INDIGENOUS CONSTRUCTION TECHNOLOGIES IN FLOOD-PRONE AREAS OF WESTERN KENYA

S.K. Makhanu[1*], S.B.B. Oteng'i[2], S.S. China[3], G. W. Waswa[4], M.N. Masibo[4], G.W.B. Masinde[5]

Centre for Disaster Management and Humanitarian Assistance (CDMHA), Western University College of Science and Technology, Kenya

ABSTRACT

Shelter and sanitation are essential for the well-being and development of most societies. The approach and technology for the provision of shelter and sanitation varies with the social, economic and environmental conditions of a place. Sanitation of places with piped water is different with places without piped water. Likewise, shelter technology for regions prone to earthquake is different from that for areas not prone to earthquake. The purpose of this study was to identify indigenous knowledge and technologies in post-disaster construction in the flood prone areas of Budalang'i, in western Kenya, with emphasis on shelter and sanitation.

The study focuses on shelter systems such as; human living houses, food stores, and livestock shelters; and sanitation systems such as toilets, water wells and pans. The study considers social, physical and environmental conditions of the region. Baseline survey, and observation methods were used to determine the existing indigenous technologies. Interviews of key informants and direct observation methods were also used in the study. Identification and analysis of construction concepts in the area was done. The study recommends in-depth study of other indigenous technologies since are useful and easily sustainable in reconstruction phase of the disaster.

Keywords: indigenous technology; shelter; sanitation; flood disaster

---

[*] Corresponding author: Centre for Disaster Management and Humanitarian Assistance (CDMHA), Western University College of Science and Technology P.O. Box 190-50100, Kakamega, Kenya, Tel: +254-(0) 56-30871, Fax: +254-(0) 56-30153 E-mail: ksmakhanu@wust.ac.ke

[1]Professor and Director
[2]Associate Professor
[3]Researcher
[4]Assistant Researcher
[5]Post-graduate Student,

INTRODUCTION

Location

River Nzoia lies in the western region of Kenya. The catchment area is bounded by latitudes 1^o 30'N and 0^o 30'S and Latitude 34^o E and 35^o 45'E. River Nzoia flows into Lake Victoria just North of Yala swamp and rises from Cheranganyi hills in the East with tributaries feeding it from mount Elgon in the North. The basin covers an area of about 12000km^2 and a total length of 275km. River Nzoia basin transgresses many regions thus land use will vary accordingly. In the lower regions of Budalang'i the soils are poorly drained and mainly of clay type due to the frequent flooding. Thus, agriculture is not very prevalent in this area; the area is generally flat and swampy. The permanent swamps cover a total area of 25 km^2. Figure 1, shows the location of Budalang'i on the map of Kenya.

Main Land Use

Livestock rearing and fish farming are common activities. Agro-economic conditions are generally poor throughout the sub-area. Cotton is practically the only crop produced for the market. Maize farming is done on small scale for the local market only. Sugar-cane farming is practiced on small farms. Most roads are not tarmacked, which poses a serious problem in the communication network.

The Hydrology of River Nzoia Basin

The mean monthly rainfall trend represents two maxima and minima over the year. The First and Second maxima occur from April to May and July to November respectively. The minimum and maximum mean monthly rainfall is 20mm and 200mm respectively. The mean annual rainfall is between 1000 to 1500mm (Makhanu, 2005). The highest river discharges occur between May and September while the lowest river discharges occur between January and March.

Floods and Sedimentation

River Nzoia is characterized with flooding in its lower reaches. The river floods frequently, annually. This is due to the large catchment area versus one river to let the water into the lake. There is intense erosion in the upstream region due to deforestation. The soil blocks the channel or fills it, hindering the free flow of water. Deposition of the material eroded in the upstream takes place in the downstream. The deposition is intensive due to the low gradient of the riverbed (Makhanu, 2005). The deposition reduces the depth and thus the capacity of the river, which eventually results into flooding. Dykes have been constructed over 32 km stretch in the downstream of the river Nzoia to contain the flood problem, but floodwater breaks them at weak points. The introduction of food for work program by non-governmental organizations also destructed voluntarily repair work that was being undertaken by the community. Dykes are destroyed by burrowing animals such as rats, squirrels and ants,

Erosion in the upper catchment area of the basin is due largely to deforestation. Erosion in the lower reaches of the basin is caused by the progressive movement of the meanders causing bank materials to be moved downstream. Erosion in the upper catchment area leads to mass sedimentation in the lower areas. The solution lies largely in the control of erosion in the upper catchment. Annual sediment delivery in river Nzoia is between 158,400 to 326,350 tonnes (Dunnes, 1974).

