8

Flood Water Based Irrigation in Kenya

Overview Paper Spate Irrigation

Spate Irrigation Network

Introduction

Irrigation in Kenya

Irrigation in Kenya has a long history spanning over 400 years. Historical records show that irrigation in Kenya has existed for many years along the lower reaches of River Tana and in Keiyo, Marakwet, West Pokot and Baringo districts. This irrigation would mainly be dependent on high spate flows. Rice irrigation activities also existed along the river valleys around Kipini, Malindi, Shimoni and Vanga where slaves were used to construct the rice schemes in the early nineteenth century. Asian workers building the Kenya - Uganda Railway line also started some irrigation activities around Makindu and Kibwezi. Drainage systems were started in Central Kenya and especially in Karatina in the mid 1930s putting under crop production large tracks of swamp areas. The continuous flow directed into a main drain from numerous natural springs would, during dry periods, be used to irrigate short season crops. In the 1950s and due to demarcation and land adjudication whole swamps were drained to clear areas for agricultural production as a result of the limited land area available to the families who received an equivalent of consolidated cultivated land parcels which in most cases did not meet land needs of a family.

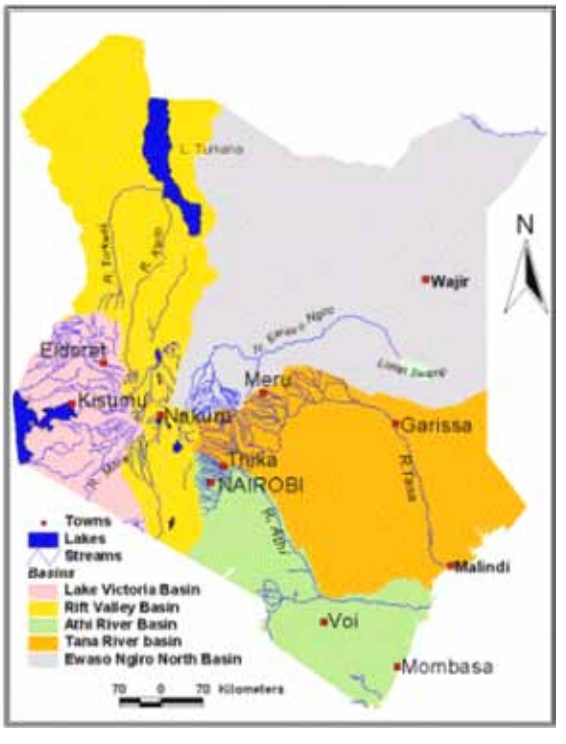
Production under modern irrigation systems can be traced to the period after the introduction of cash crop farming such as coffee, pineapples, sisal and lucerne. During the Second World War (1939-1945), prisoners of war and conscripted labour were used in the construction of irrigation schemes at Karatina, Naivasha, Njoro Kubwa in Taveta and on the shores of Lake Victoria.

In 1946, the African Land Development Unit (ALDEV) embarked on a broad agricultural rehabilitation programme, which included development of irrigation. In the mid 1950s, the Unit initiated a number of irrigation schemes, including Mwea, Hola, Perkerra, Ishiara and Yatta furrow using detainee labour. In these schemes the land was owned by the state through the Ministry of Agriculture.
In 1966 National Irrigation Board (NIB) was formed through irrigation Act cap 347 to manage tenant based national irrigation schemes. In 1978 Small Scale Irrigation Unit was formed in Ministry of Agriculture for development of smallholder irrigation schemes.

From late 70s large scale commercial farmers producing mainly coffee expanded irrigation capacities using mechanical water abstraction and overhead sprinkler applications. In the period after the 1970s, farmers especially in the horticulture industry, adopted new and modern water saving irrigation technologies such as drip and green houses for production of high value crops and flowers.

Kenya has a total land area of 58.26 million hectares out of which only 11.65 million hectares (20 %) receive medium to high rainfall while the rest is arid and semi-arid. Out of the medium to high rainfall areas, about 7 million hectares is used for agricultural production. This area can be significantly increased through irrigation. In 2003, irrigation accounted for only 1.5 % of total land area under agriculture but directly contributed 3 % to the GDP. It provided 18% of the value of all agricultural produce. This demonstrates the potential of irrigation to transform agriculture.

