Well into the 1990s then, they worked as "free" but still dependent workers on the large-scale irrigation schemes. Neither under colonial rule nor under government ownership did farmers have a say on management of the schemes or benefit from the produce (NIB, 2003).

Since 1966 these large-scale irrigation schemes have been managed by the National Irrigation Board (NIB), a government parastatal of the Ministry of Water and Irrigation (MWI). It is semi-autonomous and operates relatively independent of the Ministry. Up to the end of the 1990s the NIB schemes were centrally managed with farmers getting very little profits. The end of the 1990s saw the collapse of all but one of the NIB irrigation schemes, some of which were even taken over and operated by the farmers. Partly because these schemes were already as good as unviable under NIB management, but also due to the limited managerial skills possessed by the farmers themselves, this attempt of individual management proved unsuccessful. By the year 2000 nearly all of these irrigation schemes were operating under capacity, or not operating at all. This raised a lot of concern and NIB, with the consent of the farmers, took over some management functions of the schemes based on an understanding with the farmers. While the NIB manages the irrigation structures, the farmers are responsible for land management and marketing. This restructuring process, which has yet to be completed, was coupled with a dramatic process of reorientation and reform which has changed the mindset of the farmers (Ngigi 2003). This modernization process is clearly noticeable in the NIB management system and there is hope of coexistence and sharing of responsibilities in the management of the schemes.

In 1977 the Small Scale Irrigation Unit (SSIU) was set up within the Ministry of Agriculture (MoA) to supplement the NIB. The task of the SSIU, which later became the Irrigation and Drainage Branch (IDB) in 1978, was to support the development of smallholder irrigation schemes. When this unit was transferred to the MWI, it continued to have the task of promoting smallholder schemes. Today the unit has the following two major

responsibilities: Water allocation systems regulated by big water contractors and irrigation schemes fully and independently managed by water user associations.

Furthermore, the so-called Regional Development Authorities (RDAs) were set up from the 1970s. The RDAs were given a far-reaching mandate for the development of their respective regions, including the development of irrigated agriculture. These authorities initially developed large, so-called public commercial schemes, and later went on to develop community-based irrigation systems, some of which are still in operation today. The first purely commercial flower and vegetable farms, also based on irrigation systems, were set up in the late 1980s, mostly in the areas around Naivasha, Eldoret, Nanyuki, and Nairobi.

2.4.1 Literature on Existing Irrigation Potential in Kenya

The 540,000 Ha potential that is irrigable with available water sources is part of the 1.3 million hectares total potential. This fraction is located in areas that can, on average, be classified as being under UM 2-4 zones known for coffee production, bananas, maize, many types of vegetables, legumes and fruits. Tana and Athi River, Ewaso Ngiro and Kerio Valley basins are in these locations. Without influence from the government farmers can be guided to produce crops of high value that can make them realize their returns within a reasonable time. This approach will build reliable ownership among the producers just like the smallholder schemes in other areas. It may have to be born in mind that some of the areas like Tana and Kerio Valley are under relatively hot conditions and experiencing high evapotranspiration in longer periods of a year. These conditions may worsen with the experiences of climate change. It therefore would be prudent to start with the investments

and advice that may help the farmers to adapt to climate change rather than planning to exploit the potential with the management of NIB instilled into the new systems. This will automatically work towards reducing sustainability of the production processes and farmers' organizational development.

The physical environment of these locations is fragile and mainly in the 3rd production zone characterized with inadequate rainfall between 250-750 mm per year. It is uncertain whether the irrigation potential noted in the lake basin can really access water given the collapsed renegotiations between the East African states and Egypt concerning the Nile water originating from the basin.

Expansion and development of irrigated land has shown a declining trend of private large farms from about 1998 to date, a low rate expansion of public schemes and a considerable growth of the private smallholder schemes within the same period. The case of smallholder growth can be attributed to support from private sector organizations like SISDO that give support to individual smallholders in terms of loans and irrigation equipment and easy access to usable water resources as a result of registration of WUAs. The public schemes (national schemes) have shown some growth that can be attributed to the government, FAO, FRG and others efforts to revive the schemes.

Irrigation by large farms seem to be going down probably because of the high production costs resulting from the high input costs, supervision and extension services. With the Eurep-GAP conditions, production systems and practices have had to be thoroughly checked including mechanisms of ensuring traceability. This is mainly in relation to export products.

Issues of competition in the world market may also be suspect for the reducing production in large irrigation farms, not to mention emerging approaches to business where some exporting companies contract smallholder to produce the desired products for specific markets.

The country has two main agricultural production systems that can be relied on for the alleviation of food insecurity. These are rain-fed and irrigated agriculture systems. About 84% of the country's 576,000 Km², falls under arid and semi arid lands (ASALs) and not suitable for rain-fed agriculture due to unreliable and erratic rainfall (ASDS 2010-2020). About 16% is suitable for agricultural production, with high and medium agricultural potential and reliable rainfall. These ASALs are used as rangelands and agropastoralism and pastoralists. However, agricultural growth must be led by intensification and substitution towards more high-value products, and expansion of the cultivated area through irrigation.

According to the Agricultural Sector Development Strategy (ASDS) 2010-2020, Kenya is among countries classified as water-deficient and that water resources are unevenly distributed both in space and time. About 56% of all the country's water resources is in Lake Victoria basin, except the highlands which are endowed with springs and rivers. The inadequacy of water, inability to adopt irrigational efficient systems, unavailability of water storage facilities have been noted as factors that are limiting the country's irrigation based agriculture. Large commercial farms and private smallholder irrigation schemes account for 82% of irrigated land. The remaining 18% is under government managed schemes (MWI 2009-2010). These put together make only 4% of the irrigated land which is by far

insignificant to make a notable difference in food security initiatives. The 26% of agriculture's contribution to the country's GDP can greatly be improved if agricultural production is increased through expansion of cultivable land. However, this has to be accompanied with adoption of new production technologies, value addition to farm produce and market oriented farming. Apart from contribution to the GDP and alleviating food insecurity, desirable outcomes depicting sustainable growth of the sector will form the development envisioned by a number of strategies already formulated to guide the sector's development towards achievement of vision 2030. The strategies include the Strategy to Revitalize Agriculture (SRA) and the Agriculture Sector Development strategy.

