

Understanding and addressing the drought in Kenya: opportunities of harvesting water with roads

30



Practical Note



A look into the impact and mitigation of drought in Kitui-East, Kenya

What are the opportunities for road water harvesting in agro-pastoralist communities?

Drought is striking in Kenya, especially in the semi-arid and arid lands where (agro-) pastoralists live. Kitui County is one of the areas in Kenya where a number of people are receiving relief food. Their burdens are harsh, as the rains have failed 2 seasons consecutively. This means no produce from the land and it becomes difficult to find enough feed for cattle. We visited Kitui-East to listen to the people about their situation and share their story. What is their experience, and how are they dealing with this situation? Also a road stretch of 30km along Mwitika-Kyamatu-Masikalini road was assessed to find out about the opportunities to harvest water.

A drought is a period of below- average precipitation in a given region, resulting in prolonged shortages in water supply, whether atmospheric, surface water or ground water. A drought can last for months or years, or may be declared after as few as 15 days. It can have substantial impact on the ecosystem and agriculture of the affected regions and harm to the local economy.

1. The scenario of drought

Elijah Mwozya is area chief in Mwitika location, Kitui-East, he explains that the drought is now taking its second year in the area. "We received no yields from our farms in the last season, November-December 2016. We grow maize,



Figure 1: Livestock waiting for water under a baobab tree.

green grams, cow peas, millet, sorghum, cassava and pigeon peas. In the first season of 2016 we got around 50 % of the harvest, due to insufficient rains. The rains are not enough these days, they are not consistent. We used to have real rains, daily rain for the entire season. Now, it can rain today, and tomorrow, but then it can be dry again for two weeks. So the crops are halfway in maturing, and the rains are lost. So the crops will wither and die. These changing rain patterns have occurred in the last 3 - 5 years is my estimate."

"To get water for livestock is a great challenge. Livestock needs to go far these days, because there is lack of pasture and boreholes are failing. There are two boreholes in my location and one has water. But the price to operate a borehole is very high, because you need to fuel your dieselpump to pump up the water. This will take 60 l/day, coming down to 6,000 KSH per day. The water therefore is not pumped to distribution tanks. Despite investments in borehole construction, they are under-utilized and people resort to other water sources. For larger livestock holdings this water is becoming very expensive. Especially if you compare with the price of water in the kiosks, which is 3 KSH/20 l jerry-can. Now farmers who cannot afford to buy water, have to take their livestock to the river. They track distances up to 30 km to water their animals."

Other sources of water are earth dams. In the sub-location of Mwitika there are three earth dams, which have all dried up. Already from early February no water was remaining in the earth dams, due to failing rains. "We have also tried shallow wells, but this does not work, because of hard rock formation, low groundwater levels and poor recharge."

Asking the chief about what he thinks are reasons for this drought situation, he elaborates in 3 points ranking in importance:

1. "First, People have not been protecting their shambas (farmland) with soil and water conservation. Now there is a hard crust on the soil, the water cannot go down. The soil is washed away quickly. So if you just dig a little, the soil will be dry. I think that if people would dig, you would hold water and soil moisture for a longer time. Our soils are very fertile, the problem is water.
2. Secondly, when I was born, there were trees everywhere. Trees keep moisture in the soil, they cover the soil, you can do mulching etc. You prevent water to evaporate from your soil. Now they have cut all the trees for charcoal. This is the headquarter of charcoal burning. And the slopes are found without trees.

- Thirdly, farmers grow crops that are not fit for current climatic conditions. "Instead of growing crops like maize and beans, which require a lot of rains and takes three months to mature, they should be encouraged to grow drought resistant crops like green grams and cow peas. They can change to green grams and sell for a high price. But also for this there are costs involved and there is no money left to invest, and certainly not to take risks."

The situation in Kitui East has changed, Elijah says: "When we were young we used to wash our faces and legs on our way to school, all the streams from these hills had water but due to charcoal burning they dried up."

