

Indigenous Irrigation and Food Security in Tot Division, Kerio Valley, Kenya

Daniel Kipkorir

School of Arts and Social Sciences
Moi University
P.O. Box 3900-30100 Eldoret, Kenya

Joram Kareithi

School of Arts and Social Sciences
Moi University
P.O. Box 3900-30100 Eldoret, Kenya

Abstract

Kerio valley is one of the driest areas in the republic of Kenya. The region is inhabited by the Keiyo and Marakwet sub-groups of the Kalenjin speaking people. The Keiyo inhabit the south while the Marakwet occupy the northern part of the region. Oral traditions state that the communities settled in the semi-arid valley in small agnatic clans in early 1800s and have for hundreds of years used indigenous irrigation furrows to enhance food security through food crop cultivation. Kerio Valley experiences an annual rainfall of 900-950mm per year which mostly falls in the months of May and August with intermittent dry spells within the months. Irrigation activity, therefore, supplements the insufficient rain. The Marakwet introduced the irrigation by tapping water from perennial rivers such as Embobut, Aror, Embomon, Enou, Tunyo, Chebilet, Kiptinos, Embolot and Chesegon. Recent studies show that Tot Division is highly plagued with hunger. Although the area has many irrigation furrows, it is perennially dependent on food relief by government and other agencies. Decay of the irrigation systems and increased population are the main factors that have directly contributed to food insecurity in the valley.

Key words: Marakwet, indigenous irrigation, furrows, food security, Tot Division.

Introduction

Tot is one of the four divisions in the Kerio Valley region of the greater Elgeiyo/Marakwet County, Kenya. It is located in the northern end of the county and lies at 1°10'N to 1°15' N and 35° 35' E to 35° 40'E and at an altitude ranging from 800 to 1200 metres above sea level (Government of Kenya: Economic Recovery Strategy Implementation Progress Report, 2007). The division is transversed by five main rivers (Chesegon, Embobut, Embolot, Enou and Embomon) all of which flow into the Kerio River and then to Lake Turkana in northern Kenya.

The area is divided into five administrative locations namely, Kaben, Endo, Koibirir, Mokoro and Murkutwa. In the units there are a total of sixteen administrative sub-locations. The division is bordered by steep escarpments on the western part (the Marakwet escarpment) and flat plains (the Kerio Valley) on the east.

Crop cultivation is the main economic activity for the people of Tot Division. The area is endowed with fertile soils suitable for the cultivation of crops such as sorghum, finger millet, cassava and maize. Cassava was introduced by the British colonialists as “anti-famine food crop” in the 1940s and since then, the crop has remained the reliable food in times of drought in the valley. The Kenya’s ministry of agriculture recognises the contribution of the “orphan crops”, namely sorghum, millet green grams, cow peas among other traditional crops in boosting food security especially in the arid and semi-arid lands (ASAL) like in Marakwet (Government of Kenya: Ministry of Agriculture, 2009:5-7) and in the implementation of the national food and nutrition policy (Government of Kenya: Ministry of Agriculture, 2011). Crops are grown between the months of April and May and in September, October, November and December. There are two harvest seasons in March and August.

Land for cultivation is traditionally divided into that of men and women. Marakwet women acquired rights to land for cultivation by marriage. The lands were given by men and consisted of several plots in different places of the clan areas. Men owned lands and had full rights in use (Critley, 1982). The amount of land held by households varied for land adjudication has not been undertaken in the division. Adams, *et. al.* (1997) reported that plots per households in Tot Division range from one to six acres and a majority had two and four acres spread in the valley and foothills of magnificent Marakwet Escarpment.

Families with insufficient land for cultivation leased more land (often for three to four years) from other clansmen with larger pieces. Kipkorir and Welbourn (2008) reported the payment is in form of castrated male goats (*setim*) or old female goats (*chepynosop arran*). Moore (1986) reported that in the lease, the owner of the land was given crop harvests in exchange of labour and other production costs. When the farm yields declined the farmers left the fields to fallow and cultivated other virgin lands. Few farmers apply both manure and chemical fertilizers to restore soil fertility (Kipkorir and Welbourn, 2008). In the homesteads crop harvests were stored in two granaries (*kapchogen*), one for the man and the other for the wife (*kapchogo korka*). Additional wives had own granaries.

This separation of the male head of household’s harvest from the wives’ is a traditionally widely practiced food security measure in which the man’s food store becomes a strategic food reserve in case of drought (Akong’a and Kareithi, 1998). A woman’s granary is her own and no one would consume the grains in it without her consent. The woman controlled the grains in the store for consumption and also for sale to purchase basic household items. The grain in the man’s storage was mainly reserved for making local beer for traditional ceremonies for the kinship (Moore, 1986) and as strategic food reserve in case of drought. The grain stores are round-shaped shelters whose inner walls and floors are smeared with clay mixed with cow-dung.

The stores are constructed of wattle, stone and mud and elevated on stone stilts to minimise infestation of grain by pests and rodents. Crop cultivation is largely supported by traditional irrigation furrows. The structures are managed by the entire community in terms of maintenance and distribution of water to the farmers.