The growth of irrigation in the country has been slow owing to the fact that the investment cost is high and the fact that food commodities could be easily accessed from the so call grain basket regions. Equally true, not all communities viewed grain commodities as staple food, centrally to the prevailing dependence of the grain as a major source of food. Influence of climate change has posed limitations to crop performance forcing the Kenyans to explore the opportunities in production under irrigation.

Although, all the schemes managed by the government agencies have resumed cropping covering some reasonable proportion of the land available, most of them have had very severe problems in the past. These severe problems were mostly experienced in the late 1980s and early 1990s when most schemes ground to a halt due to complaints and uprising by farmers against the management of their schemes by NIB. Mwea farmers for example, kicked out NIB from its schemes and serious riots were experienced that led to some deaths

and low productivity immediately after. This affected other schemes to an extent of closing down because the NIB became insolvent.

2.4.2 Literature Related to Government Initiatives towards Irrigation in Kenya

As a result of declining, little or no rainfall in most parts of the country, the country has a challenge to deal with a looming food crisis. In this pursuit, the Government has highlighted various interventions. The country's blue print, Vision 2030, has recognized irrigation as a key sector to spear-head economic development for the next 20 years through full exploitation of irrigation and drainage potentials in the country which is standing at 1.3 million hectares.

Food production in the country has been declining in the recent past and that of maize rock-bottomed in 2008 to about 26 million bags, some 10 to 12 million bags short of the national consumption. This was occasioned by declining, little or no rainfall in most parts of the country and the Post Election Violence (PEV) of 2007/08 (refer to my earlier comments). By 2009, the country faced a looming food crisis of major proportions. Due to the strategic importance of the maize crop as security crop, the government was pricked on the need to enhance its production under irrigation, and thus the birth of the National Economic Stimulus Project on food production under irrigation. The programme addresses challenges in other sectors too, so as to balance on the effects of food insecurity. For the ESP to counter the looming food crisis, the government undertook an emergency strategy to put additional 35,550 acres under irrigation. This effort led to the establishment of food production systems under irrigation starting with Hola and Bura irrigation schemes.

The target projections for the production of Maize and rice under irrigation in the first phase were 14,600 acres of maize and 20,950 acres of rice, with expected revenue of Ksh. 912,500,000 and Ksh. 1,885,500,000 respectively. Achievements however, were way off the mark especially that of maize which realized only 40% of the target production and 27% of expected revenue. Rice performance was fairly good; achieving 10% above the target production and 84% of the anticipated revenue. When these achievements are taken into account, we get the picture that the government is being too ambitious in its projection. At the same time coordination among the parties steering the Vision 2030 failed to share with the ESP implementing agencies for possible harmonization of the targets and objectives in the light of available resources.

The government of Kenya proposes to increase the area under irrigation by 56,000 ha per year from the current 120,000 ha to 400,000 ha in 5 years as shown in the figure above. This target is higher than the Vision 2030 of increasing the area under irrigation by 32,000 ha per year to 300,000 by 2012. This is an ambitious project which whose success remains questionable. The history of expansion of irrigation schemes managed by the government is riddled with failures and stagnation over the years. Between 1985 and 2005, the nationally managed schemes grew by 25% compared to the private farms and the Smallholder schemes which grew by 100% and 167% respectively over the same period.

To achieve the target therefore as shown in figure 5 above, a number of assumptions have to be born in mind including the probability that the water resource will not pose constraints despite the glaring climate change effects. Effective coordination and concerted efforts from

the government, beneficiaries and other stakeholders will come by concurrently with adoption different approaches of doing business accompanied with modern technology. Key issues of funding and improvement on timely release of the funds will need to be addressed. Government officials have not been entirely transparent in their operations where accusations of corruption have been quite frequent. For the success of this ambitious programme, farmers' concerns need to be addressed through stakeholder management committees where the farmers are adequately and effectively represented. These are issues to do with scheme management, land allocation and use, marketing and payments. Land tenure issues need to be addressed concurrently to create an environment conducive to private investments and natural resource management.

Diminishing extension staff numbers will have to be supplemented from private advisory service provision domains to ensure that management of irrigation schemes is not perceived as an ordinary activity. The current staff to farmer ratio stands at 1:400 contrary to the FAO recommended ration of 1:200. This remains a big task for the ministry. There is also the issue of the high cost of inputs within the schemes which should be addressed to ensure that farming within the schemes remain profitable and attractive to the farmer.

The other issue is the huge amount of water needed for the achievement of the targets and the diminishing water in the current schemes. The main challenge facing Mwea irrigation scheme and small-holder farmers around the scheme is water scarcity and the absence of a strategy for sharing the resource. Unless these, among other issues, are adequately addressed, the Economic Stimulus Programme (ESP), as noble as it sounds is bound to fail.

2.4.3 Literature Related to Irrigation by pastoralists

The study shows that even pastoralists, namely the Masais and the Pokots may be successful irrigation users and that, under the pressure of the last droughts in Kenya, pastoralists are increasingly getting interested in adopting irrigation. All of the interview partners saw increased food security and more balanced nutrition (especially for children) as the greatest benefits of irrigation. Irrigation may be life-saving for pastoralists, and it may also serve to prevent migration into urban centers (Ngigi, 2002).

Irrigation improves both the role and the status of women in pastoralist societies. For women, irrigation means a chance to contribute productively to family incomes in the absence of the men. This gives them more freedom and self-confidence. According to water users, including the men, this effect saved the lives of many people especially children during the 2006 drought period. Moreover, inclusion of women in water user groups, which was noted in Narok, generates emancipation and modernization impulses in other spheres of life. Pastoralists indicate that they find change in this direction acceptable. Pressure on resources is so great that the changes made – even if this implies the progressive emancipation of women – is accepted by the men. In the long run this offers an opportunity to escape the poverty spiral, as noted by the irrigation officer responsible for the district (Kull, 2006).

Irrigation not only increases the options open to societies to improve their food security and, possibly, larger incomes, it also makes such societies more open and flexible in regard to certain traditions that are no longer suited to given conditions. For instance, the goal of possessing the largest possible cattle herd – even if this means jeopardizing the overall survival chances of the total cattle population in times of drought – is gradually being questioned by pastoralists themselves. Following the 2006 drought shock in Massai Mara, some pastoralist groups have indicated that they are prepared to reduce the size of their cattle herds to be able to benefit from the newly created food potentials offered by vegetable cultivation. If for example supportive incentives are used to encourage this willingness, then the indirect effect of irrigation would be to counteract overgrazing and contribute to environmentally adapted land use (Kiteme and Gikonyo, 2002).

