# Community-led action to use forestry in building resilience to climate change: a Kenyan case study Njoro Division, Nakuru District, Kenya

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## 1. Introduction: livelihoods, climate and local resources

Njoro Division is located in the greater Nakuru District on the eastern edge of the Mau Forest Complex, the largest single forest block in Kenya. The area lies between the forest and Lake Nakuru National Park, a world famous flamingo habitat. The greater Nakuru District is situated between 35º 28' – 35º 36' E longitude and 0º 13' – 1º 10' S latitude.

Njoro stands at an altitude of 1,800 m (6,000 ft) above sea level and has a mild, agreeable climate. Temperatures range between 17–22° C, while the average annual rainfall is in the region of 1,000 mm.

Njoro's resources include crops and trees on farms, livestock, and a small amount of water and riverine forest. In the past, the land was covered with forests but due to the expansion of agriculture and the general population growth, these have receded.

In 2002, the population of Njoro Division was 87,489. The estimate for 2007, using a growth rate of 2% per year, is 96,595.

The main livelihoods of the people of Njoro Division are saw-milling, cattle-keeping and farming. Njoro's climate allows its population to grow crops like barley, wheat, potatoes, beans and more recently maize.

Since 1995, people have diversified their activities to include selling wood, charcoal and water. Many people run small kiosks selling food and other commodities.

The area is served by the Nairobi–Kisumu railway and has good roads. There is a thriving urban centre with a post office and many primary and secondary schools. The area hosts one of the oldest universities in Kenya, Egerton University. As is typical in Kenya, Njoro has many churches and a mosque. The area has a government administrative office and three hospitals.

There are many civil society organizations, including farmers' and forest associations, youth groups, women's groups and community-based organisations (CBOs). Compared to other Kenyans, the people of Njoro lead an above average lifestyle.

In April 2007, the International Institute for Environment and Development (IIED) commissioned the Forest Action Network (FAN), a Kenyan nongovernmental organisation (NGO), to carry out a case study of **community-led actions to use forestry in building resilience to climate change in Njoro Division.** The information for this case study was gathered using a structured questionnaire administered to important segments of the population in Njoro Division. In particular, the following categories were included: farmers, cattle-keepers, agricultural experts, natural resource experts, saw-millers, wood and charcoal sellers, water sellers and government administrators.

In total, FAN administered 100 questionnaires. The majority of those interviewed had heard of climate change (95%). Of the people interviewed, 53% had lived in Njoro for more than 10 years, 20% had lived there for 5–10 years and 17% for less than 5 years. The overall conclusion is that the majority are struggling to cope with the effects of climate change and would like more assistance and information.

## 2. Changes in climate

Recent changes in the local climate

While scientists, civil society organisations and government administrators discuss climate change in workshops and conferences, the local people living in Njoro do not speak directly about climate change. Some of their statements from our study are included below:

*Mama Fatuma, who runs a local butchery at Bondeni Njoro, said: "These days we do not know what is happening. Either there is too much rain or none at all. This is not useful to us. When there is too much rain, the floods that result cause us harm. When there is not enough rain, the dry conditions do us harm."*

*Dr. Geoffrey Tunya, a lecturer at Egerton University and resident of Njoro for more than 30 years, said: "Rain does not come regularly and when it does it comes in torrents. There are extended droughts. Rivers are drying up."*

*Daniel Peniel, from the community-based organisation Cross Roads, said: "The intensity of the sun seems to have increased. Planting trees and drought-resistant crops is the only way out of climate change in Njoro."*

*Felix Litali, a charcoal seller and member of the community-based organisation Maendeleo, said the forest has saved him from absolute poverty as he depends on it for his business.*

*Alex Kamau, a resident of Njoro for over ten years, said there is no doubt the climate has changed. "The days are too hot while the nights are very cold. The rain is not regular, and the rivers are drying up. Our farms are no longer productive. There is a shortage of firewood and charcoal. We have to graze our livestock inside the forest."*

*Jackson Kipngetich, a cattle farmer who has lived in Njoro for more than ten years, said: "Njoro is experiencing bad temperatures. It is getting too hot. Rainfall is unreliable. People have to plant more trees and change their crops to those that can cope with these changes."*