For centuries Marakwet households have relied on furrow water for crop irrigation and were able to adequately meet their food security levels. In the current food deficit situation which perennially faces the Marakwet and their Pokot neighbours, relief agencies have recognised the potential of the traditional irrigation systems in achievement of food security in the region and have embarked on funding them.

In the past all farmers used flooding irrigation method by simply directing the furrow water to the fields using traditional hoes (*mokombe*) and other local implements. Flush floods which are sometimes experienced in arid and semi-arid lands in Kenya however cause destruction of furrow infrastructure hence disrupting livelihoods from farming (Ngaira, 2009). Irrigation water is allocated to the farming households through clan's water council (*kimwar*). In most cases, distribution depends on communal participation in maintenance of furrows. Each day the farmers have two irrigation periods, the afternoon irrigation (*tisho*) from 2pm to midnight and the night irrigation (*toboi*) from midnight to 11am.

Households have the right to be allocated water in any of irrigation periods (Adams. *et al.* 1997). Those with no rights to any furrow obtained the water either through purchase or forging alliances with clans which own the furrows. Adams *et al.* (1997) observed that such households obtain water in free period (*lugon*) when clans are "taking over" water from other members.

In the recent years Tot Division is periodically plagued with hunger. Production of food crops in the area has been gradually declining. For instance in 2004, 2005, 2006 and 2007, the production of cassava, maize, finger millet and sorghum decreased by an average of 2.8%, 15%, 21.3%, and 30.8%, respectively (Government of Kenya: Marakwet District Development Report, 2002-2008). Based on this, the division received the highest quantity of the total relief food distribution in the county at an annual average of 44 % (Government of Kenya: Marakwet District Development Report, 2002-2008). This paper assesses the contribution of the irrigation furrows in sustenance of food security for the households.

Methodology

The study was undertaken in November and December, 2008 in five sub-locations of Tot Division namely, Sibow, Sagat, Kisiwei, Talai and Barkelat. A descriptive research design was used and the population of the study comprised all households that used twelve irrigation furrows drawn from the Embobut Perrenial River. A sample of 230 households was randomly selected and a semi-structured questionnaire was administered to collect data on the use of the furrows in crop irrigation and status of food security levels in the households.

Data was analysed by use of Statistical Package for Social Sciences software and results presented in form of descriptive statistics. In addition, key informant and in-depth interviews were carried out with knowledgeable individuals in the community. The persons included community elders and leaders, furrow repair technicians and managers of non- governmental organizations (NGOS). The individuals were also invited to focus group discussion (FGD) to triangulate the research information.

Findings and discussions

Food crop production and consumption in Tot Division

Crop cultivation is the main economic activity for the people of Tot Division and is thus the main source of food security. However, like in other societies which inhabit the ASAL regions livestock is an important source of livelihood.

From the research findings, 67.8% of the respondents are cultivators, 13% are business men and women, 10.4% are herders, 6.5% are government employees who mainly work as teachers in local primary and secondary schools, while 2.2% do not engage in any economic activity and were dependent on relatives, relief agencies, and friends for a living.

The occupation categories highlighted above are not mutually exclusive. Cultivators are also herders, business people are also cultivators and so on and so forth. However, each household emphasises one activity as their main source of livelihood depending on its dependability while still using other avenues as auxiliary sources. Therefore, these activities proceed hand in hand as complimentary pursuits for the households' resource repertoires. Farmers mainly use simple tools such as traditional hoes (*mokombe*) in cultivating, planting and weeding of the crops.

Recent household food crop production and consumption data show that cassava is the most produced while maize is the most consumed crop in the area in Table 1. The production of food crops depend on irrigation through the traditional furrows. Farmers use flooding irrigation method by simply directing furrow water to crop fields using the hoes. Crops are grown in April and May and also in September, October, November and December. There are two harvest seasons (March and August) for the above mentioned food crops (see Table 1) except for cassava which is a perennial crop.

Indigenous irrigation and crop production in Tot Division

The study started with the working hypothesis that decay of Marakwet furrows has reduced food crop production in the division and contributed to food insecurity experienced in the area. Study findings showed that 98.26% of the respondents produced food crops through the irrigation furrows which were their main source of subsistence, while only 1.74% did not. A majority (98.3%) of respondents depend on irrigated food crops for subsistence. This means that irrigation systems must produce adequate crops to avert hunger. The deterioration of the furrows therefore implies that the respondents do not produce adequate food and are thus vulnerable to hunger.

The study findings show that 94.8% of the respondents reported that the deterioration of the furrows has reduced food crop production while 5.2% of them stated that deterioration has not reduced food crop production. Asked whether they received sufficient water for irrigation of crops, 61.3% of the respondents stated that they did not while 38.7% said they receive enough. This implies that larger number of people do not produce adequate food crops which then translate into hunger in households because of inadequate harvests. In the category of respondents who stated that they receive insufficient water 12.8% are from the Kapsyoi clan, 12.1% are from the Kasukut clan, 10.6% are from the Shaban (Kowow) clan, 9.9% from the Kapterik clan, 9.9% from the Kamariny, 9.2% from the Kabarmwar clan, 7.1% from the Kapsogom clan, 7.1% from the Kapsiren clan, 7.1% are from the Shaban clan, 6.4% are from the Kapchepsom clan, 4.3% are from the Kaptebeko clan, 2.8% are from the Kasike clan and 0.7% are from the Kapchebet clan.