Irrigation requires pastoralists to engage in types of work wholly new to them, including e.g. digging canals and cultivating crops. Furthermore, many pastoralists are unaccustomed to regular work in the framework of an 8- to 10-hour workday. Consequently, pastoralists first have to learn both these activities and how they are best organized. The World Bank has achieved some successes here with its so-called Rapid Results Approach; the approach is geared to formulating, in stages, clear-cut objectives and strictly translating them into practice in the course of 100 days. 28 Furthermore, pastoralists are in need of comprehensive technical extension services and training to help them on their way as successful irrigators (Aeschenbacher, (2003).

Due to the scarcity of surface water and its unequal distribution in the areas inhabited by pastoralists, irrigation schemes will have to be restricted to a limited number of locations, and this means that in the short run irrigation will be a realistic alternative only for some pastoralists with a view to expansion with improvement in water resources through creation of storages. In times of drought and hunger, pastoralists from other areas tend to besiege irrigation schemes, demanding their share of the resources there. Since even today the sense of group affiliation among the Masai is still quite strong, the operators of irrigation schemes often share their produce with them, even though this means that they themselves will not have enough to survive on. In other words, there is good reason to assess the present situation of pastoralists, both with and without irrigation, as quite precarious. In the medium term, the question is how best to strike a balance between beneficiaries and non beneficiaries and how this balance might best be formalized. In the long run, otherwise, conflicts between individual pastoralist groups are as good as inevitable (Blank, et al, 2002).

2.5 Influence of Irrigation on Food Security

Achieving household food security requires broad policy instruments such as strategies for increased production, supply and price stabilization, employment, land distribution, macroeconomic growth, distribution of the gains from economic growth, population growth and income stabilization. With respect to agriculture more support will be necessary for extension work, credit availability, irrigation and encouragement of greater use of inputs such as fertilizer and improved seeds. Because of agriculture's central role in generating employment and income in rural areas, policies aimed at increasing agricultural production and productivity are essential for improved household food security and nutrition in sub-

Saharan Africa. However this does not mean that focus must be only on food production for domestic consumption. Research by the International Food Policy Research Institute (IFPRI) in the Gambia, Kenya and Rwanda showed that cash crop production can result in significant increases in household income and improved household food security (Kennedy & Haddad, 1992). In this context, it is important to emphasize not only the absolute level of income, but also the control of income and the source, as these can significantly influence household food security (FAO, 1997).

Food enters a household in a variety of ways. A household may produce food when it has the human and material resources to do so, and such households are said to have direct access to food. The ability of farmers to produce food in adequate amounts and sufficient variety depends to a large extent on their access to resources. Food is also purchased. Most households purchase a portion of their dietary requirements depending on need and affordability. This type of food acquisition represents economic access. Rural farming households regularly purchase a proportion of food commodities which they do not produce themselves. Given the ways food is accessed, diversity of food and income sources is considered to be one of the main practices against risk in agrarian communities (FAO, 1997).

There are many areas where smallholder's food security comes under risk such as: failure or loss of crop production due to pests and drought; agricultural trade due to disruption of exports and imports; large sudden food price rises and loss or lack of employment. Households which are most at risk are: smallholders with little income diversification and

limited access to improved technology such as seeds, fertilizer, irrigation and pest control; smallholders who are highly specialized in export crop; poor households highly dependent on imported food; poor net-food purchasing households and wage earning households (FAO/WHO, 1992).

Global projections on food indicate that hundreds of millions of people in developing countries remain hungry. Developing countries will be more dependent on food imports. Poor countries will be the least able to pay for food imports. Climate change could increase the dependency of some developing countries on food imports. Hardest hit will be small-scale farmers affected by other factors such as drought. Some countries, mainly in Africa are likely to become more vulnerable to food insecurity. Much future production growth will come from increased productivity, irrigation being a crucial production factor. Institutional innovations will be required to create incentives to enhance water productivity to permit increases in agricultural production (Ruttan, 2006).

2.6 Problems and advantages of the modern irrigation scheme

The modern irrigation system was built up and paid by the Chinese Government in cooperation with the Ethiopian Government.

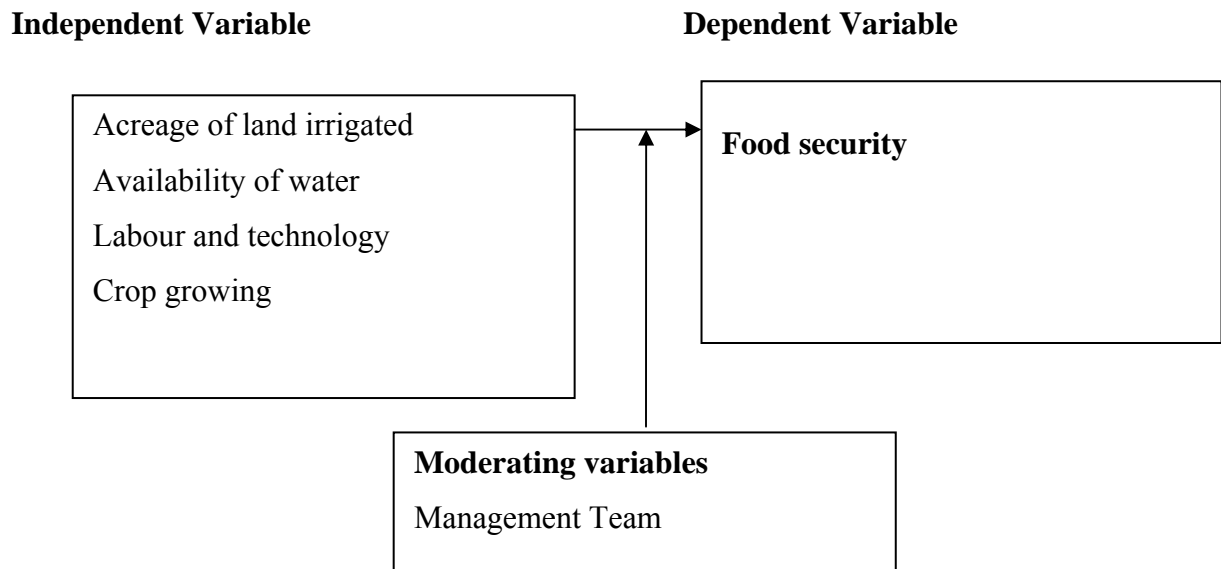
Main purpose of its construction was to increase the amount of irrigation water, enhance cash crop (cotton) and food crop (beetroot) production and to decrease water losses (Agricultural Office, 2007; Belete, 2006).