Rainfall

The people of Njoro are of the opinion that the climate, particularly rain patterns, has changed. The rain does not come when expected and when it does, it falls heavily. The Egerton University weather station gave us the following information on rainfall, and on maximum and minimum temperatures[2]:

| Year | Annual rainfall in mm |
|---|---|
| 1980 | 762.3 |
| 1981 | 934.8 |
| 1982 | 1159.5 |
| 1983 | 961.3 |
| 1984 | 666.4 |

[2] For detailed monthly rainfall figures see Annex 1

| | |
|---|---|
| 1985 | 1137.2 |
| 1986 | 915.3 |
| 1987 | 762.9 |
| 1988 | 1134.9 |
| 1989 | 1081.6 |
| 1990 | 1064.4 |
| 1991 | 959.0 |
| 1992 | 795.3 |
| 1993 | 840.2 |
| 1994 | 981.0 |
| 1995 | 928.6 |
| 1996 | 899.0 |
| 1997 | 1179.9 |
| 1998 | 1150.1 |
| 1999 | 658.9 |
| 2000 | 670.8 |

Temperatures

| **Year** | **Recorded temperatures** | | |
|---|---|---|---|
| | Maximum | Minimum | Range |
| 1980 | 21.4 | 17.6 | 3.8 |
| 1990 | 20.0 | 18.0 | 2.0 |
| 2000 | 22.3 | 17.4 | 4.9 |

Effects on the local environment

The change in climate in Njoro has had a discernable effect on the local environment. The unreliable rainfall has led to some rivers becoming seasonal. For example, the Enjoro (Ndarugu) river, which flows from the Mau forest complex to Lake Nakuru, does not flow throughout the year. At Egerton University, at least two out of ten boreholes have dried up. At nearby Ngondu, some boreholes have become saline.

An increase in strong winds has been reported, particularly during the dry season. These dry winds drive away moisture in the air, which could be further reducing precipitation.

*Agriculture*

Agricultural patterns also offer an insight into the changing climate. Since the people of Njoro practice rain-fed agriculture, any change in rainfall is followed closely by farmers. The Kenya Agricultural Research Institute (KARI) of Njoro gave us the following information on the crops grown at Njoro:

| **Year** | **Most important crop** | **Second in importance** | **Third in importance** |
|---|---|---|---|
| 1980–1990 | Wheat | Potatoes | Maize |
| 1990–2000 | Maize | Wheat | Potatoes |

Farmers offered the following reasons for why they changed from one crop to another:

| Name of crop | Reason for abandoning crop |
|---|---|
| Wheat | Unreliable rainfall |
| Potatoes | Unreliable rainfall |

KARI staff told us that wheat is less adaptable to climate change and therefore farmers are giving it up. For potatoes, a small rise in temperature seems to increase pest attacks.

The change in climate is confusing farmers in Njoro. To survive, they are planting quick-maturing crops such as beans and potatoes, as well as planting crops any time it rains. It is not uncommon to see the bizarre situation of mature maize and a recently planted crop growing right next to each other. Farmers can no longer categorise seasons as planting or harvesting seasons.

*Water*

For the residents of Njoro, any change in the availability of water is significant. Many residents depend on multiple sources because no one source is completely reliable. Households which have piped water also draw from a community bore hole and harvest rainwater.

The Enjoro River is a potential source and those people who live close by draw water from it. But pollution emanating from Egerton University and the Njoro bean canning factory means this water is not clean. Local dams are no longer in regular use because they have silted up. Poor soil conservation practice has meant that flash floods, resulting from irregular and torrential rain, carry soil into these dams.

Impacts on forestry-related aspects of local livelihoods

Respondents told us that reduced rainfall has led to the slow growth of trees. At the same time, demand for forest products has not decreased. Now it is common for people to use fruit and fodder trees for fuel, resulting in less to eat for both people and livestock. Even those trees normally reserved for seed harvesting have been chopped down. This has resulted in a shortage of tree seeds, and tree nurseries are producing fewer seedlings than required. In particular, our research unearthed the following:

- Live fences (kei-apples, cypress) do not grow quickly enough and people now use other materials to construct fences;
- Insecurity has increased as more and more people are losing their traditional means of livelihood;
- The unsustainable management of the eastern Mau forest has led to the closure of three of the six large saw-mills, with the remaining ones running at less than 50% of their capacity.