Among the respondents who receive insufficient water, 70.2% associated the insufficiency to damage of the furrows from short abrupt heavy rains, while 29.8% stated that it is because of sharing of furrow water and increased population. From the research findings, 16.7% of the respondents use the Kapsogom furrow, 14.3% use the Kapsiren furrow, 13.9% use the Kapterik furrow, 13% use the Kasukut furrow, 11.7% use the Kamariny furrow, 9.6% use the Kapsyoi furrow, 7.8% use the Kaptebeko furrow, 6.1% use the Kamariny/Kabarmwar furrow, 4.3% use the Shaban furrow and 2.6% use the Kasike furrow.

This is shown in Table 2. A total of ten furrows are used by the respondents. In the five sub-locations studied, there are twelve furrows. Two furrows (Kapsiren/Kerio Valley Development Authority (KVDA) and Kabarmwar, are no longer used by the community. The Kapsiren/KVDA furrow is largely used by the KVDA for fruit and maize irrigation in small farms near Tot Trading Centre. In 1984 the KVDA requested furrow waters from the Kapsiren clan for use in fruit and maize irrigation in the division. At this period, Kapsiren clan owned two furrows one of which they leased to the KVDA. The agreement was that the KVDA would use the furrow in return for jobs offer to members of the Kapsiren clan. So far, the KVDA has employed seven full-time and fifteen part-time employees from the Kapsiren clan in this agreement. The clansmen and women work in Tot and Aror KVDA field offices in the Kerio Valley.

Kabarmwar furrow was heavily damaged in 1990s and early 2000 from mudslides. Today, the clan uses Kamariny/Kabarmwar furrow. The furrow was inherited from a legendry Marakwet woman (*chebo kobil*) who lived in the present day Talai Sub-Location many centuries ago. Oral traditions state that Kamariny and Kabarmwar clans migrated to Tot Division at the same time and claimed ownership of the furrow. For many years, the clans have been sharing the furrow. The Shaban (Kowow) clan uses the Kapterik furrow. The Kapterik own the furrow as they were the first to survey the furrow route from the Embobut River over the Kapchubai Escarpment.

According to oral traditions Shaban clan contributed labour during digging of the furrow and this entitles them right to access and use. The Kapchepsom clan uses Kapsiren furrow for they also contributed construction labour. The sharing has implications on sufficiency of water for crop irrigation in the division. It has resulted to rationing a factor which has contributed to withering of crops and conflict amongst the farmers. Besides, the sharing of the furrows water insufficiency is also attributed to climatic change and increased population. In the ASAL areas of Kenya climate change has led to reduction of river flows and consequently irrigation crop production (Ngaira, 2009).

From the study 35.7% of respondents from Kapsyoi clan were of opinion that water insufficiency is attributed to increased population. The Kapsyoi clan had approximately 150 households a large number of who may go for up to a month without being allocated the irrigation water by the kimwar. The study shows great variation on “the most irrigated crop” in the households. In the division, 54.3% of the respondents irrigate cassava, 19.6% irrigate sorghum, 10.9% irrigate maize, 12.2% irrigate finger millet, 2.2% irrigate green grams, and 0.4% irrigates bananas while 0.4% irrigates water melons. This data is presented in Table 3.

The table shows that many (54.3%) of the respondents irrigate cassava. This is because cassava requires little water for the irrigation compared to the other food crops as it is a drought tolerant crop. Farmers have concentrated on the irrigation of the cassava crop as a response to insufficient water. The cultivation of cassava enables the farmers to minimize risks of crop losses from the reduction of water as a result of the deterioration of the furrows. Of the total respondents who receive sufficient water, 68.5% irrigate cassava. Unfortunately, cassava is often affected by mosaic disease. This has complicated efforts made by farmers to safeguard food security in the division.

Food crop harvests by the respondents

A majority (67.83%) of the respondents do not harvest enough irrigated food crops for the needs of their household till next harvest season. Only 32.17% harvest enough.

This means that a majority of the respondents experience food shortages since irrigated food crops are their main source of subsistence and so due to low incomes they have a low purchasing power to afford enough food. In addition a majority of the respondents are not engaged in employment as there are limited employment opportunities in the area.

From the study, 52.2% of the respondents harvested 1-3 bags of the irrigated crops, 6.5% harvested 4-6 bags, 7.4% harvested 7-9 bags, 24.8% harvested 10-12 bags and 9.1% harvested 9.1%. The crops harvested are sorghum, cassava, bananas, Maize, finger millet, green grams and water melon (Table 4). It shows that 52.2% of the respondents harvested 1-3 bags of the crops. Table 5 shows the main crops harvested. They include cassava, sorghum, maize, finger millet and green grams. The harvests of 1-3 bags only lasts for a few weeks or months depending on the size of the household after which families are faced with hunger and have to seek for alternative ways of obtaining food till next harvests which is often after six to seven months.