During the construction, there was a disagreement between the Ethiopian and Chinese Government because the Chinese did not build the main canal the way the Ethiopians wanted so the Ethiopian Government redrew every responsibility for the project. However, the Ministry of Agriculture brought the material to construct also modern field canals but unfortunately the Chinese had already stopped before the main canal was finished. Although the modern canal led to a lot of advantages, one of the main objectives of the construction has failed because water loss is still a problem. Moreover, increased water usage by farmers and salinity are constraints for adequate irrigation practices.

2.7 Conceptual Framework

The study adopted a conceptual framework that shows the relationship between the dependent and independent variables as shown in Figure 2.1

Figure 2.1 Conceptual Framework



Source: Author (2013)

Irrigation scheme entails growth of various food crops such as maize, sorghum, cassava, groundnuts and vegetables. The management of irrigation scheme initiated can lead to availability of food hence ensures food security of a region. However, without an effective management team with adequate skills and equipment, irrigation scheme initiated might not be effective.

2.7 Knowledge Gap

Most of the studies reviewed talked about importance of irrigation schemes but did not bring out clearly the concept of food security. This study intended to find out the relationship between irrigation and food security in Central Pokot District, West Pokot County through Wei-Wei irrigation scheme.

CHAPTER THREE

3.0 RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter focused on the research design used in carrying out the study and they include the target population of the study, the sampling design and the sample size, the data collection instruments and techniques, reliability and validity of research instruments, data collection procedures and the data analysis techniques.

3.2 Research Design

Research design is the plan for carrying out the research study (Kombo and Tromp, 2006). This study employed a case study research design. A case study is a deliberate attempt by the researcher to collect data from farmers of population in order to determine the current status of that population with respect to one or more variables (Mugenda 2003). A case study research design was used because the population studied was too large to observe directly. A case study research design was therefore useful because of the economy of taking a sample of the population to generalize results for the whole population.

3.4 Target Population

The study targeted 245 people who comprises of 20 employees of Wei-Wei irrigation scheme and 225 beneficiaries of the scheme.

3.4 Sampling Design and Sample Size

According to Mugenda (1999), the main factor considered in determining the sample size is the need to keep it manageable. This enables the researcher to derive from it detailed data at affordable costs in terms of time, finances and resources. Sampling is a procedure of selecting a part of the population on which research is conducted, and which ensured that conclusions from the study is generalized to the entire population. The researcher employed stratified simple random design to select the sample size. Stratified sampling was used to select a sample from employees' categories of the total population. According to Oso and Onen (2005), stratified sampling technique is a technique that identifies subgroups in the population and their proportions and select from each subgroup to form a sample. It groups a population into separate homogenous subsets that share similar characteristics so as to ensure equitable representation of the population in the sample.

Simple random sampling was used to select 30% of the group from different categories. In simple sampling technique, the sample was selected without bias to arrive at specific respondents from each stratum. 30% of the support staff was selected as the sample size. According to Oso and Onen (2005), if the proportion of the target population estimated to have characteristics being measured is known, 30% of the target population can be used as the estimate.

Table 3.1 Target Population and Sample Size Determination

Category	Population	Sample Size determination	Sample size
Employees	20	30% of 20	6
Beneficiary	225	30% of 225	67
Total	245	30% of 245	73

3.5 Data Collection Instruments

Both primary and secondary data were used. The primary data was obtained from the beneficiaries. The secondary data was obtained from project records. The data collection instruments used included questionnaires and interview schedule.

This study used questionnaire, which is a widely used and useful instrument for collecting survey information. As Wilson and McLean (1994) stated, questionnaire provide structured information, being administered without the presence of the researcher, and often comparatively straightforward to analyze. Questionnaire as a tool for data collection has its own advantages and limitations.

The advantages found from the literature includes; that the data collected through the use of questionnaire are efficient, reliable because of anonymous, honest, economical (in terms of time and money), quick (even possibly mailed), consistent (little scope for bias), offers the possibility of standardizing and comparing scales, and enables the anonymity of the data sources to be preserved. Nevertheless, the major limitations are lack of qualitative depth,

low response rate, inability to offset a lack of sufficient data or an error in the scale used (Thietart *et al.* 2001 and Cohen *et al.* The researcher can select several types of questionnaire, from highly structured (closed ended) to unstructured (open ended). Structured questionnaire is appropriate to gather straight forward and uncomplicated information. It is easy to classify and quantify, require less time and effort, and ingenuity to answer. But it is tedious and time consuming to prepare questions. The researcher also may not have a full range of responses to prepare closed ended questionnaire. In addition, the respondents have no chances to express their own views, and to qualify, develop or clarify their own answers.

On the other hand, unstructured questionnaire gives a greater insight and understanding of the topic being studied. But it may be difficult to classify and quantify and must be carefully interpreted. Thus, the use of either mere structured or unstructured questionnaire has its own flaws. To mitigate the limitations of both types of questionnaire, semi-structured questionnaire is a powerful tool (Cohen *et al.* 2000). Dawson (2002) also stated that researchers tend to use a combination of both open and closed questions. Such questionnaires begin with a series of closed questions, with boxes to tick or scales to rank, and then finish with a section of open questions for more detailed response.

The study also employed the use of interviews as a method of collecting data. An interview is a purposeful discussion and/or conversation with two or more people, and helps the researcher to gather valid and reliable data that are relevant to achieve research questions and objectives. Interviews may be structured (using standardized questions for each

respondent), semi-structured, and unstructured conversations (Saunders *et al.* 2003). Structured and semi-structured interview questions were designed for this exercise and administered to Wei-Wei irrigation scheme project managers and employees under study. The reason for use of interviews is that they are easy to administer since the questions are prepared in advance. They also allow a great deal of information to be gathered in a short period of time. Interviews also eliminate many sources of bias common to other instruments like observations. In addition, interviews help seek clarification through probing. The questions that were asked were confidential between the researcher and the respondents.