## 3. Changes in resources

Njoro's resources include crops and trees grown on farms, livestock, a small amount of water and small stands of riverine forest. During our research we found the following:

- The unpredictable rain patterns have discouraged people from investing in farming. Former farm workers have moved into Njoro town where they eke a meagre living carrying out petty trading activities.
- The drying up of boreholes has encouraged the population to move to areas where water might be more available, such as Njoro town.
- The drop in the water levels in the Enjoro River has restricted the ability of farmers to rear cattle. Some cattle farmers have switching to rearing sheep.
- Cattle farmers who zero-graze – feeding their animals grass from the forest adjacent to Njoro – cannot buy enough supplies because of the increased demand for grass from the forest.
- Cattle farmers have become more aggressive and are travelling farther and farther in search of pastures.
- Religious organisations are sinking boreholes in search of water.
- Anyone building a new house installs facilities to harvest water in the hope of collecting water when it rains.

## 4. Adaptations in resource management and resource dependence

Local forestry-based adaptation

Most of the people we talked to were familiar with the idea that planting trees can reduce the effects of local climate change. For a long time now, farmers in Kenya have been bombarded with the message that “trees attract rain”. Many farmers have already planted trees on their farms in the hope that the rains will come back to Njoro. The trees planted include *Eucalyptus*, *Pinus patula, Grevillea robusta* and kei-apples. Farmers also find the trees useful as windbreaks, for live fencing and, in the long run, for fuel-wood or timber.

There have been other motivators for farmers to plant trees. The Kenya Power and Lighting Company has publicly stated that there is a shortage of electricity transmission posts in the country. Numerous stories have appeared in the press about how some Kenyans are getting rich by selling their trees. The hope of profiting quickly is the reason for farmers planting quick-growing *Eucalyptus*, in spite of the fact that this species is thought to require more water than others.

Some examples of extensive tree planting can be found at the O’jays farm, which has 75 acres of *Eucalyptus grandis*; the Njoro Club, which has planted over five acres of trees; Mr. Ngumbi and Dr. Otaro, both of Egerton Estate, who have each planted half an acre of *eucalyptus*; and Mr. Kirungu, a local farmer who has planted more than one acre of *eucalyptus*.

Cattle owners are also involved in the quest to cope with climate change. Faced with difficulties in obtaining fodder, they now either take their cattle to the forest to graze, or buy fodder from young entrepreneurs who ride into the forest every day on their bicycles. Those cattle farmers who also farm crops have taken to planting fodder crops like napier grass and *Callandria calothyrsus*.

To cope with the demand for tree seedlings, some NGOs and CBOs have established tree nurseries. These nurseries specialise in seedlings that are most in demand, such as *Eucalyptus grandis* and *Grevillea robusta*.

Because agriculture is longer as stable as it used to be, some farm workers have opted to sell wood and charcoal. They obtain their material from the forest or from farmers. On any day, there are more than 300 bicycles carrying wood or charcoal to Nakuru, some 20 kilometres away from Njoro.

As for people who use wood for fuel, many are now using improved stoves to save fuel. Many people we talked to told us that the prices for charcoal and firewood have risen over the past few years.

In particular, our survey established that:

- People are moving away from farming and are looking for other jobs, especially in the informal sector[3]
- More people now reply on food relief to supplement whatever they can get from their informal jobs
- Some farmers have now taken to planting crops whenever it rains with the hope that the rains will last. This uncertainty is expensive and not good for the farmers.

Failure to adapt

Some farmers have failed to adapt to climate change and their livelihoods have changed as a result. For example, in 2005 some farmers from the Ngongongeri scheme insisted on growing wheat in spite of the reduced precipitation. Many of them lost the whole crop and have now switched to maize farming.

The farmers' inability to adapt can be linked to the collapse of local farmers' organisations. One such example is the Rumwe Dairy Association. Only five years ago, this association was purchasing milk from farmers and offering artificial insemination and livestock vaccination services. But in the last few years its membership declined and the association subsequently folded and no longer offers the remaining cattle farmers assistance.

Some of the farmers who have failed to adapt think that climate change is an act of God. Church leaders encourage this attitude by urging the people to pray for more rain.

## 5. Roles of local institutions

While most people in Njoro may have heard of climate change, they are unsure how to adapt and look to local institutions to show them the way. There are three categories of local organisations operating at Njoro[4]. These are:

- Government institutions, from local to national, including departments responsible for agriculture, education, environment, forestry, livestock, and water.