Farming practices

Elijah: "In this area people are used to shifting to another field, there is enough land. On average five acres, while a few have more than 50 acres of land. If one field becomes unproductive, you leave it and shift to another. Therefore they do not preserve their soils and have no commitment to dig terraces and trenches. This also results in bare fields which are more prone to erosion and loss of soil. I think it would be best if people cultivate small pieces of land that they can manage. Also livestock is an issue, people let their goats and cattle graze freely and do not keep them from entering fields with crops. It can damage everything. Before, children used to look after cows, but now it is compulsory for them to go to school. The wife now has to look after cows, but she also has to work on her farm and in the house. Almost all labour is done by women, men are not serious. Men do not want to look after five cows the whole day. And also they do not want to tie cows and goats, because they believe the animals will not get fat. We need rules to compensate people for the damage, but people here are not financially stable. It cannot be resolved and the practice continues. Pigeon peas for example are much affected by livestock, because they stay for two seasons. In the dry season livestock will come to eat and destruct."

A paralyzing combination

The ongoing drought in Kitui-East has resulted in many negative impacts. The lack of water results in no produce from the farm, so no income. Livestock is still reared, though people are reluctant to sell. This has a number of reasons; first is the strong cultural value of livestock determining the status and welfare of a family. Secondly, the low prices



Figure 2: A woman collecting firewood

of livestock during times of drought hinder people to sell.

The prices of livestock go down heavily in times of drought, a cow from 50,000 KSH now goes for 20,000 KSH. At the same time prices for food are going up, the staple food, maize, is normally 20 KSH per kg, though now it costs 50 - 70 KSH per kg. This has a paralyzing effect on the people. There is no produce, so no income, and prices of food are going up. And, livestock as their last lifeline is also at a threat. Selling livestock might be their only option, but reluctance grows with prices going down. Another issue is that mostly women take care of livestock, though men have the decision power. Though women would want to sell part of livestock to provide for their food, the husband is often reluctant to sell. When asking a woman with a herd of about 50 goats if she would want to sell one goat she replied: "I cannot sell to you, I am afraid for my husband if I do."

Elijah: "Right now I have seen that people are not preparing their fields. The last two seasons they have spent a lot of money, now they fear to spend the last resources they have and get nothing. Food relief is provided in this area. We have identified 100 household per sub-location. The number of people who depend on relief food will be bigger."

Impact on social life

Moreover, there is a wider impact on the lives of people that arises due to the drought situation, as Chief Elijah explains: "Life becomes difficult. Income from selling livestock is very low, and this is the only income they have due to failing harvest. There is a bank providing loans to women, but they fear they cannot repay. Also organizations train farmers on soil and water conservation and provide seeds of green grams. These are good plans, but if the rain fails, what do you do? It is most important to

get food and to pay school fees. So people sell livestock to pay. Also many people resort to casual labour, selling water and charcoal burning.”

The tense situation for families who are struggling to pay for food has many severe impacts on families and society. For instance, the number of school drop outs is increasing. This is because parents cannot pay the school fees of their children. There are more drop-outs at schools that do not provide food. Parents then rather keep children at home or send them to work. While schools that can provide meals are able to keep children in school. Young children are kept at home to look for water, or do casual labour. In some cases young girls are engaged in sexual activities to get money to buy food, sometimes parents are aware that this happens. All this causes tensions to rise, increases domestic violence and alcohol problems, and increased numbers of divorce. Families are not stable and there is always chaos in the house. When fathers come home drunk, they demand food first, while the children have not yet eaten. Drought impacts social life within families and society in a devastating manner.



Figure 3: Madam Kamene Kaluni



Figure 4: Ballast and charcoal for sale along the roadside

2. How to deal with drought?

Kamene Kaluni and Janet Kakuu are two women living in Mwitika location in Kitui East.

Both share that due to the drought they had no harvest and their livestock is dying, and it becomes difficult to find casual labour to earn a living. Kamene: “I have not received any yields from my farm and livestock is dying. The drought started last year but one. To earn a living I gather ballast from locally available material, do charcoal burning, casual labour and I sell livestock.”