3.5.1 Validity of the Research Instruments

According to Mugenda (2003), validity is the accuracy and meaningfulness of inferences, which are based on the research result i.e. the degree to which results obtained from the analysis of the data actually represents the phenomena under study. Therefore questionnaires or interview schedules are said to be valid when they actually measure the intended parameters. The need to test the content validity of the research instruments is inevitable. This served to ascertain that the item produced was relevant to the objectives of the study. To test validity of the research instruments used in this study, the researcher sought the assistance of the supervisors to ensure that they are valid. The researcher also consulted the Department of Project Planning and Management of University of Nairobi to examine the pertinence of the content to be used in the questionnaires and interview schedule in relation to the purpose of the study. The feedbacks provided were utilized by the researcher to modify the items to ensure that they cover the variables investigated in the research.

3.5.3 Reliability of the Research Instruments

Reliability is to ensure that the consistency of research measurement or the degree to which the questionnaires as a measure of an instrument, measures the same way each time it is used under the same condition with the same subjects (Orodho, 2005). A measure is considered reliable if a research's finding on the same test given twice is similar. Data reliability ensures that the research will ensure that there is precision with which data is collected. If the same results are gained time after time, no matter how many times you conduct a piece of research, this suggests that the data collected is reliable. The test –retest technique was used to test the reliability of the research instruments. The test involved administering the same instrument twice to the same group of subjects with time interval of one week. The researcher observed that the instrument measured the research phenomena consistently hence reliable.

3.6 Data Collection Procedures

Before collecting data, the researcher sent a letter to Wei-Wei irrigation scheme management requesting to be allowed to collect data from the project. The letter had a copy of permit obtained from University of Nairobi. This was done two weeks before the actual date of data collection so as to enable the respondents to prepare for the study. During the day of the data collection, the researcher went to the irrigation scheme site to seek permission from the head teachers to carry out the study. After permission was granted, the researcher proceeded to the respondents to whom he also explained the purpose of his visit. The respondents were assured of the confidentiality of any information they gave.

3.7 Data Analysis

This refers to the examination of the coded data and making inferences (Kombo and Tromp, 2006). In this study, data was analyzed using both descriptive and inferential statistical techniques. The objectives were analyzed descriptively; by way of using frequency tables and percentages. This was done through the use of a computer programme called Statistical Package for Social Science (SPSS) version 19.

3.8 Ethical Considerations

Rights, anonymity and confidentiality of the respondents were respected in all phases of the study. Informed verbal consent with the respective Wei-Wei irrigation scheme management and the respondents were taken before data collection. Through verbal consent process, the type and purpose of the survey, discussion or interview; issues of anonymity and confidentiality; voluntary participation and freedom to discontinue the interview/discussion at any stage; and absence of any known risk or benefit for participating in the study was explained beforehand. To preserve anonymity, all findings were presented without ascribing names or identifiable personal description.

CHAPTER FOUR

4.0 DATA ANALYSIS, INTERPRETATION AND PRESENTATION

4.1 Introduction

This chapter presents analysis and findings of the study as set out in the research objective and research methodology. The study findings are presented on the impact of irrigation scheme on food security, a case study of Wei-Wei irrigation scheme in Central Pokot district, West Pokot County, Kenya. A total of 67 questionnaires were issued and 61 were fully answered and returned translating to 91% return rate. This showed that the respondents were cooperative and positive in participating in the study.

4.2 Presentation of the Findings

4.2.1 Gender of the Respondents

Data on gender of the respondents under study was sought to determine who between men and women were mostly engaged in irrigation related activities at Wei-Wei irrigation scheme. The findings on respondents' gender are as shown in Table 4.1.

Table 4.1 Gender

Gender	Frequency	Percent
Male	38	62.3
Female	23	37.7
Total	61	100.0

Gender of the respondents depicted 62.3% were male and 37.7% were female. The findings showed although there were more males involved in the activities related to Wei-Wei irrigation scheme, women also are involved in the project as a form of collective responsibility in ensuring food security in their households. . This was an indication that the scheme had achieved a third of the employment opportunity for women as provided for the constitution.

4.2.2 Marital Status of the respondents

Marital status of the respondents was sought. This information was to establish whether marital status of the residents influenced their commitments and juggling between family responsibilities and farming activities supported by the Wei-Wei irrigation scheme. The study findings on this item are as shown in Table 4.2

Table 4.2 Marital Status

Gender	Frequency	Percent
Married	49	80.3
Single	9	14.8
Divorced	3	4.9
Total	61	100.0

Majority of the respondents as depicted by 80.3% were married, 14.8% were single and the remaining 4.9% were divorced. The results showed that majority of the respondents had families/dependents who needed food hence the project was useful for their food security.

4.2.3 Age Brackets of the Respondents

Information on age brackets of the respondents was sought to determine whether individuals participating in Wei-Wei irrigation scheme were young, mature or old. The results are presented as indicated in Table 4.3.

Table 4.3 Age Brackets

Age Brackets	Frequency	Percent
20-29 years	19	31.1
30-39 years	23	37.7
40-49 years	15	24.6
Over 50 years	4	6.6
Total	61	100.0

The study established that 31.1% of the respondents were in the age brackets of between 20-29 years, 37.7% fall under the age brackets of between 30-39 years, 24.6% were aged between 40-49 years and the remaining 6.6% were aged over 50 years. The study findings indicated that majority of the residents were in their prime age of between 20-50 years which showed they were active in participating in farming activities supported by Wei-Wei irrigation scheme.

4.2.4 Educational Level of the Respondents

Highest educational level of the respondents was sought. This informational was crucial in determining whether the respondents had adequate skills in relations to modern technology in irrigation. The results of this item were as shown in Table 4.4

Table 4.4 Educational Level

Educational Level	Frequency	Percent
No formal education	6	9.8
Primary	31	50.8
Secondary	24	39.4
Total	61	100.0

Educational level of the respondents indicated that 9.8% had no formal education, 50.8% were primary school level leavers and 39.4% had secondary school educational level. The study revealed that the respondents are fairly educated though they didn't have other training skills on irrigation and farming which may have affected the quality of crops produced as well as difficulties in using modern technologies of irrigation.