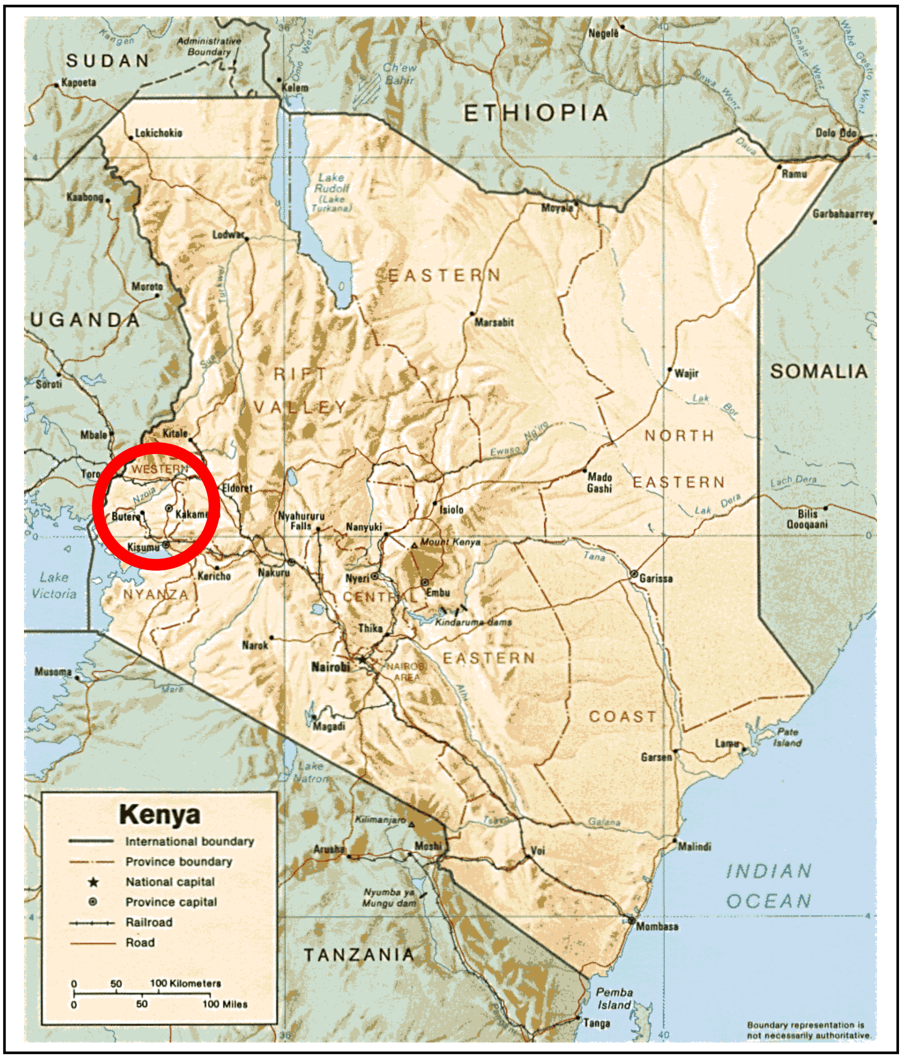

Figure 1: Map of Kenya showing the location of Budalang'i flood plain

Indigenous Knowledge

Indigenous knowledge has been widely used in expanding scientific knowledge and empowering the resident communities. According to McCall (1995), there is compelling evidence of the extent and rationality of utilization of indigenous knowledge in East Africa. In western Kenya, extensive knowledge of indigenous plant species and corresponding uses such as food, fodder, construction materials, herbal medicines, wood-fuel exist. In agricultural sector, local knowledge that has been used include: knowledge of crop rotation, seasonal planting of crops, hunting wild animals, trapping eatable insects, honey and fungi (mushroom) collection, pest and weed control. Indigenous knowledge has been brought about as a result of adaptation, individual trial or accidental discoveries. In East Africa many cases have been reported of deliberate farmers' experiments with crop breeding, crop mixes or protective measures (McCall, 1995). The pressing need for development of indigenous knowledge has been the occurrence of natural events, satisfaction of societal needs including protection from and influence of neighbouring communities, the regional climate and prevailing technological changes. Figure 2 below shows utilization of hydrostatic force to aid in emergency evacuation of non-absorbent household commodities by local persons.

Figure 2: Picture showing flooded area and flood victims tracking hand-woven basket containing household goods.