The development of the irrigation and drainage sector has been below expectations over the years. Based on matching mean flood flows and



80 % dependable monthly flow with irrigation demand with no water storage the land surface potential for irrigation is estimated at 539,000 hectares. Only approximately 110,000 hectares of the total irrigation potential has been exploited. The country also has approximately 600,000 hectares suitable for land drainage including flood protection of which only 30,000 Ha has been exploited.

Basin	Potential	Development (ha)
1. Tana	205,000	68,700
2. Athi	40,000	11,000
3. Lake Basin	200,000	10,700
4. Kerio Valley	64,000	5,400
5. Ewaso Ngi'ro	30,000	10,000
Total	**539,000**	**105,800**

Spate or Flood Irrigation in Kenya

Irrigation in the field is concerned with obtaining water from a source and transferring it through a conveyance system to the soil within usable range of roots of the growing plant. An irrigation system consists of abstraction, conveyance, application and drainage components.

Flood irrigation in Kenya is practiced mostly at a private level. For the traditional flood fed irrigation, water collecting in drainage systems flows into low lying areas in other cases water from full flowing rivers with their origin in the highlands over flows the banks to depressions and low lying areas. As the water dissipates due to evaporation and flow to other areas or back to the streams farmers in the area would plant. For crops like sorghum the stored soil moisture would be adequate to bring the crop to maturity while maize would require at least on rain event to fully mature. It is therefore common that during the short rain season in Kenya only sorghum will be grown in the flood fed systems while during the long rains, when some incident rain is expected within the arid areas, sorghum and maize will be grown.

Flood fed irrigation has been practiced by the Pokomo and Marakote people along the Tana River for many years growing rice, bananas, among other crops. Among the Somalis in North Eastern Province flood fed irrigation has been practiced to grow grain crop of sorghum traditional) and maize (newly introduced) in Mandera District (Takaba and Banisa Divisions). Maize however requires at least one incident rain to mature and is only grown during the long rain season. Over flow from Daua River along the Kenya Ethiopia boarder is used in areas of Rhamu, Rhamu Dimtu, Malka-Mari, Harere where sorghum and maize are grown. In Wajir District Buna Division - Korondile Location flood fed sorghum is grown. In Habaswein District flood fed sorghum and maize are grown. Other areas where floods are used to support sorghum growing in the North Eastern Province inclued Modogashe especially along Lagdera dry stream in Garissa District and Booni Forest area in Masalani District. Dasheik (ox-bow) farming is practiced along the lower reaches of the Tana River. Over flow from the Tana within the immediate flood plains that extends about 2 to 5 Km provide adequate moisture for crops grown after the flood event. Flood fed agriculture has as well been practiced for many years by the Marakwet in Northern Rift Valley in Kenya. In these traditional systems the communities would utilize the naturally occurring depressions along the flood basins of the rivers. Flood irrigation systems can be classified as small individual owned and range from 1 to 2 ha.

The country has high rainfall in the highland zones and a good network of rivers. During rain seasons lower reaches on some of the drainage systems experience flooding that interrupts normal agricultural activities as well as other livelihood activities. This has been the case with Budalangi in Western Kenya most rain seasons. This is due to inadequate flood protection measures, weak dikes *(as is the case in the photo when the dikes in Budalangi were breached in 2007)*, and/or appropriate systems to utilize the flood waters (in-field system of drainage channels) without causing the disruption and destruction they are currently associated with. In the overall substantial agricultural land is un-useable due to seasonal flooding while the after effect of the flooding limit

land use and stored soil moisture is in most cases lost through evaporation. The flood magnitude has as well increased over the years due to destruction and degradation of catchment areas and in some cases river migration.

Flood fed irrigation or flood recession planting has been in practice in Kenya for many years. Until recently use of flood water and controlled flooding for crop growth has however not been the focus of irrigation development in Kenya. However natural flood outlets from main drainage systems have over the years been developed into intakes for controlled irrigation with the abstraction levels being lowered, and by so doing allowing flow out of the flood basin into equally low or even lower areas outside the immediate flood basins. The lowered intake level would in this case allow all year flow into the irrigated field. With such development Kenya has realized irrigation development of many of the small scale small holder irrigation scheme. Such schemes include Sagana Irrigation Project, Ichiara irrigation Scheme among other small holder irrigation Scheme. As well large scale irrigation project have been planned to allow gravity irrigation in areas of low embankments where natural floods occur within the immediate vicinity such is the case with the not yet constructed Kora Kora intake for the Bura Irrigation Scheme.