4.3 Specific Objectives

This section discusses specific objectives of the study.

4.3.1 Food crops/livelihood of Wei-Wei irrigation scheme

The study sought to determine the current crops grown and irrigated on households at Wei-Wei irrigation scheme. The results were as shown below. The study used a three-point likert scale that ranged from, A=Strongly Agree, D=Disagree and UD=Undecided.

Table 4.5 Food crops of the Scheme

Sources	Response in percentage			Total
	A	D	UD	
Maize	58(95.1%)	3(4.9%)	-	100
Beans	-	54(88.5%)	7(11.5%)	100
Cowpeas	-	48(78.7%)	13(21.3%)	100
Sorghum	3(4.9%)	58(95.1%)	-	100

Majority of the respondents as represented by 95.1% agreed that maize is one of the current crops grown and irrigated on household plots at Wei-Wei scheme and 4.9% remained undecided. On the other hand, 88.5% of the respondents disagreed that beans are grown on households plots at Wei-Wei scheme and 11.5% were undecided. Further, 78.7% of the respondents disagreed that cowpeas is grown on household plots at Wei-Wei scheme as 21.3% were undecided. Finally, 4.9% of the respondents agreed that sorghum is grown at Wei-Wei scheme and 95.1% opted to remain undecided. The findings show that maize and sorghum are some of the crops that have been supported by the project/scheme. t

4.3.2 Main sources of livelihood before Wei-Wei irrigation scheme

The study sought to establish the main source of livelihood of the residents before the commencement of the project. The findings were as shown in Table 4.6.

Table 4.6 Sources of livelihood before the Scheme

Sources of livelihood before the scheme	Response in percentage			Total
	A	D	UD	
Cereals	3(4.9%)	58(95.1%)	-	100
Livestock	30(49.2%)	-	31(50.8%)	100
Wages	-	48(78.7%)	13(21.3%)	100
Food aid (GOK Relief)	28(45.9%)	33(54.1%)	-	100

The findings showed that 4.9% of the respondents agreed that cereals have been grown in the area as a source of livelihood before the inception of Wei-Wei irrigation project while 95.9% disagreed. Majority of the respondents as represented by 49.2% agreed that people of Pokot Central have been depending on livestock as a source of livelihood before the project was started and 50.8% disagreed. On the other hand, 78.7% of the respondents disagreed that wages have been a source of livelihood for the people of Pokot Central before Wei-Wei irrigation scheme was started as 21.3% of the respondents opted to remain neutral. Finally, 45.9% of the respondents agreed that people of Pokot Central have been depending on food aid (GOK relief) as the main source of livelihood, though, 54.1% of the respondents disagreed. The findings showed that livestock has been the source of livelihood for the people of Pokot Central which has resulted to cattle rustling. Also government aid has been of great helpful for the people of Pokot Central.

4.3.3 Main sources of livelihood after Wei-Wei irrigation scheme

The study went further and sought to determine the main source of livelihood for the people of Pokot Central since the inception of Wei-Wei irrigation scheme and the results were as follows.

Table 4.7 Sources of livelihood after the Scheme

Sources of livelihood after the scheme	Response in percentage			Total
	A	D	UD	
Cereals	46(75.4%)	15(24.6%)	-	100
Livestock	9(14.8%)	52(85.2%)	-	100
Wages	6(9.8%)	55(91.2%)	-	100
Food aid (GOK Relief)		33(54.1%)	28(45.9%)	100

The results showed that 75.4% of the respondents agreed that there is increase in production of cereals after the inception of Wei-Wei irrigation scheme and 24.6% disagreed. Some 14.8% of the respondents agreed that livestock is still a source of livelihood for the people of Pokot Central despite the inception of Wei-Wei irrigation scheme while 58.2% of the respondents disagreed. Further, 9.8% of the respondents agreed that wages form part of livelihood for the people of Pokot Central as a result of Wei-Wei irrigation scheme and 91.2% disagreed. Finally, 54.1% of the respondents disagreed with the fact that food aid (GOK relief) as a source of livelihood for the people of Pokot Central since the inception of Wei-Wei irrigation scheme and 45.9% were undecided. Due to the fact that cereals has risen and dependency on GOK relief or aid is an indication that the project has positively impacted the lives of the people of Pokot Central which has improved food security. The quantities of food produced in a year by farmers has risen to between 30-50 bags

4.3.4 Current means used by the people of Pokot Central to get food

The respondents were required to indicate current means they use to get food. The findings were presented as shown in table 4.8.

Table 4.8 Current means of Livelihood

Current source of food	Frequency	Percent
Internal production	6	9.8
Income from internal production	12	19.7
Wage income / Wei-Wei irrigation scheme project shares	43	70.5
Total	61	100.0

Table 4.8 showed that 9.8% of the respondents indicated that their current source of getting food was through internal production, 19.7% cited that income from internal production was the current source for them to get food and 70.5% reported that wage income / Wei-Wei irrigation scheme project shares was the current source for getting their food. Wei-Wei irrigation scheme engaged people in production, earning of wages from services rendered to production/farming activities and their shares from the project hence diversified source of getting food.

4.3.5 Level of food availability through Wei-Wei irrigation scheme

The inception of We-Wei irrigation scheme was to ensure food security. The study sought to establish the level of food availability through Wei-Wei irrigation project. The results of this concern were tabled as shown in table 4.9

Table 4.9 Food availability from the Scheme

Level of food availability	Frequency	Percent
Very sufficient	9	14.7
Average/managing	48	78.7
Below average	4	6.6
Very bad	-	-
Total	61	100.0

The study established that 14.7% of the respondent indicated availability of food since the inception of Wei-Wei irrigation scheme as very sufficient, 78.7% cited the availability of food as average/managing and 6.6% indicated that availability of food as below average. The findings showed that Wei-Wei irrigation scheme has improved availability of food in Pokot Central.

4.3.6 Rating the money spent on food purchase currently compared to the one used before the project was initiated

The inception of Wei-Wei irrigation scheme was intended to improve abundance of food and reduce money spent to purchase food. The people of Central were asked to rate their expenditure after the inception of Wei-Wei irrigation scheme and the results were as follows.