Of the 67.4 % respondents whose harvests do not last till the next harvest 97.8% attribute the little harvest to damage of furrow. In the last three decades furrow water were sufficient and the communities cultivated large areas in the valley. The Kapsyoi clan cultivated large areas of Oron, Kacham Cham and Kapkoros. The Shaban clan cultivated the greater Kapkirwok area and the Kapsiren cultivated the Inoti area. Today, the community cultivates very few areas.

Land ownership is still communal in the division. So far, no land adjudication has been done. The communities cultivate respective clan and lineage lands. Families own dispersed strips of land both in the Marakwet Escarpment (which is also the main residential area) and in the valley where cultivation and herding are mainly practised. Those with insufficient cultivation land in the valley often lease from relatives and friends within the clans or from the other clans in the area. Payments are in form of goats, money and access to furrow water. Kapchepsom clan mainly lease land for cultivation. This is because they only have a small portion of cultivation land at the foot of the escarpment, some few kilometres from Tot Sub-District Hospital.

According to oral history they were the last to migrate to Sibow hundreds of years ago and found most of the land already occupied by clans who preceded them, namely, Kapsyoi, Kapsiren and Shaban. In Sagat Sub-Location, the Kaptebeko clan cultivates the Kitiber, Kisibai and Cherusyot areas. In Kisiwei Sub-Location, the Kasike clan cultivates the Chepkutuny and Kiloswa areas while the Kapsogom clan cultivates the Chesirkoyo area. The Kamariny and Kabarmwar clans in the Talai Sub-location cultivate Koibirir and Cheburokorun areas respectively. In Barkelat Sub-Location, the Kasukut clan cultivates the Kutoi area while the Kapterik and Shaban of Kowow clans cultivate the Sangutan area near banks of the Kerio River.

Gender, access to irrigated land, and household food security

Women acquire rights to cultivation areas through marriage. Men provide cultivation land to support the families while women contribute farm labour. Women gain usufruct rights to land through marriage or affiliation to a male clan member as a daughter or sister. It is at marriage that men constructed granaries (*kapchogen*) for storage of harvested crops. Marakwet society is patriarchal and men own economic resources (land and livestock) which they redistributed to sons through inheritance.

The furrow taboos practised in Marakwet society disadvantage single, divorced, separated and widowed women from utilisation of furrow water (Kipkorir and Kareithi, 2012) and thus their ability to produce irrigated food crops for their households is highly affected.

Customarily, women are forbidden from diverting furrow water to the crop fields. Furrows are owned by clansmen who have authority over their water use. Women under menstruation are considered unclean and therefore culturally forbidden from contact with the furrow water as it is believed to lead to leakage and breakage of the structures. Women household heads have therefore to pay for the services of males during such periods to make use of the water safely as contravention of the taboos is believed to cause miscarriages and infertility.

Furrow maintenance work is culturally reserved for women in the traditional division of labour as women may not possess the skills required, may pollute the furrows if they are in menstruation and sometimes lack the stamina and endurance required in the work given the terrain and the materials used. Since furrow users are required to participate in their regular repairs or in lieu pay a fine or suffer denial of use, women who have no adult male to participate occasionally find themselves disadvantaged in crop production, hence more vulnerable to hunger compared to those with adult males.

Of the 230 respondents interviewed, 87% are married, 6.5% single, 1.7% divorced, 2.2% separated and 2.6% widowed. This information is shown in Figure 1. With (87%) of the respondents married it means that a majority of women in the sample households have access rights to farm lands and men to participate in the furrow work. Women aspire to be married and strongly stick to married life so as to access land for cultivation in to provide food for their families. However, some households are *defacto* female headed where men have out-migrated for employment purpose. In such households irrigated crop production suffers on account of gender.

Irrigation water sufficiency and household food security

In the 1980s, the Marakwet produced adequate food crop and the surplus was even stored and some sold. Olenja (1982) reported many granaries in Tot Division and other areas of the Marakwet community, an indication that surplus grain was stored to last till the next harvest. The surplus was exchanged for meat and milk from the Pokot and poisoned arrows from the Tugen. Today, there are few granaries in the division implying that food insecurity is on the rise. The little harvests are stored in small spaces in huts and verandas of iron-roofed houses.

In the study it was anticipated that respondents who receive sufficient furrow water from their designated clan owned furrow for irrigation harvest enough food while those with insufficient water harvest inadequate food. A cross-tabulation on whether respondents receive sufficient water and whether they harvest adequate food crops to last till the next harvest showed some relationship. 14.2% of respondents who received insufficient irrigation water had inadequate food harvests. On the other hand, 38.2% of the respondents received sufficient water for the food crop production but produced inadequate food to last till the next harvest.