[3] See flow chart on failure of agriculture
[4] Annex 2 contains a list of local institutions at Njoro

- Religious organisations
- Community based organisations

Government institutions

The most visible government institutions working at the local level at Njoro are those responsible for agriculture, education, forests, livestock, public administration, security and water. These local institutions have little autonomy, and simply implement the policies of their parent departments.

Because the national Kenyan government currently has no policy on climate change, the local institutions also do not address this subject. For this reason, local people do not directly approach government institutions for information or assistance with adaptation to climate change.

Another obstacle to effective engagement with the government is that local people often see these institutions as 'commanding and controlling' rather than offering assistance. As a result, they often avoid dealing with these institutions. For example, the government requires a permit for trucks transporting forest produce (wood, charcoal), but not for bicycles transporting the same goods. The government incorrectly assumes that forest produce ferried on bicycles is for subsistence purposes, while trucks are transporting goods for sale. As a result, more than 300 bicycles travel on the road between Njoro and Nakuru every day carrying charcoal or wood for sale.

Despite this, local government does give assistance on adaptation to climate change indirectly. The government agriculture research station and the local agriculture office provide information to farmers on what alternative crops to grow in the changed weather conditions, while the forest and water officers advise farmers to plants trees and harvest rain water.

Religious organisations

In Njoro there is one Islamic mosque and dozens of Christian churches. From our research we believe these religious institutions don't encourage any serious thought on the causes of climate change, and more often ask their faithful to pray for good weather. We came across preachers telling their faithful that climate change is caused by forces that the human race cannot understand and that only God can save us. Some of them suggest that climate change is ushering in the end of the world. For this reason, we believe religious institutions are not currently assisting local people to adapt to climate change.

Community based organisations

Community based organisations at Njoro can be divided into the following broad categories: youth groups, women's groups and farmers/forestry groups. The youth groups concentrate on preparing their members for adulthood and adult roles in the community. They help their members obtain skills in business management and small-scale manufacturing. The women's groups help members invest their funds in business ventures and construct rain water harvesting tanks. They also offer support to widows.

Farmers/forestry groups are the CBOs most interested in climate change. These groups are most made up of men as they are often the richer members of the community. They decide which crops or trees to plant on their land, whether to keep cattle or sheep, and whether their livestock should go out to graze or fodder should be brought to them.

## 6. Conclusions – what local organisations could do

Local organisations have the opportunity to assist the people living in Njoro to adapt[5] to climate change.

Government institutions

Government institutions employ well-educated officials who are all aware of climate change and its effects. They are able to access information on how people can best adapt to climate change. However, these officials don't often act autonomously, sticking to the 'government rule-book' and doing 'only what your senior officers tell you to do'. We believe these officials have a responsibility to break away from their rule-book mentality and assist local people to survive climate change. For example, they could organise or participate in community forums and pass their knowledge on to the local people. However, from our observations, we believe nongovernmental organisations and the local universities are more likely to support such a forum.

Religious organisations

In our experience, local religious organisations are the most difficult to deal with. They steadfastly hold on to their theory of creation as elucidated in their holy books. Their attitude towards anything that sounds scientific or cannot be explained through their beliefs is to avoid or ignore it altogether.

On the other hand, the national headquarters of these religious organisations do have information on climate change and environmental degradation. The local branches should be encouraged to check with their head offices for direction and to participate in forums on climate change.

Community Based Organisations

Community based organisations (CBOs) are well placed to reach a large number of people in Njoro. For this reason, we believe they are the best vehicle to distribute adaptation messages. These CBOs can mobilise their members to participate in forums on climate change, adaptation and resilience. They can carry out farm trials of quick growing crop and tree species, and lead on decisions such as which crop and tree species to plant. They can help establish tree nurseries and distribute seeds and seedlings. Further, these institutions can determine the carrying capacity of their land in the case of livestock farmers. They can also encourage the use of improved fuel-wood stoves and rain water harvesting techniques.

[5] A complete table of institutions and adaptive strategies is in Annex 3

## Annex 1: Monthly rainfall at Njoro 1980-2000

Njoro should be expected to have two rainy seasons (Nov-Dec and (Apr-May) but it turns out that the highest rainfall month is April, as expected, but August is the second highest.