Table 4.10 Expenditure on Food

Response	Frequency	Percent
More	2	3.3
Less	56	91.8
Same	3	4.9
Total	61	100.0

Majority of the respondents as depicted by 91.8% indicated that they spend less on food purchase since the inception of Wei-Wei irrigation scheme, 4.9% indicated that money spent on food was the same as before the initiation of the project and 3.3% indicated that the money is more. The findings depicted that majority of the people in Pokot central are directly involved in the project thus they produced food hence they didn't need to purchase anymore thus they spend less on food. Those who spend same or more were the ones who were not directly involved in the project (those lease their plots to others).

4.3.7 Effects of Wei-Wei irrigation Scheme on Settlement at Central Pokot District

Through an open ended questionnaire, the respondents were asked to indicate the effects Wei-Wei irrigation scheme on settlement at Central Pokot District.

Table 4.11 Irrigation and Settlement

Effects on settlement	Frequency	Percentage
Modern structures	48	78.7
No movement of people	13	21.3
Total	61	100.0

They cited that Wei-Wei irrigation Scheme has enhanced settlement of people whereby structures or buildings are modern and there is no movement of people in search of grass for the animals.

4.3.8 Influence of Wei-Wei irrigation scheme on Trade at Central Pokot District

The respondents were asked to indicate how the project has influenced trade in the county and they cited as follows

Table 4.12 Irrigation and Trade

Effects on trade	Frequency	Percentage
New business structures	48	78.7
No new business structures	13	21.3
Total	61	100.0

In relations to the influence of Wei-Wei irrigation scheme on business at Central Pokot District, the respondents indicated that the scheme has opened business avenues whereby business like hard-wares, shops, car wash, posh-mills and M-Pesa outlets.

4.3.9 Effects of Wei-Wei irrigation scheme on education at Central Pokot District

The respondents indicated that due to irrigation that has ensured food/abundance/security, there has been opening of schools (primary, secondary) and tertiary colleges. People are now getting formal education that will assist to work on the irrigation scheme.

4.4 Analysis of Interview Schedule

This section deals with the analysis of interview schedule form the employees of Wei-Wei irrigation scheme

4.4.1 Reasons for initiation of Wei-Wei irrigation scheme

The study sought to determine from the employees of Wei-Wei irrigation scheme on the main objective of the project and they cited as follows.

Table 4.13 Reasons for initiation of Wei-Wei irrigation scheme

Reasons	Frequency	Percent
Improve food security	3	50
Reduce dependency on GOK relief	2	33.3
Reduce cattle rustling by focusing von farming	1	16.7
Total	6	100.0

Half of the respondents as represented by 50% indicated that the objective of Wei-Wei irrigation scheme was to improve food security in the area, 33.3% cited the aim was to reduce dependency on GOK relief and 16.7% indicated that the project was initiated to address cattle rustling which had been the main source of livelihood in the region.

4.4.2 General perception of the irrigation scheme

The officials of the project were asked to indicate their perception on the irrigation scheme and they cited as follows.

Table 4.14 General perception of the irrigation scheme

Reasons	Frequency	Percent
Improve and expand the acreage	4	66.7
Maintain the acreage	2	33.3
Reduce the acreage	-	-
Abandon the project	-	-
Total	6	100.0

Majority of the respondents as indicated by 66.7% indicated that the project had improved and expanded in acreage while 33.3% felt that the project had remained the same and maintained the acreage.

4.4.3. Rating of the project in regard to food security

The project officials were asked to rate food security as a result of inception of Wei-Wei irrigation scheme and the results were as follows.

Table 4.15 Rating of the project in regard to food security

Reasons	Frequency	Percent
Very good	3	50
Good	3	50
Fair	-	-
Poor	-	-
Total	6	100.0

The study showed that 50% of the officers cited that food security since the inception of the project is very good and 50% cited that food security since the inception of Wei-Wei irrigation scheme is generally good.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the discussion of the findings, conclusions, recommendations and suggestions for further research. This study was carried out with the main purpose of finding out the impact of irrigation scheme on food security, a case study of Wei-Wei irrigation scheme in Central Pokot District, West Pokot County, Kenya.

5.2 Summary of the Major Findings

5.2.1 Food crops/livelihood of Wei-Wei irrigation scheme

Majority of the respondents as represented by 95.1% agreed that maize is one of the current crops grown and irrigated on household plots at Wei-Wei scheme. On the other hand, 88.5% of the respondents disagreed that beans are grown on households plots at Wei-Wei scheme. Further, 78.7% of the respondents disagreed that cowpeas is grown on household plots at Wei-Wei scheme. Finally, 4.9% of the respondents agreed that sorghum is grown at Wei-Wei scheme.

5.2.2 Main sources of livelihood before Wei-Wei irrigation scheme

The findings showed that 4.9% of the respondents agreed that cereals have been grown in the area as a source of livelihood before the inception of Wei-Wei irrigation project. Majority of the respondents as represented by 49.2% agreed that people of Pokot Central have been depending on livestock as a source of livelihood before the project was started. On the other hand, 78.7% of the respondents disagreed that wages have been a source of

livelihood for the people of Pokot Central before Wei-Wei irrigation scheme was started. Finally, 45.9% of the respondents agreed that people of Pokot Central have been depending on food aid (GOK relief) as the main source of livelihood.

5.2.3 Main sources of livelihood after Wei-Wei irrigation scheme

The results showed that 75.4% of the respondents agreed that there was increase in production of cereals after the inception of Wei-Wei irrigation scheme. Some 14.8% of the respondents agreed that livestock is still a source of livelihood for the people of Pokot Central despite the inception of Wei-Wei irrigation scheme. Further, 9.8% of the respondents agreed that wages form part of livelihood for the people of Pokot Central as a result of Wei-Wei irrigation scheme. Finally, 54.1% of the respondents disagreed with the fact that food aid (GOK relief) as a source of livelihood for the people of Pokot Central since the inception of Wei-Wei irrigation scheme.

5.2.4 Current means used by the people of Pokot Central to get food

The filed findings indicated 9.8% of the respondents indicated that their current source of getting food was internal production, 19.7% cited that income from internal production was the current source for them to get food and 70.5% reported that wage income/Wei-Wei irrigation scheme project shares was the current source for getting their food.