The study shows that 60% of the respondents who received insufficient furrow water but harvested adequate food are from the Kabarmwar clan while 40% are from the Kaptebeko clan. This means that the respondents seek for ways of accessing sufficient furrow water outside their clan designated furrows for irrigation of their food crops. The Kabarmwar clan forge alliances with other clans (who often have sufficient water) to access more water. In this arrangement, the Kabarmwar households irrigate crops using 'borrowed' waters and then share the harvest with the households which provided them with water from their designated clan furrows. It also implies that the respondents "steal" irrigation water from other farmers. The study affirms earlier findings on study of the rules, theft, gender and water rights on the Marakwet irrigation systems.

According to Adams and colleagues, the Marakwet farmers often steal irrigation water from their own members. Findings showed that those who receive sufficient water but produce inadequate harvest are faced with insufficient household labour. Insufficient labour is partly attributed to lack of cooperation between men, women and children in households who initially depended on each other for the subsistence food production. This is due to engagement in alcoholism and other off-farm activities leading to neglect of farming.

Food security situation in Tot Division

From the study 53.9% of the respondents stated that hunger is the main challenge for people in Tot Division, 38.3% stated that remoteness is a challenge while 7.8% pointed to insecurity as shown in Table 6. Asked whether hunger in the division is associated with the deterioration of the furrows, 96.96% stated that it is while 3.04% of the respondents did not agree. The division receives 900-950mm of rainfall annually, which is insufficient for crop cultivation). Irrigation furrows are used to supplement low rainfall. During 1980s and early 1990s, food security level in the division was high because the furrows were in good condition and cultivation fields were extensive.

Harvests were adequate and surplus was even sold at the local markets such as Tot and Chesegon (Osteberg, 2004). Increased hunger in the area is partly attributed to people's engagement in alcoholism and gambling. The youth are not fully undertaking farming even with the little water available. Instead they engage too much in alcoholism and gambling at the trading centres such as Tot, Soko Mjinga, Kabaldamet, Chebilil, and Sangach. Only the *Kaplelach* and the *Kipnyigeu* age-sets are fully actively engaged in food crop production in the division. The *Kaplelach* are the men aged 50-59 while *Kipnyigeu* are men aged 40-49 based on male circumcision age grading at time of data collection.

These age-sets highly cooperate in household labour for food crop production because a majority of them still adhere to the Marakwet traditions such as male and female circumcisions of the offspring. Sufficient meals must be provided during the seclusion of the initiates for them to heal faster. In addition, a majority of the *Kaplelach* and *Kipnyigeu* are also polygynous, and this compels them in producing adequate irrigated food crops for the household consumption. Going by their age, they are also perpetuating a subsistence legacy based on the traditional irrigation they have lived with for many decades.

Confronting food insecurity in Tot Division

In order to counteract shortage of food in the area, 43% of the respondents engage in casual labour, 10.87% sell cash crops and 10% purchase foods directly from the market, 3.04% borrow food, 4.35% seek for relief food and 28.7% sell livestock (Figure 2). Unemployment forces Marakwet people to engage in unskilled jobs because they cannot compete for formal employment in other parts of the country owing to low education levels (see figure 3).

The livestock mostly sold for food purchases include goats and sheep. Of the total respondents who sell livestock to purchase food crops 43.9% and 46.2% reside in Talai and Sagat Sub-Locations, respectively. The respondents mostly sell goats as alternative ways of acquiring food as a result of the inadequate food crop harvests. A study by Liyama et al (2007) among the Keiyo ethnic group in Kenya revealed various crop-livestock diversification patterns by households to improve both income and food security, a strategy also observed among households in Tot Division of Marakwet. The respondents in the sub-locations studied mostly keep goats and sheep for food security.

The study concurs with the research by Bryceson (1990) on food insecurity and the social division of labour in Tanzania 1919-1985. According to Bryceson, the Tanzanian peasant communities respond to food insecurity by selling livestock, a measure which consequently led to the disruption of the nutrition obtained from the livestock products such as meat, milk and blood.

Of the total respondents interviewed, 0.9% had sold livestock a day before the interview, 7.8% a week before, 27.8% month, 62.6% a year and 1.3% had never sold any livestock to purchase food (Table.7). A majority (62.6%) of the respondents had sold livestock to purchase food crops a year ago. This implies that livestock are often reserved for other household expenditure including school fees and bride-wealth. This explains why a majority of the respondents prefer to engage in casual labour to purchase food crop rather than to sell livestock. The findings concur with study by Osteberg (2004) on the role of livestock in the Marakwet community.

Osteberg found that livestock are utilized for bride-wealth and fines and also exchanged for rights to furrow water for crop irrigation. In addition livestock are reserved for slaughter during ceremonies. Moore (1986) observed that Marakwet slaughter goats at ceremonies and that goat skins provided ceremonial clothing during the male and female circumcision and marriage ceremonies. Rearing of goats continues to be dominant in the community. The Ministry of Agriculture is currently promoting production of dairy goats as a mitigation measure to food insecurity in the division. The activity is aimed at generating income from the sale of goat's milk which the communities would then spend on the purchase of food crops.