What are the trends 1980-2000? (note these are visual trends not statistical):

1. No trend in mean annual rainfall
2. A decrease in the amount of rainfall (and therefore the proportion of the annual rainfall) falling during April and May, in the main rainy season
3. Increased variability in rainfall in January and February – so that in some years far more rain falls then than in the official rainy season

| Year | Month | Rainfall in mm |
|---|---|---|
| 1980 | January | 51.7 |
| | February | 15.0 |
| | March | 70.3 |
| | April | 132.9 |
| | May | 153.6 |
| | June | 74.0 |
| | July | 19.0 |
| | August | 78.0 |
| | September | 19.0 |
| | October | 15.9 |
| | November | 129.0 |
| | December | 3.9 |
| | TOTAL | **762.3** |

| Year | Month | Rainfall in mm |
|---|---|---|
| 1981 | January | 2.4 |
| | February | 30.7 |
| | March | 151.8 |
| | April | 148.8 |
| | May | 78.5 |
| | June | 33.9 |
| | July | 154.4 |
| | August | 122.2 |
| | September | 112.5 |
| | October | 17.2 |
| | November | 28.9 |
| | December | 51.3 |
| | TOTAL | **934.8** |

| Year | Month | Rainfall in mm |
|---|---|---|
| 1982 | January | 9.9 |
| | February | 22.8 |
| | March | 4.4 |
| | April | 151.2 |
| | May | 239.0 |
| | June | 28.6 |
| | July | 54.0 |
| | August | 273.3 |
| | September | 29.2 |
| | October | 114.7 |

| | | |
|---|---|---|
| | November | 162.5 |
| | December | 69.9 |
| | TOTAL | **1159.9** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 1983 | January | 20.0 |
| | February | 31.5 |
| | March | 9.5 |
| | April | 128.3 |
| | May | 64.5 |
| | June | 44.0 |
| | July | 71.7 |
| | August | 203.2 |
| | September | 115.5 |
| | October | 84.1 |
| | November | 73.5 |
| | December | 115.5 |
| | TOTAL | **961.3** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 1984 | January | 6.9 |
| | February | 13.1 |
| | March | 13.8 |
| | April | 112.2 |
| | May | 21.6 |
| | June | 35.9 |
| | July | 61.4 |
| | August | 93.8 |
| | September | 77.2 |
| | October | 67.5 |
| | November | 110.8 |
| | December | 52.5 |
| | TOTAL | **666.4** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 1985 | January | 21.6 |
| | February | 47.2 |
| | March | 138.2 |
| | April | 394.3 |
| | May | 130.8 |
| | June | 143.1 |
| | July | 27.1 |
| | August | 73.3 |
| | September | 32.6 |
| | October | 29.3 |
| | November | 72.7 |
| | December | 29.0 |
| | TOTAL | **1137.2** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 1986 | January | 3.6 |
| | February | 5.4 |
| | March | 42.6 |
| | April | 189.6 |
| | May | 76.8 |

| | | |
|---|---|---|
| | June | 120.7 |
| | July | 127.3 |
| | August | 109.7 |
| | September | 124.6 |
| | October | 17.4 |
| | November | 54.3 |
| | December | 44.3 |
| | TOTAL | **915.3** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 1987 | January | 15.4 |
| | February | 10.0 |
| | March | 39.3 |
| | April | 93.6 |
| | May | 120.6 |
| | June | 134.1 |
| | July | 59.4 |
| | August | 83.1 |
| | September | 31.8 |
| | October | 17.6 |
| | November | 151.0 |
| | December | 7.0 |
| | TOTAL | **762.9** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 1988 | January | 84.8 |
| | February | 26.6 |
| | March | 58.1 |
| | April | 240.1 |
| | May | 129.3 |
| | June | 99.8 |
| | July | 180.0 |
| | August | 151.1 |
| | September | 70.1 |
| | October | 45.9 |
| | November | 61.3 |
| | December | 55.0 |
| | TOTAL | **1139.9** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 1989 | January | 14.3 |
| | February | 88.2 |
| | March | 78.9 |
| | April | 136.8 |
| | May | 110.8 |
| | June | 24.4 |
| | July | 124.6 |
| | August | 96.2 |
| | September | 96.1 |
| | October | 120.4 |
| | November | 108.9 |
| | December | 95.7 |
| | TOTAL | **1081.6** |