Kamene is a widow and owns four acres of land. Asking her for opportunities to harvest water she says: “Being near a cross-culvert, an earth dam could help in my place. To construct trenches and terraces in my farm, I think it would cost me 10,000 KSH. I would be happy if we can get water, maybe with a borehole or with an earth dam. Also I like to have drought resistant seeds like green grams, cowpeas and pigeon peas.”

Janet works at a water vending kiosk along Mwitika-Masikalini road, she is also a farmer. The water supply comes from river Thua and is sold at 3 KSH per 20 l jerry-can. “Last season I received no yields from the farm. Because of drought there is no grass and water for my livestock. People come to the kiosk with their livestock to water them. It becomes very difficult to find water when the water kiosk is not in good condition. They walk long distances to search for water, some even walk for more than 35 km. I work in this kiosk to earn a living. Others do charcoal burning, making ballast, sale of livestock and some depend on relief food. Others move to urban areas to do casual labour. Because their families need water, food and school fees for their children. The effects on our social life are serious, there is an increasing number of school drop outs. Husbands become irresponsible, and the social violence and divorce cases are increasing.”





Figure 5: Water kiosk where Janet works, people wait for hours to get water, donkeys are of great help.

Chief Elijah: “When the rains are coming we cannot harvest water from the roads, this is something our people are not aware off. They have not reached the state that they find soil and water conservation a priority. Poverty is a serious problem, income is distorted by the rains, it is failing for livestock and crops. Therefore they are not prioritizing on their fields now, they do not have the means to do so. First priority now is to get some ready income to buy food and pay school fees.”

Elijah: “We need to encourage people to plant Melia Volkensia on their farms. This can help to control effects of climate change and conserve our area. And it is one of the best hard wood varieties, so people can earn a living from the sales of its products. So we can increase forest cover, and after

nine years when the tree is big enough people can sell the timber.”

3. On the road

What are the opportunities for road water harvesting and can they mitigate the impact of the droughts?

A road stretch of 30 km was taken along Mwitika-Kyamatu-Masikalini road in Kitui-East. This is a rural road of Class D. Below pictures are found of the location of the road stretch and the elevation profile.

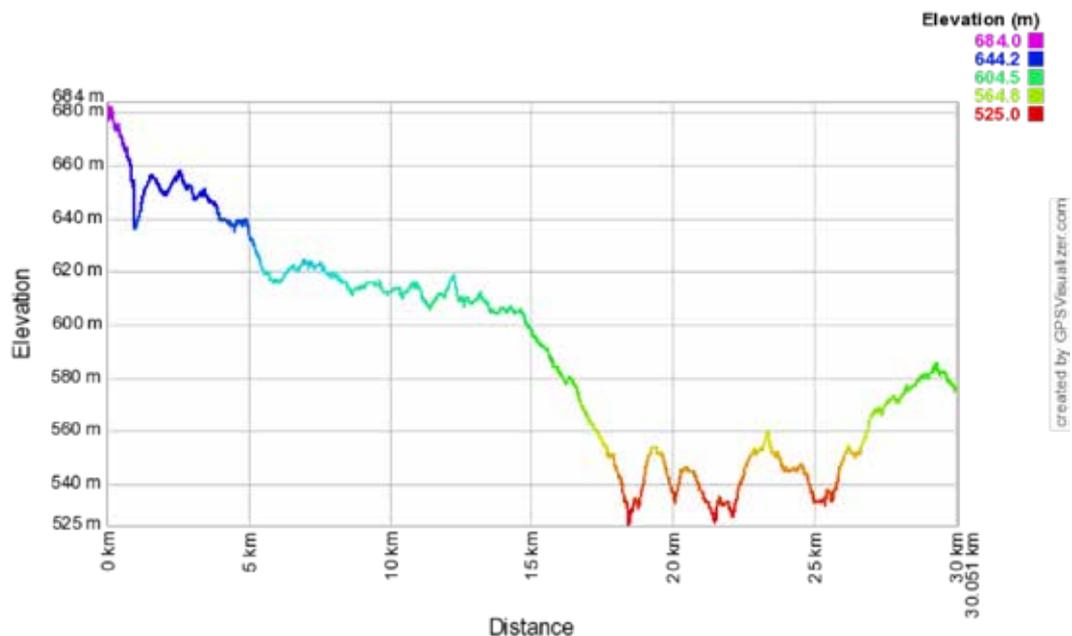


Figure 6: Elevation profile 30 km road stretch



Figure 7: Road stretch, showing sedimentation and erosion on the side

Road gradients

Based on the elevation profile estimations can be made on the slope gradient of the road stretch. Calculations are made on 2 sections with highest slope.