A majority (66.6%) of the respondents from Barkelat Sub-Location sold cash crops (mainly mangoes) to earn income which they use to purchase extra-food. Mangoes are more abundant in the sub-location than in other sub-locations studied. Christian missionaries settled at Liter Centre in the present day Barkelat Sub-Location in the 1950s and encouraged the community to plant mangoes to raise household incomes. Generally, there has been a gradual increase in cash crop cultivation in the division, an indication that people are venturing into commercial farming (Table 8). The employed and the self-employed respondents purchase food directly from market.

Few people seek for relief food following inadequate harvests. From the study, 83.5% of the respondents stated that the last time they received relief food was a year ago, 7.4% received a month ago 0.4% received a week ago, 0.4% received a day ago and 8.3% never received any relief food as indicated in Table 9. A cross-tabulation of sex of the respondents and the last time the respondents received relief food showed more men received relief food than women as shown in Table.10. The relief food is mostly distributed to household heads who are men.

They are in a position to receive it on behalf of household members. A cross-tabulation of the last time the respondents received relief food and the sub-locations show that 92.3% of the respondents in Sagat, 90.2% of the respondents in Barkelat, 85.5% of the respondents in Talai, 77.3% of the respondents in Kisiwei and 77.2% of the respondents in Sibow Sub-Locations received relief food a year ago. Monthly distribution pattern of the relief food showed that 12.3% of the respondents in Sibow, 11.4% respondents in Kisiwei, 6.5% respondents in Barkelat, and 3.8% respondents in Sagat Sub-Locations received it.

Of the 230 respondents, 3.8 % in Sagat Sub-Location and 2.3% in Kisiwei Sub-Locations receive relief food weekly and within some days respectively. The local leaders, particularly Assistant Chiefs and Councillors, influence distribution patterns of the relief food.

But in Sibow, the respondents are highly in need of relief food because of very low crop production as a result of damage of the furrows and reduced flow of water in the main river. Three clan furrows (Kapsyoi, Shaban and Kapsiren) are the last to be tapped from Embobut River and thus receive very little furrow water compared to the furrows in Sagat, Kisiwei, Talai and Barkelat Sub-Locations which are tapped from the upstream.

The findings show that the relief food is distributed to the old and the disabled. 28.8% of the respondents who receive the monthly relief food are aged 60 years and above. The food is distributed to the old and disabled because they cannot fully engage in productive activities. Relief food comprises maize, beans, rice, sorghum and millet. It's distributed in *gorogoro* (two kilogramme plastic or aluminium containers).

Food purchase in Tot Division

From the study, 7.4% of the respondents purchase food daily, 20% purchase weekly, 34.3% purchase monthly and 38.3% purchase yearly from the market as presented in Table 11. This confirms food insecurity in the division where households can not produce enough for their subsistence. The food purchases include, but not limited to maize, beans and finger millet. The purchases are determined by individual's income which in the case of Tot Division is relatively low because of high unemployment rate.

The low income is attributed to unemployment because of lack of formal education which is a key to employment and other economic opportunities. The study reveals that a minority (14.78%) of the respondents completed secondary school and college and so the standard of education is low, with 81.8% having no education or only primary school education (Figure 3). Without a proper formal education, it is very difficult for residents of the area to secure employment, hence a significant number of households have limited income to purchase adequate food. The lack of formal education by the majority of the respondents partly explains why most of the inhabitants are largely dependent on subsistence cultivation for their livelihood.

Consequently, the fact that distribution of rainfall in Tot Division is unreliable compels the residents to heavily rely on furrows for crop irrigation. Efficient operation of the irrigation furrows, therefore, determines to a large extent, the food security levels in the households. In recognition of the contribution of indigenous water furrows in food insecurity mitigation, the Kenya Red Cross Society has recently signed an agreement with the Pokot and Marakwet communities to share Embobut water resources for irrigation downstream in a multi-million shillings Tot-Kolowa Food Security Project (The Star Newspaper, Nairobi, November, 1 2012; Relief web report, 2012).

Conclusion

Irrigation is one of the major determinants of food security in the ASAL regions. The art was developed thousands of years ago as a strategy of enhancing food security. Since its inception, irrigation has played an enormous role in crop production worldwide. It is estimated that one third of the world's food is produced by irrigation (Bourenane and Mkandawire 1987; FAO, 1995). In the Sub Saharan Africa, indigenous irrigations accounts for 35% of the total land under irrigation It has been found that indigenous irrigation is significant in supporting a number of rural households with food in times of famine. In addition, the indigenous irrigations are cost effective in terms of maintenance. This is because it is often managed by farmers themselves. To a greater extent, Marakwet irrigations furrows are still used for crop irrigation in the semi-arid Kerio Valley, Kenya.

Many households continue to heavily rely on the furrows for crop irrigation and food security. It is therefore imperative that these structures be adequately maintained for use by farmers in the area so as to safeguard food security level.