| Year | Month | Rainfall in mm |
|---|---|---|
| 1990 | January | 96.5 |
| | February | 132.9 |
| | March | 127.5 |
| | April | 153.9 |
| | May | 112.5 |
| | June | 64.5 |
| | July | 58.2 |
| | August | 73.4 |
| | September | 62.7 |
| | October | 91.6 |
| | November | 43.7 |
| | December | 47.0 |
| | TOTAL | **1064.4** |

| Year | Month | Rainfall in mm |
|---|---|---|
| 1991 | January | 57.4 |
| | February | 2.5 |
| | March | 88.6 |
| | April | 129.1 |
| | May | 72.9 |
| | June | 86.6 |
| | July | 148.9 |
| | August | 205.6 |
| | September | 35.2 |
| | October | 99.2 |
| | November | 35.4 |
| | December | 5.6 |
| | TOTAL | **959.0** |

| Year | Month | Rainfall in mm |
|---|---|---|
| 1992 | January | 12.4 |
| | February | 12.5 |
| | March | 26.6 |
| | April | 162.4 |
| | May | 64.2 |
| | June | 64.7 |
| | July | 80.8 |
| | August | 77.3 |
| | September | 52.6 |
| | October | 68.9 |
| | November | 69.3 |
| | December | 99.3 |
| | TOTAL | **795.3** |

| Year | Month | Rainfall in mm |
|---|---|---|
| 1993 | January | 82.5 |
| | February | 114.4 |
| | March | 29.0 |
| | April | 49.5 |
| | May | 99.0 |
| | June | 116.0 |
| | July | 84.1 |
| | August | 69.6 |
| | September | 42.1 |

| | | |
|---|---|---|
| | October | 23.4 |
| | November | 82.8 |
| | December | 55.8 |
| | TOTAL | **840.2** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 1994 | January | 3.0 |
| | February | 20.8 |
| | March | 70.6 |
| | April | 139.4 |
| | May | 123.9 |
| | June | 95.7 |
| | July | 140.2 |
| | August | 100.5 |
| | September | 41.9 |
| | October | 56.9 |
| | November | 191.0 |
| | December | 5.1 |
| | TOTAL | **981.0** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 1995 | January | 2.5 |
| | February | 60.9 |
| | March | 80.0 |
| | April | 91.6 |
| | May | 102.4 |
| | June | 106.0 |
| | July | 78.4 |
| | August | 50.8 |
| | September | 131.7 |
| | October | 128.4 |
| | November | 48.8 |
| | December | 47.5 |
| | TOTAL | **928.6** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 1996 | January | 9.6 |
| | February | 51.7 |
| | March | 85.2 |
| | April | 29.8 |
| | May | 37.5 |
| | June | 158.2 |
| | July | 145.1 |
| | August | 166.0 |
| | September | 83.0 |
| | October | 15.1 |
| | November | 111.9 |
| | December | 6.5 |
| | TOTAL | **899.0** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 1997 | January | 22.5 |
| | February | 0.0 |
| | March | 24.1 |
| | April | 229.0 |

| | | |
|---|---|---|
| | May | 73.9 |
| | June | 100.7 |
| | July | 108.6 |
| | August | 180.6 |
| | September | 39.9 |
| | October | 157.4 |
| | November | 155.2 |
| | December | 89.8 |
| | TOTAL | **1179.9** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 1998 | January | 144.1 |
| | February | 129.6 |
| | March | 48.3 |
| | April | 159.2 |
| | May | 150.7 |
| | June | 51.1 |
| | July | 62.9 |
| | August | 95.2 |
| | September | 113.0 |
| | October | 93.9 |
| | November | 93.2 |
| | December | 8.9 |
| | TOTAL | **1150.1** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 1999 | January | 37.9 |
| | February | 0.3 |
| | March | 90.6 |
| | April | 40.9 |
| | May | 33.0 |
| | June | 19.9 |
| | July | 79.1 |
| | August | 91.3 |
| | September | 25.0 |
| | October | 65.2 |
| | November | 118.9 |
| | December | 56.8 |
| | TOTAL | **658.9** |

| **Year** | **Month** | **Rainfall in mm** |
|---|---|---|
| 2000 | January | 1.2 |
| | February | 0.8 |
| | March | 2.0 |
| | April | 56.8 |
| | May | 30.6 |
| | June | 115.9 |
| | July | 88.8 |
| | August | 105.9 |
| | September | 29.3 |
| | October | 77.2 |
| | November | 96.2 |
| | December | 66.1 |
| | TOTAL | **670.8** |