In the overall Kenya has good climate and fairly good soils for growing a wide variety of crops and livestock forages, the only limiting factor being water availability. The Government of Kenya aims to focus on:

- Accelerating the construction of irrigation and drainage infrastructure.
- Increasing productivity per unit area.
- Increasing water harvesting and storage.
- Improving water management, irrigation efficiency and sustainability.

By encouraging and putting some measures in place that will enhance flood water harvesting and storage for crop production, the suitable soils and climate resources will provide a good potential for expansion and intensification of production of food crops, industrial crops, horticultural crops, pastures and forages using improved flood fed irrigation systems.

In recent past there has been accelerated development of on farm water reservoirs mainly holding water used for individual farmer small scale irrigation as well as domestic and livestock water. At the same time water storage system such as subsurface dams and sand dams with water being stored within sand reservoirs that limit evaporation have seen acceptability and replication from the few that were in Kitui, Mwingi and Makueni of Eastern Province to other areas where sandy river beds exist. Such water is now used to irrigate small scale gardens growing vegetables for family use as well as for local markets. On stream storage via construction of earth dams on small streams that have large variance in flow provide large quantities of water used by medium to large scale individual irrigation system that mainly grow for export market. Large off-stream reservoirs have been built to hold run-off that can later be used for crop production as well as irrigated crop production.

The photo shows a recently completed off stream reservoir, designed by and constructed under supervision of the writer, that will hold 120,000 m^3 of run-off mainly from a dry river bed and will be used to provide water for a 45 acre drip irrigation system. Due to the high cost of investment the farm will only produce high value crops mainly for export. In the picture the reservoir had just received some water from incident rains.

Water diversion structure for the reservoir built in gabions is shown in the picture below.

Spate Irrigation Potential

Kenya has a landmass of 582,000 Km^2 out of which only 16 % of this is of medium to high potential. The high potential area receives over 1000 mm annual rainfall and accounts for less than 20 % of the agricultural land and carries about 50 % (15 million) of the country's population. The medium potential area receives between 750 mm to 1000 mm per annum, occupies 35 % of the agricultural land and carries 30 % (9 million) of the population. The rest of the country (80 %) is classified as Arid and Semi-Arid (ASAL) with mean annual rainfall of less than 750 mm and carries about 20 % of the population. This scenario clearly shows that the country is poorly endowed with potential for rain-fed agriculture.

However assuming that the Semi-Arid receive an average of 400 mm of rain per annum this would translate to approximately 186,240,000,000 m^3 of water. With 45 % run-off, there would be potential to harvest of up to 80,000,000,000 m^3 that could be put to use for various agricultural, livestock production and to develop adequate water resources for the national parks, as wildlife is the main drive of Kenya's tourism sector.

With the adoption of water harvesting and storage technologies, the current irrigation potential could be increased by a further 800,000 Ha, to 1.3 million Ha from the current 80 % dependable monthly flow based potential of 539,000 hectares. It will mostly be the water that would otherwise have been lost as run-off and that subsequently end in the Indian Ocean that will be harvested, stored and utilized to increase crop production and hence food security.

During the state opening of the 10th Parliament the President of Kenya committed that the Government will table the National Water Harvesting and Storage Policy to facilitate harnessing and storage of the recurrent floodwaters. The policy, it is hoped, will as well guide and provide regulation on harvesting of run-off for crop and livestock production as well as provide indications of incentives that could be employed to encourage individuals and groups to embark on large scale water harvesting and storage for economic activities within the agricultural sector.

The irrigation policy, that identifies water harvesting and storage as a way to increase irrigated agriculture and the water harvesting and storage policy soon to be tabled in parliament and that will greatly focus in water deficit areas within the dry Arid and Semi Arid lands will greatly contribute to improved and modernized flood fed irrigation systems. Such improvement will ensure that within the 80 % landmass that is Kenya's ASAL, a sustainable system to utilize the land and occasional and limited water resources can be put in place.

Dependable stream flow, run-off and flood water harvesting combined with effective exploitation of ground water resources and innovative management of trans-boundary water resources could even allow increasing the irrigation potential for Kenya to well beyond the 1.3 million ha envisaged when only 80 % dependable flow and water harvesting and storage are taken into account.