Section 1: 0 - 0.8 km = 800 m, elevation 684 - 637 = 47 m. Hence, $47/800 = 0.05875 * 100 = 6\%$

Section 2: 15 - 18.5 km = 3,500 m, elevation 598 - 525 = 73. Hence, $73/3,500 = 0.02 * 100 = 2\%$

In general it can be said that the road has a gentle slope of 0 - 2 %, there are a few sections that go up to around 6 %.

Road condition and structures

The road profile is in flatland terrain and it is graded with Murram soils, which is sandy material

often used for construction purposes. Along the road there are five water tanks and seven water kiosks, providing water to the community, all water supply is from Thua River. Agro-pastoralism is most common in the area, combining crops of maize, beans and peas with livestock holding. Whereas due to the drought situation currently little cultivation is taking place on the farm, the focus is on livestock. Average farm size is five acres and vast majority is rain-fed.

Road damage from water

On the road there are many occurrences of sedimentation, mainly in the side drain. Especially the drains in flat terrain are fully silted up. On the stretches with a higher gradient (> 5 %) there is severe erosion in the side drains and gully formation in adjacent lands. On the road foundation itself

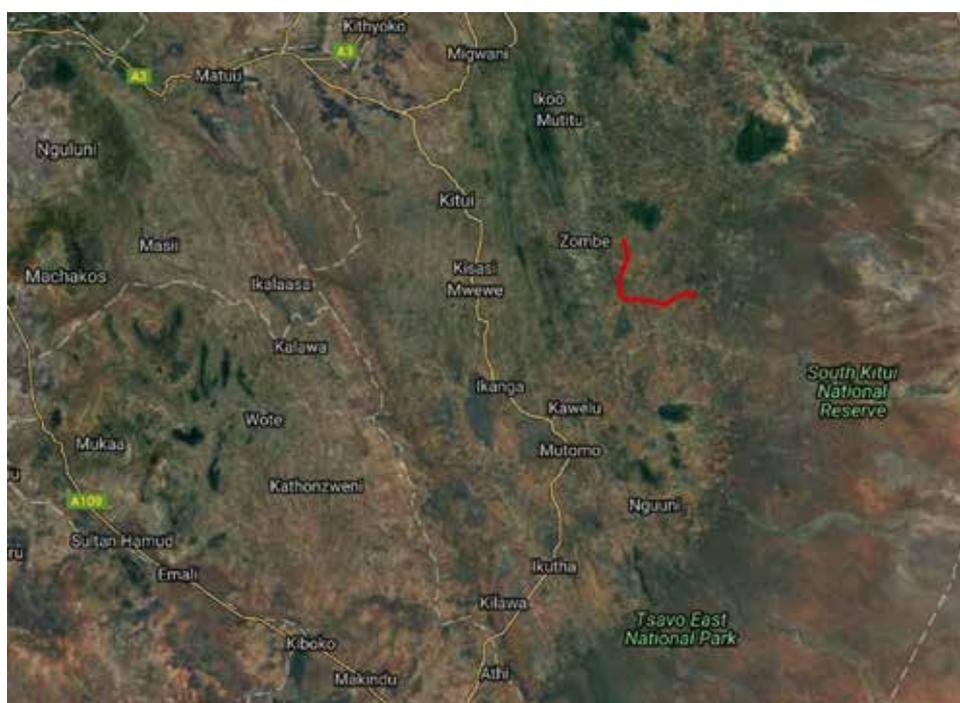


Figure 8: Location of 30 km road stretch Mwitika-Kyamatu-Masikalini



Figure 9: Side culvert scoured out, road trajectory re-allocated on the right side. Down: New cross-culvert on new road is causing erosion and gully-formation in side drain.

there are five stretches of 1 - 2 km of corrugation. Vegetation is limited along the road banks along the entire road stretch. The main vegetation in the area being shrubs with some baobab trees. Grasses along the road are missing, and also there are very few trees directly near the road.