Table 1 Food crop production and consumption data for Tot Division, 2007

Crops	Ha	Yield /ha	Total Annual production (Bags)	Total production (Tons)	Monthly Consumption (Bags)	Annual Consumption (Bags)
Maize	680	25	5,000		2,723	32,676
Sorghum	1338	10	13,380		2,587	31,044
Finger millet	1313	8	10,500		896	10,752
Cow peas			1,000		250	3,000
Ground nuts			4,000		8,33	10,000
Green grams			2,000		375	4,500
Sweet potatoes			1,000		416	5,000
Beans			200		666	8,000
Total		45	37,080		8,746	104,972
Cassava	1700	18		30,600	2,587 Tons	31,044
Total	3331				2,587	31,044

Source: Government of Kenya: Marakwet District Crop Development Office, Ministry of Agriculture and Livestock Development-2007 (Tot Divisional Office)

Table 2. The Furrows used by the respondents

Furrow's Name	Frequency	Percentage
Kamariny	27	11.7
Kamariny/Kabarmwar	14	6.1
Kapsiren	33	14.3
Kapsogom	38	16.5
Kapsyoi	22	9.6
Kaptebeko	18	7.8
Kapterik	32	13.9
Kasike	6	2.6
Kasukut	30	13.0
Shaban	10	4.3
Total	230	100.0

Table 3. The most irrigated crop by the respondents

Crop	Frequency	Percentage
Sorghum	45	19.6
Cassava	125	54.3
Banana	1	0.4
Maize	25	10.9
Finger Millet	28	12.2
Green gram	5	2.2
Water melon	1	0.4
Total	230	100.0

Table 4 Quantity of crop harvest in bags

Quantity(Bags)	Frequency	Percentage
1-3 Bags	120	52.2
4-6 Bags	15	6.5
7-9 Bags	17	7.4
10-12 Bags	57	24.8
Above 12 Bags	21	9.1
Total	230	100.0

Table 5 Cross-tabulation of crops irrigated and quantity of harvest in bags

Crops	The quantity of crop harvested in bags					No. of respondents
	1-3 Bags	4-6 Bags	7-9 Bags	10-12 Bags	Above 12 Bags	
Sorghum	30	1	7	7	0	45
Cassava	48	13	1	43	20	125
Banana	0	0	0	0	1	1
Maize	16	1	1	7	0	25
Finger Millet	22	0	6	0	0	28
Greengram	4	0	1	0	0	5
Water melon	0	0	1	0	0	1
Total	120	15	17	57	21	230

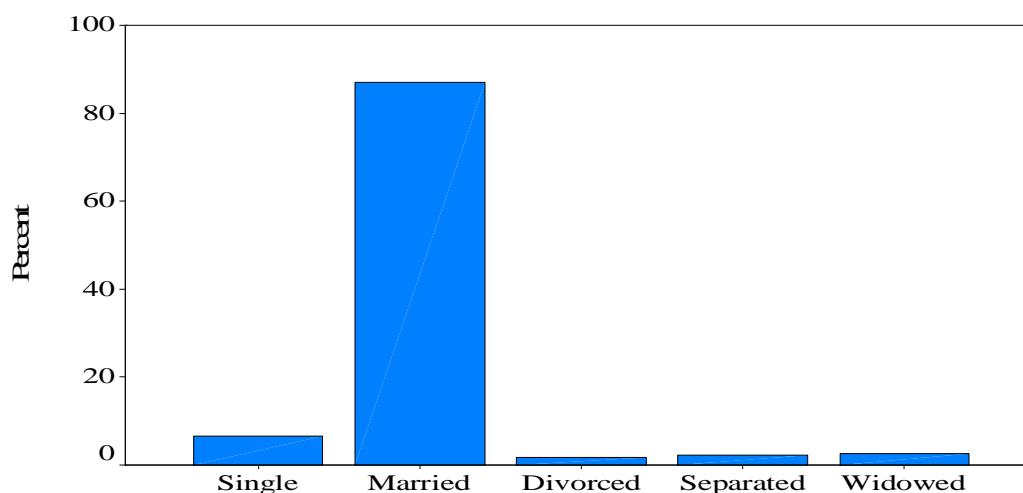
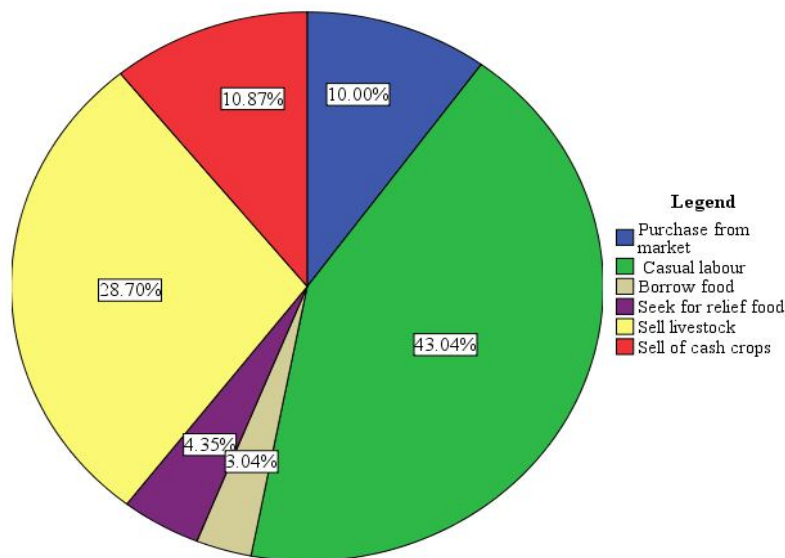