5.2.5 Level of food availability through Wei-Wei irrigation scheme

The study established that 14.7% of the respondent indicated availability of food as since the inception of Wei-Wei irrigation scheme as very sufficient, 78.7% cited the availability of food as average/managing and 6.6% indicate that availability of food as below average.

5.2.6 Rating the money spent on food purchase currently compared to the one used before the project was initiated

Majority of the respondents as depicted by 91.8% indicated that they spend less on food purchase since the inception of Wei-Wei irrigation scheme, 4.9% indicate that money spent on food is the same as before the initiation of the project and 3.3% indicated that the money is more.

5.3 Conclusions

Based on the findings on the impact of irrigation scheme on food security, a case study of Wei-Wei irrigation scheme in Central Pokot District, West Pokot County, Kenya, the following conclusions can be made.

The study established that cereals are the main food crop grown at Pokot Central as a result of Wei-Wei irrigation scheme. The production of food has increased to an average of 30-50 bags a year

The study established that Wei-Wei irrigation Scheme has enhanced settlement of people whereby structures or buildings are modern and there is no movement of people in search of grass for the animals.

In relations to the influence of Wei-Wei irrigation scheme on business at Central Pokot District, the respondents indicated that the scheme has opened business avenues whereby business like hard-wares, shops, car wash, posh-mills and M-Pesa outlets

The respondents indicated that due to irrigation that has ensured food/abundance/security, there has been opening of schools (primary, secondary) and tertiary colleges. People are now getting formal education that will assist to work on the irrigation scheme.

5.4 Recommendations

In view of the findings' conclusions, the following recommendations are put forward:

Wei-Wei irrigation scheme management should foster for Expansion of areas under irrigation, institutional coordination and modernization. This will increase areas under irrigation programme and ensure improved productivity hence improved food security.

The management should train the people involved in farming activities supported by the irrigation scheme on with irrigation management. There should be coordination between irrigation authorities and agricultural authorities as a means of harmonizing training measures and combining them in reasonable ways.

5.5 Suggestions for Further Research

The scope of the study was based on impact of irrigation scheme on food security, a case study of Wei-Wei irrigation scheme in Central Pokot District, West Pokot County, Kenya. This was therefore not exhaustive and the following suggestions on areas of further research can be taken up.

- a) Effective utilization of rain water for irrigation purposes
- b) Effects of irrigation schemes on poverty eradication

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APPENDIX III: Questionnaire For the repondents

Dear respondents

I am a student at University of Nairobi undertaking Masters' Degree in Project planning and Management. It is a requirement that a student writes a thesis in the field of study. For that purpose I request you to spare your time to fill this questionnaire that is intended to find out **the impact of irrigation scheme on food security, a case study of Wei-Wei irrigation scheme in Central Pokot District, West Pokot County, Kenya**. Kindly spare some time to fill the attached questionnaire to enable me complete this study for which I will be very grateful. You are kindly requested to fill in the blank spaces at the end of each question or statement or simply put a tick where appropriate. This information will be used purely for academic purposes and will be treated in strict confidence. You need not include your name. Any additional information that you might feel is necessary for this study is welcome.

Your participation in this study will be valuable as it will contribute to the achievement of the study objectives. Please respond as honestly and truthfully as possible. Put a tick (√) on the appropriate answer on the statements below.

Thanks in advance for your support.

QUESTIONNAIRE ON WEI-WEI IRRIGATION SCHEME

Section A (To be filled by famers/ beneficiaries)

PART 1 (Demographic information)

1. What is your gender?

a) Male b)Female

2. What is your marital status?

a) Married b) Single c) Divorced

3. What is your age bracket? (*Please tick under only one of them*).

	20-29 years	30-39 years	40-49 years	Over 50 years
Age				

4. What is your highest educational level?

	N/A	Primary	Secondary	Bachelor's Degree	Master's Degree
Qualification					

PART B (Food crops/livelihood information)

1. What are the current crops grown and irrigated on household plots at Wei-Wei scheme?

Use the following likert scale. A = Agree, D = Disagree and N = Neutral,

Food crops	A	D	N
Maize			
Beans			
Cowpeas			
Sorghum			

Any other, specify.....

2. What are the main sources of livelihood before and after Wei-Wei irrigation scheme?

i) Before Wei-Wei irrigation scheme

Sources of livelihood before Wei-Wei irrigation scheme	A	D	N
Cereals			
Livestock			
Wages			
Food aid (GOK Relief			

Any other, specify.....

After Wei-Wei irrigation scheme

Sources of livelihood after Wei-Wei irrigation scheme	A	D	N
Cereals			
Livestock			
Wages			
Food aid (GOK Relief			

Any other, specify.....

3. What are the current means you use to get food?

- a) Internal production
- b) Income from internal production
- c) Wage income / Wei-Wei irrigation scheme project shares

4. What is the level of food availability through Wei-Wei irrigation scheme?

- a) Very sufficient
- b) Average/managing
- c) Below average
- d) Very bad

5. How can you rate the money spent on food purchase today compared to the one you used before the project was initiated?

- a) More
- b) Less
- c) Same

Interview schedule for the project officials

1. What are the reasons for inception of Wei-Wei irrigation Scheme?

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2. What are the various kinds and quantities of food crops grown at Wei-Wei irrigation scheme?

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3. What is your general perception of the irrigation scheme?

- a) Improve and expand the acreage
- b) Maintain the acreage
- c) Reduce the acreage
- d) Abandon the project

4. What is the status of food availability in Central Pokot?

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.....
.....
.....

5. What is your rating of the project in regard to food security?

- a) Very good
- b) Good
- c) Fair
- d) Poor

6. What is the contribution of the scheme to food security and the standard of living of the people of Central Pokot?

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7. What are the effects of Wei-Wei irrigation scheme on settlement at Central Pokot District?

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8. What is the influence Wei-Wei irrigation scheme on business at Central Pokot District?

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9. What are effects of Wei-Wei irrigation scheme on education at Central Pokot District?

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10. What is the contribution of the scheme to food security and the standard of living of the people of Central Pokot?

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11. What are the challenges facing Wei-Wei irrigation scheme?

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12. What are some of the recommendations that you would suggest in addressing challenges facing Wei-Wei irrigation scheme?

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