Water Diversion Structures

For the traditional flood fed irrigation systems no improvements would be made to the intake or the point through which water would enter in to the cultivated depressions. In most cases the water would be diverted to these depressions via naturally occurring low laying sections on the river banks, natural channels would direct the flood waters to the depression when such was far from the stream. Where improvements were necessary i.e. to slow water flow along the stream, stones, logs and branches would be used and these would force flow through the breached bank or a naturally lower section of the bank.


Beramo Lagga, Buna Division

Due to nature of spate flows i.e. flash flows available for a limited time span and that can occur at any time of day or night and the fact that spate irrigation systems are not highly developed in Kenya to allow flows distribution during these spates, there has been greater focus at developing systems that will "catch" the floods

and make it possible to utilize such waters at ones own discretion. Over the years improvements have been made in storage systems for use when floods have dissipated. Such storage systems include;

- Storage in sand: sand dams, sub-surface dams
- On-stream storage reservoirs, masonry, reinforced concrete and earth dams
- Off-stream reservoirs, earth pans, ponds with supply channel from dry river beds
- Dug earth pans on relatively flat areas collecting waters

Organizational Structure

Kenya's irrigation sector can be put into three organizational categories namely

a. **Smallholder schemes**: these are irrigation schemes owned, developed and managed by communities as irrigation water user groups or individual farmers. These schemes produce for farmer subsistence and for the domestic market, and also for the export market. There are 2,500 such irrigation schemes covering an area of 47,000 hectares, a figure that accounts for 46 percent of the total area under irrigation. Over 47 % of the population active in irrigated agriculture works on schemes of this type. The Irrigation and Drainage Department (IDD) of Ministry of Water and Irrigation (MWI) is responsible for the overall development of smallholder irrigated agriculture.
b. **Public schemes**: these are irrigation schemes developed and managed by public agencies, specifically NIB and Regional Development Authorities (RDAs). Ninety percent of Kenya's rice is produced on NIB schemes. These schemes account for 12 percent of Kenya's irrigated land.
c. **Private schemes**: These are commercial high tech schemes mainly irrigating high value crops for export market. These schemes employ a workforce of about 70,000 persons. These schemes produce almost exclusively for the export market and cover 42,800 hectares (or 42 %) of the land under irrigation. Private schemes employ 41% of the population active in irrigated agriculture.

At the spate irrigation system the flowing are recognized as the responsibility in terms of gender.

Activity	Men	Women
Infrastructure-related	X	
Operation (water distribution)	X	
Maintenance	X	X
Agricultural Practices		X
Harvesting	X	X
Marketing		X

Maintenance of Spate Systems

Water harvested for domestic and livestock use on communal basis and stored in medium and small scale earth pans have traditional rules that ensure maintenance of reservoir based on animals watered or water drawn from the pan, this is mainly so in the North Eastern Province.

Challenges in Flood feed Irrigation Systems

Rain seasons have become more and more unpredictable - water harvesting and storage for use when needed and at a time when it gives better results is now advocated by the Government. However the high cost of developing these resources may limit their development and their contribution to increasing irrigated areas.

Recommendations

To improve spate irrigation in Kenya the following is recommended.

- Targeted studies to document traditional spate irrigation systems (mainly flood recession cropping)
- Targeted studies to document flood related irrigation systems including flood water harvesting and storage extents and areas under controlled irrigation mainly from flood water storage
- Mapping of water harvesting structures especially surface storage based on satellite imagery

References

National Policy on Irrigation and Drainage Development; Government of Kenya, Ministry of water and Irrigation

Reconnaissance Survey Report for Water Harvesting and Irrigation Potential in Wajir North Constituency; Ministry of water and Irrigation

Irrigation Development for Food Security, Wealth and Employment Creation; Proceedings of the National Irrigation Stakeholders Workshop; Ministry of water and Irrigation

Colofon

This Overview Paper is prepared by Peter Maina Muthigani, muthiganip@wananchi.com, muthiganip@gmail.com or cactus.ams@gmail.com.

This paper is based on an earlier version presented at the FAO-SpN Workshop in Opportunities and Potentials in Spate Irrigation, Cairo, April 2008.

The Spate Irrigation Network supports and promotes appropriate programmes and policies in spate irrigation, exchanges information on the improvement of livelihoods through a range of interventions, assists in educational development and supports in the implementation and start-up of projects in spate irrigation.

For more information: www.spate-irrigation.org.

October 2011