The road crosses four streams and along three a drift has been constructed. On this road stretch there are 46 mitre drains, four cross culverts, two side culverts (one not being used and scoured out, road trajectory is replaced) and one borrow-pit (dry).

Currently there are no techniques in place that can harvest road runoff through existing culverts and

mitre drains. Flood water spreading is uncontrolled and people along the road complain there is too much water flooding their fields at once. One farmer tried to make terraces and trenches, but when the floods came everything was destroyed during the first rainy season. This farmer also has a shallow well, though the water is at a depth of 17m. There are currently no storage facilities along adjacent farmland. He emphasizes that the water should be slowed down by a system of checks upstream. The area is a flatland surrounded by hilly terrain, when water comes it is with high intensity, though there is no storage capacity.

The main challenge is that the capacity of soils to capture water has reduced. At the same time



Figure 10: Cross-culvert, 2 culverts replacing 1 old culvert which has scoured out on the other side.



Figure 11: This same cross-culvert leads into a channel, though water is not harvested.

water comes in floods. Therefore solutions should be sought in measures of digging trenches, soaking pits, check dams in small streams, culvert diversions, and allocation + channelling to natural pans/depressions to store water. The entire catchment needs to include these measures to enable water to stay and infiltrate into the soils.

4. How to turn this situation around?

A lot needs to be done in Kitui East for this water harvesting opportunities to be utilized. Intensive public sensitization is needed to help people to use the opportunities they have in their farms. Charcoal burning and ballast making is a short term solution, though it will not last. Road water harvesting together with good practices on conservation agriculture are key for the future of this area. The good terrain in Kitui East make road water harvesting a possibility.

Options for the area include:

- Systematically promote road water harvesting making use of all opportunities along the road
- Tree planting programs
- Link with ward/sub-county officers on water and agriculture to provide technical support. Investment capital is a major issue. Explore the option of food for work. Spate irrigation. The area has characteristics of a floodplain, and with improvements of retaining soil moisture it can be suitable for spate irrigation. Road structures can be used to control and check water coming in. This practice is uncommon in the area, so it would demand technical support and training on these techniques.
- Water retention structures on a catchment scale i.e. digging trenches, soaking pits, check dams in

small streams, culvert diversions, and allocation + channelling to natural pans/depressions to store water.

- Possibility of sand dams/sub-surface dams to store water in sandy river beds, in combination with shallow wells upstream, this can cater for domestic water supply.

A possible scenario on a 10 km road stretch:

The typical conditions of this road is one of sandy grading material, little slope and floodplain conditions in times of rainfall. Therefore it is key to channel water into recharge pits/areas, to divert into farms and collect in ponds. A lot of rain comes in once, so there is the need to let the water infiltrate.

The road department of Kitui County Government constructs mitre drains normally. Taking a spacing of 100 m on each side, this would mean 20 mitre drains. Here road operators can link to farmers to direct mitre-drains and help digging the first meters to the farm. Which a farmer can then extend into the farm through trenches. The standard size of a trench is 1m wide by 0.5 m deep. The estimated costs of hiring casual labour for a trench in Kitui East would be 600 KSH per meter. So a 50 m trench, would cost 30,000 KSH, when entirely done with casual labour. However, depending on the situation, household labour can be provided in many cases. In the farm also soaking pits and ponds can further increase storage capacity and soil moisture. Road operators can also convert two borrow-pits into harvesting ponds. These ponds can serve as drinking water for livestock, which are now often taken to water kiosks where women give them water in jerry-cans. Depending on levels of groundwater shallow wells can be a valuable addition to abstract clean water for domestic use. The additional costs for road construction is estimated < 5 % of the total budget for road construction and maintenance costs are likely to reduce.

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