## Annex 2: Table of local institutions working at Njoro

| Name of Institution | Type of institution | Role in climate adaptation or mitigation |
|---|---|---|
| Ministry of Agriculture | Government | Advises farmers on appropriate crops |
| Forest Service | Government | Advises farmers on appropriate tree species |
| Ministry of Water | Government | Advises farmers on water harvesting techniques; monitors water availability and use |
| Provincial Administration | Government | Ensures security, arbitrates when conflict arises |
| Kenya Agriculture Research Institute | Quasi-government | Carries out research on appropriate crops for Njoro and other areas |
| Egerton University | Education (quasi-government) | Has an environment and natural resources department that carries out research on many aspects of climate change, for example water and wood-fuel availability |
| Jitegemee Youth Group | CBO | Supports young people to start small-scale businesses |
| Jikaze Women's Group | CBO | Assists women to construct rain water tanks in their homesteads |
| Rumwe Farmers' Association | Farmers' association | Encourages farmers to grow fodder trees |
| Njoro Community Forest Association | Forest users' association | Sustainable management of state and local government forests |
| Njoro Golf Club | Private members' club | Has planted trees around the golf course. Operates a small tree nursery which supplies seedlings to the local community |
| Business Association of Njoro | Private members' association | Some of the members are saw millers who would like to participate in forest management through concessions |
| St. Lwanga Catholic Church | Church | Operates a water bore hole selling water to the community at reduced prices |
| Forest Action Network (FAN) | NGO | Provides a resource centre for community meetings and operates a tree nursery |

## Annex 3: Institutions and recommended adaptive strategies

| Name of Institution | Type of institution | Recommended adaptive strategies |
|---|---|---|
| Ministry of Agriculture | Government | Support farmers to switch to early maturing crops; promote alternative foods to wean communities from dependence on potatoes which no longer do well in Njoro; advise central government on the local climate change situation and initiate policy change in relation to climate change |
| Forest Service | Government | Support farmers to grow trees appropriate to the changing climate; assist charcoal producers to use the most efficient production methods |
| Ministry of Water | Government | Advise farmers on water harvesting |

| | | |
|---|---|---|
| | | techniques; support farmers on soil and water conservation; assist in de-silting dams |
| Provincial Administration | Government | Identify people who have been displaced by climate change and provide them with short-term relief food as the land recovers; they should stop stifling farmer's ambitions to harvest mature trees for use or for sale |
| Kenya Agriculture Research Institute | Quasi-government | Provide research results to farmers on crops appropriate for the change in climate |
| Egerton University | Education (quasi-government) | Carry out long-term research on the effects of climate change on water, timber and wood-fuel availability; continue to record rainfall and temperature at the university weather station |
| Jitegemee Youth Group | CBO | Continue to support young people to start small scale businesses; mobilise members to participate in soil and water conservation measures and tree planting activities |
| Jikaze Women's Group | CBO | Continue to assist women to construct rain water tanks in their homesteads; support members to establish woodlots |
| Rumwe Farmers' Association | Farmers' association | Continue to support farmers to grow fodder trees; improve marketing of farm produce to enable farmers to obtain a reasonable income and thus survive climate change |
| Njoro Community Forest Association | Forest users' association | Advocate for communities to be allowed to co-manage state and local government forests and benefit by harvesting and selling forest products |
| Njoro Golf Club | Private members' club | Expand their tree nursery to supply more seedlings to the local community; conserve mature trees on their land to serve as seed orchards |
| Business Association of Njoro | Private members' association | Support their members to participate in forest management through concessions and grow more trees after harvesting mature forests |
| St. Lwanga Catholic Church | Church | Continue to operate a water bore hole selling water to the community at reduced prices; tone down their messages suggesting that climate change is caused by providence |
| Forest Action Network (FAN) | NGO | Mobilise communities to accept a switch to quick growing crops and to other types of food; continue to provide a resource centre for community meetings; expand the tree nursery at Njoro; carry out an awareness campaign on adaptation to climate change. |