Has stated by McCally (1995) indigenous knowledge is not always universal within a community, but rather confined to a few experts, such as old people, women or 'progressive' farmers, the people of Budalang'i have specialized tasks among the family and community members. Women community members are knowledgeable in vegetable cropping, indigenous knowledge related to food and beverage preparation and storage; often related to health, drinking water and sanitation knowledge, and children care, while men are more knowledgeable in animal husbandry and shelter provision. According to Pablo (2004), the local cultures result into domestication of many species, spread and acceptability of new crops and eventually causing adaptation and shaping them to meet the emerging needs, environments and uses. This is well illustrated in Budalang'i area where food crops such as maize, sugarcane and fruits such as mangoes and pawpaw, indigenous outside this region have been assimilated into their cultures. The coping mechanisms from flood by Budalang'i residents has been over the years developed at the community level, just as the case of the Ribeirinhos of Amazon basin, who raise their crops by reducing the crop year to six months, through adapted plant management and cultivation techniques (Pinedo-vasquez, 2004). However, in construction industry, indigenous techniques have been misunderstood as being backwards and inferior (Baker, 2000)

History of Budalang'i floods and dykes

The flooding in Budalang'I region of western Kenya is as old as River Nzioa owing to its location as a low lying with flat terrain, which finds the river in its senile stage; hence flooding hazard is unavoidable. However, floods became a real hazard in Budalang'i since1940s through 1950s. Flood disaster occurred in 1945, 1948,1951, 1961 – 1962, 1975, 1977, 1978, 1997 –1998 (El Nino rains), 2001, and 2002 (Mango, 2003). Lately floods have occurred in April and August, 2003. The frequency has tremendously increased due to increase in the population exposition to the flood hazards as human settlements and crop farming encroaches the river plains, thus high vulnerability.

The Kenya government in 1961, through local leaders initiated the construction of a dyke, which covered 9.5km stretch on the Southern part of the river to protect Bunyala Rice Irrigation Scheme, which had been established. Between 1976 and 1977, 4km stretch of the dykes was constructed. Major construction of the dykes on either side of the Nzioa River was undertaken between 1980 and 1982 covering a total of 19.3km. Currently the dykes cover s total length of 32.8km, 16.2km on the Southern side and 16.8km on the Northern side of the River. The local community through "Harambee" spirit (joint effort), then referred to as "Silabalaba", maintained the dykes, an activity which involved patching up weak areas. The community forms local groups which carry out situation assessment periodically along the dykes to identify weak points for repairs.

SHELTER

Like other communities elsewhere, shelter is an important component of human live. The elements of shelter that are of great importance to Budalang'i residents are human living houses, food storage facilities and livestock shelters. The traditional homesteads of Bunyala people who lived in the flood prone areas were bounded with mud built dykes to prevent floodwaters from damaging houses. Shallow foundations were dug and fibrous tree branches placed in the foundation before a pile of clay soils being placed on the foundation in layers. The wood constructed ladder was used to pass over the dykes. Initially, flood impacts were less since people did not experience settlement problems due to low population. In flood emergency situation, camps were not there, people could shift to higher grounds without any resistance. Alternatively, they could put up with relatives and/or friends. During this time, polygamous was more rampant and unaffected household could host affected household belonging to one household head.

Human living Houses

The Bunyala people in Budalang'i traditionally live in grass-thatched roof, wood poles structure support the roof and mud walls. These materials are generally ideal for keeping the house cool since the area experience high temperatures and long sunny days due to its location on the equator. However, due to dwindling vegetative cover, (grass twigs), and availability of more durable roofing materials, iron sheets are becoming more common. Houses are constructed with the exterior ground raised above adjacent ground level to prevent shallow floodwater from entering. The raised part is usually well compacted against the wall and the ground level. Also houses in the flood prone areas are made of thicker walls than those in higher parts of this area. During walling, properly mixed mud is placed from exterior side of the wall, so that when damaged, mud that cave from the wall piles at the outside part of the house. There are two construction techniques practiced in this area; houses constructed to resist damage by floodwater and those constructed temporarily.

Houses constructed to resist damage require deep holes for wood poles foundation, and the support poles are closely placed. The wall materials are mixture of ant-hill soils and soils collected at the construction site, the thatching of the roof with grass is done by tightly tying grass twigs against the strong wooden runners with tree barks or sisal. When flooding is eminent, the mud wall is demolished from the ground to an estimated level of floodwater to avoid damage by wetting the upper part of the wall by capillarity movement (as shown in figure 3). In other cases, onsite wall materials are used for walling lower part of house, likely to be damaged by floods, while ant-hill and other imported soils are mixed with onsite soils before preparation of wall material for upper part of the wall, which is not likely to be damaged by the flood water.