Figure 1: Marital status of the respondents

Table 6. Challenges facing residents of Tot Division

Challenge	Frequency	Percentage
Hunger	124	53.9
Insecurity	18	7.8
Remotness of the Division	88	38.3
Total	230	100.0

Figure 2: Alternative ways of Acquiring Food Crops after Inadequate harvest



Harvest

Table 7: The last time the respondent sold livestock to purchase food crop

Duration	Frequency	Percentage
Days ago	2	0.9
Weeks ago	18	7.8
Months ago	63	27.4
Last year	144	62.6
Never sold any livestock	3	1.3
Total	230	100.0

Table 8 Recent production trends of cash crops in Tot Division

Crop	YEAR/Cultivation areas (Hectares)							
	2001 (Ha)	2002 (Ha)	2003 (Ha)	2004 (Ha)	2005 (Ha)	2006 (Ha)	2007 (Ha)	2008 (Ha)
Banana	1	1	1	2	2	2	2	2
Mango	120	120	125	180	205	255	260	280
Paw-Paw	80	85	87	93	94	98	98	101
Kales	5	10	15	26	29	33	35	36
Bulb onion	0.1	0.1	0.2	0.2	0.3	0.39	0.43	0.5
Melon								3
Tomato								3
Sugar cane								2

Source: Government of Kenya: Marakwet District Crop Development Office Ministry of Agriculture (Tot Division)

Table 9: The last time the respondent received relief food

Duration	Frequency	Percent
Day ago	1	0.4
Week ago	1	0.4
Month ago	17	7.4
Year ago	192	83.5
Never received relief food	19	8.3
Total	230	100.0

Table 10: Cross-tabulation of sex of the respondent with the last time the respondent received relief food

Responses			Sex of the Respondent		Total
			Male	Female	
The last time the respondent received relief food	Day's time	Count	1	0	1
		% within The last time the respondent received relief food	100%	0%	100%
		% within Sex of the respondent	0.6%	0%	0.4%
		% of Total	0.4%	0%	0.4%
	Week's time	Count	1	0	1
		% within The last time the respondent received relief food	100%	0%	100%
		% within Sex of the respondent	0.6%	0%	0.4%
		% of Total	0.4%	0%	0.4%
	Month's time	Count	13	4	17
		% within The last time the respondent received relief food	76.5%	23.5%	100%
		% within Sex of the respondent	8.3%	5.5%	7.4%
		% of Total	5.7%	1.7%	7.4%
	Last year	Count	129	63	192
		% within The last time the respondent received relief food	67.2%	32.8%	100%
		% within Sex of the respondent	82.2%	86.3%	83.5%
		% of Total	56.1%	27.4%	83.5%
Never	Count	13	6	19	
	% within The last time the respondent received relief food	68.4%	31.6%	100%	
	% within Sex of the respondent	8.3%	8.2%	8.3%	
	% of Total	5.7%	2.6%	8.3%	
Total	Count	157	73	230	
	% within The last time the respondent received relief food	68.3%	31.7%	100%	
	% within Sex of the respondent	100%	100%	100%	
	% of Total	68.3%	31.7%	100%	

Table 11: The last time the respondents purchased food from the market

Duration	Frequency	Percentage
One Day ago	17	7.4
One Week ago	46	20.0
One Month ago	79	34.3
One Year ago	88	38.3
Total	230	100.0

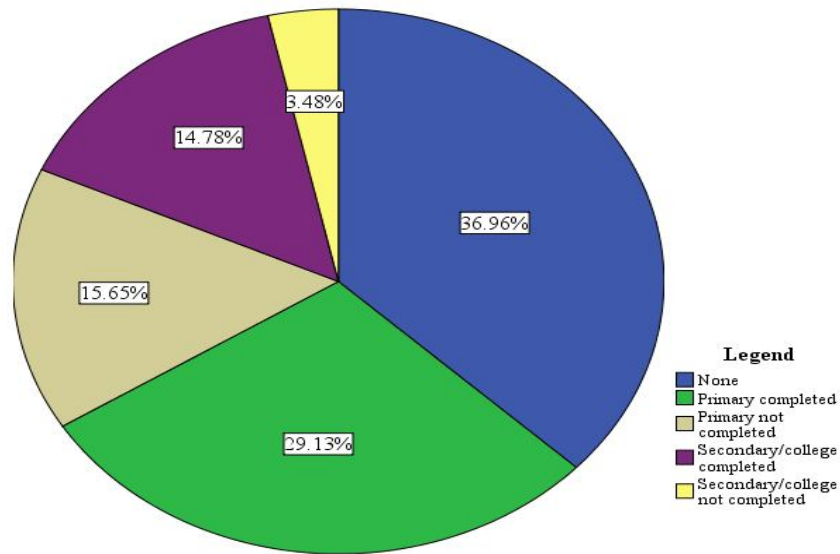


Figure 3: Education level of the respondents

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