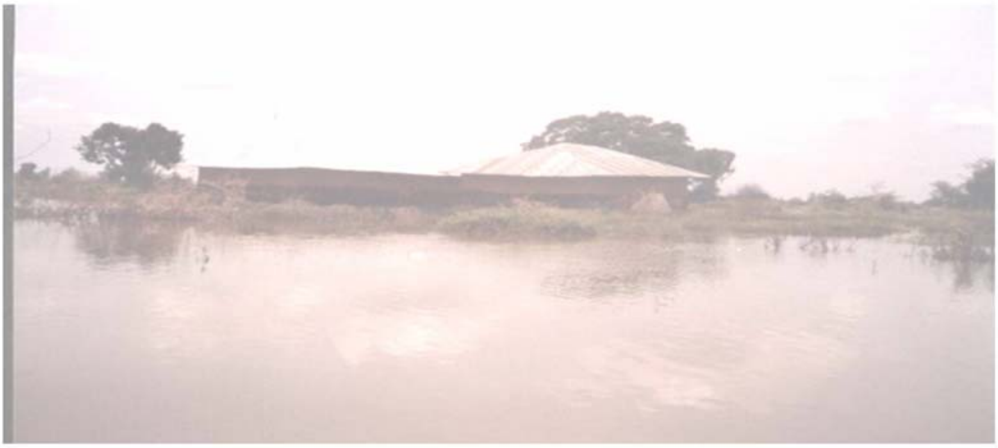

Figure 3: the level of the house that is likely to be damaged by flood water demolished

Figure 4: traditional hut construction during resettlement of flood victims after displacement by floods.

The temporally houses are constructed with shallower foundation, they use wall material extracted at the construction site, the roof is thatched by placing semi-cured grass, closely without tying it against wooden runners, with strings. The support poles are widely spaced and cut from soft wood. Temporally houses are constructed in more vulnerable areas, which are sheltered from winds to avoid placed grass used for thatching being carried by winds, while at the same time allow easy removal when the river stage reach the threshold levels. Figure 4 shows a temporally house being enclosed by a more permanent structure which is under construction. House floors are made of compacted murram, topped with clay and periodically smeared with cow-dung – clay mixture. This help in destruction of insects vectors and other organisms living in cracked floors, especially after floods.

Food stores

The development of indigenous food storage facilities has been on the basis of type of food available and occurrence of flood hazard. The staple food crops in this area are mainly cassava, sweet potatoes, finger millet, sorghum, bananas, maize and fish. The strategy for sustainable food production is through planting varying maturing food types and planting in various seasons. In this case the food crop remain on the farm until harvested for consumption. This method is only applicable for crops such as cassava and sweet potatoes. However when floods are eminent, the tubers are easily uprooted since the soils will have been softened, before floods submerge the area. However, floods do a great damage to these crops as they easily rot if left under flooded soils. Cassava and sweet potatoes are usually sliced, cured and stored in sacks or hand-woven baskets. They are either suspended from the roof or stored in the food store. The food stores are granary type, constructed with strong hardwood poles. The granary is usually placed above the ground level to prevent damage of stored food by floodwater, through direct contact. The granary is periodically smeared with clay mixed with cow-dung to seal openings and prevent entry of insect vectors. The roof is usually grass thatched, although iron sheet stores are also emerging. However, grains stored as seeds for consequent planting season are not stored in iron roofed storage facilities.

Where there is no suitable higher ground for construction of grain stores, woven-baskets and sacks are used to stores the food, where the basket is either hanged inside the house or between the house verge and walls. In some cases underground storage is done, where the hole is dug and lined with clay and is used to store foodstuffs which have been placed in guards or pottery containers. During floods, the community has developed rescue boats for evacuation of stranded victims and food.

Livestock shelters

Livestock domesticated in this region include cattle, sheep, and goats. Cattle are not sheltered in the roofed structures. Livestock shelters are located on higher grounds, often on ant-hill within the homestead. Where ant-hill or a raised ground is not available, ant-hill seeding is usually done within the homestead. The stacks used for tethering livestock are usually placed deep in the ground, to prevent being loosened and uprooted by floodwater or animal. Cattle shades are also located where there is natural vegetation, strong enough for tethering animals. Figure five below shows cattle being evacuated.

Figure 5: cattle being evacuated from flood prone areas to higher grounds

The higher grounds ensure that during floods, cow-dung is washed with floodwater to low areas leaving the livestock shelter clean. It also facilitates easy removal of cow-dung. Sheep, goats and calves are housed in roofed structures. However, most structures are not walled. Similarly, they are constructed on higher grounds to avoid floodwater.

SANITATION SYSTEMS

Floods are accompanied by a wide range of health hazards such malaria, cholera, typhoid and bilharzia, the situation leads to strain on medical facilities. The situation is usually made worse due overcrowding in the camps, due to this many deaths occur in camps. Toilet facilities although not common among the flood plain people, those that exist are submerged by the floods, hand-dug well even those at higher grounds collapse thus water becomes a great problem.

Toilets

Traditionally the indigenous community in the flood plain never used to have toilets. However due to continued disease outbreaks, the community has gradually adopted the pit latrine system. The latrines are only dug few feet down since they are highly vulnerable to floods and are reconstructed after every flood event. The latrines are the most temporary structures constructed by the community. In many cases are not roofed. Where they exist, are located in the downwind side of the homestead. The wall is usually made of mud or thatched with grass. Presently, there is efforts being made to sensitize the community on better sanitation technologies and mobile latrines that can be reused have been extensively distributed especially in public institutions.

Vector Control

The main prevalent vectors in this area include mosquitoes, tsetse flies, and rodents. Mosquitoes breed especially in rain season and more so during floods. The main technique used to reduce mosquitoes in to the house is by reducing ventilation through excluding window openings and construction of the walls to the roof level. However, non-structural measures such as use of smoke is widely used to fight mosquitoes, houseflies, and tsetse flies.

Water supply

The main source of water for the community is Nzioa River water. The area does not have springs or seasonal rivers. In normal situation, the community fetches water directly from the river. However in flood situation the residents have to fetch water from lake Victoria. Those who stay far from the lake, still have to get water for use from the River. The men who engage in fishing carry water containers along with them, to fetch water far away from the settlement, where water is believed to be relatively clean. Because of swampy conditions along the river, there are always patches of water in flood plain during dry period, where the community fetches water until is completely dry. In higher areas from the river, hand dug wells are used as sources of water. The shallow wells are dug during dry season to the water level. Since the water level is relatively deep, the wells are relatively wide and workers carry banana leaves into the wells to provide them with oxygen. The wells are dug with a conical shape, the base being smaller to avoid caving in flood season. For relatively shallow wells with good quality water, stones boulders are set beside the wells, which are used to fill the well as river stage reach the threshold level, this helps to save the effort of digging another well after floods.

CONCLUSION AND RECOMMENDATION

Although efforts have been done to identify indigenous knowledge in medicinal plants, cropping and animal husbandry, there have been little efforts done to establish the construction techniques in most regions, especially in disaster prone areas. However, if this knowledge is harnessed, it can be very appropriate in the rehabilitation and reconstruction phases of the disaster cycle. The practice will be easily acceptable and adaptable to the indigenous community hence sustainable in the long run. This will go a long way in saving training needs of personnel and reduce close post-implementation monitoring. Documentation for these technologies will make sure that technical knowledge that is considered scientific is not easily lost.

REFERENCES

1. Dunnes Thomas, (1974). Suspended sediment data for the rivers of Kenya, US department of Geological Sciences, University of Washington.
2. Makhanu S. K. (Ed.), (2005). Regional Power Integration in Hydropower, Project Report for Phase I, on Regional Power Integration in Hydropower: Workshop and Seminar on Nile Basin Capacity Building Network for River Engineering (NBCBN – RE) Held 13th – 16th June 2004, Cairo – Egypt, pg 26-27.
3. Mango Thomas, (2003). The Issue of Floods in Budalang'I division, (Report for Budalang'i Floods Stakeholders Forum, September, 1oth – 11th, 2003), Budalang'i – Kenya, pg 1-12.
4. McCall, M. K. (1995). *Indigenous technical knowledge in farming systems of Eastern Africa:* International Institute for Aerospace Survey and Earth Sciences. The Netherlands, (electronic book from the internet).
5. Pablo E., (2004). Ethnobotany of Crop Diversity and Evolution, the International Society of Ethnobiology – Ninth International Congress (Department of Anthropology - University of Kent, Centerbury, UK), 13th – 17th June, 2004, (electronic book from the internet).
6. Pinedo-Vasquez, M; Sérgio R; Fabiana M S, (2004). Evolution, Adaptation and Domestication Processes in Crop Species in Dynamic Environments of the Amazon River Floodplain. Center for Environmental Research and Conservation, Columbia University, New York, USA, (electronic book from the internet).
7. Laurie Baker, (2000). Rehabilitating Indigenous Technologies for Mud Construction, (electronic book from the internet), pg 123 - 130.