Riparian trees and some Napier grass. River is in the back. (Manuel Fischer (Tigithi Primary School))

# Trees in the riparian area as a protective and aesthetic advantage at Naro Moru River (Kenya)

## DESCRIPTION

**Trees are planted along the riparian zone to stabilize the riverbank and to prevent degradation. The wood can be used to establish a building or to generate income on the market.**

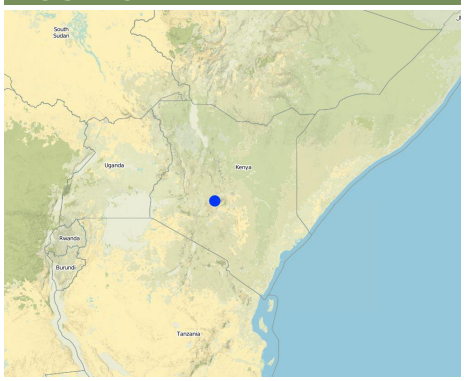
At the foot slopes of Mt. Kenya a farmer has developed a technology to protect the own land plot from riverbank erosion. The technology consists of three main measures: A wall along the riverbed, trees that are aligned on the wall as well as beside it and Napier grass wildly scattered between the trees. The wall was built on a highly exposed spot of the riverbank. Trees along and beside the wall ensure its stability. The combination of the two measures results in an effective protection of the riverbank in terms of erosion. Side effects of the technology are higher runoff during the dry season, better water quality due to less erosion and an improved riparian habitat for animals and plants.

Purpose of the Technology: For a small scale farmer, planting of trees can have advantages in an economic, an ecologic and an aesthetic point of view. The trees stabilize the soil, allow the riparian vegetation to establish, and prevent major damages through flooding. Furthermore, there are several advantages of an intact riparian zone, such as enhanced biodiversity, increased water quality as well as retention of agrochemicals. The trees also work as a kind of bank account, since the prices for wood are quite high. Trees can be cut and sold from time to time to generate an income that can be used for further investments like local entrepreneurship or building houses for family members. Last but not least, the farmer emphasized the beautiful appearance of the trees including the relatively cool micro- climate the trees are able to provide during the hot months of the dry period.

Establishment / maintenance activities and inputs: The trees were planted during the rainy season. Braches are pruned regularly and provide mulch material as well as fire wood. When trees are reaching maturity they will selectively be cut and replanted. The Napier grass is cut regularly for fodder to be feed to animals. At this particular time, there is a regular hay yield (weed). Seedlings for trees and the grasses are produced on site. Occasional pruning ensures fuel wood supply.

Natural / human environment: The plot is situated at the western side of Mt. Kenya in its foot zone, a moderate hilly region. Actually, the foot zone is a transition area between the humid mountain forest above elevations of 2500 m.a.s.l and the semi-arid savannah zone below 2000 m a.s.l. Although the region is located in the rain shadow of Mt. Kenya, there is just enough precipitation (740mm) to sustain rain fed agriculture and the farmers even benefit from a water project. During the last decades, the region has experienced a still continuing population growth which increases population pressure in the area. The good accessibility and the moderate tourism allow even off-farm income-generation.

## LOCATION




**Location:** Naro Moru, Kenya/Central Province, Kenya

**No. of Technology sites analysed:**

**Geo-reference of selected sites**
- 37.04761, -0.17511

**Spread of the Technology:** evenly spread over an area (approx. < 0.1 km2 (10 ha))

**In a permanently protected area?:**

**Date of implementation:** less than 10 years ago (recently)

**Type of introduction**
- [x] through land users' innovation
- [ ] as part of a traditional system (> 50 years)
- [ ] during experiments/ research
- [ ] through projects/ external interventions

Farmer in front of young riparian trees. (Manuel Fischer (Tigithi Primary School))

## CLASSIFICATION OF THE TECHNOLOGY

### Main purpose

- [x] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [ ] reduce risk of disasters
- [ ] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [ ] create beneficial economic impact
- [ ] create beneficial social impact

### Land use

Land use mixed within the same land unit: Ja - Agroforestry

**Cropland**

- Annual cropping: fodder crops - grasses

Number of growing seasons per year: 2

**Forest/ woodlands**

- Tree plantation, afforestation

Tree types: Cupressus species, Grevillea robusta
Products and services: Timber, Fuelwood, Nature conservation/ protection, Recreation/ tourism

### Water supply

- [ ] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

### Purpose related to land degradation

- [x] prevent land degradation
- [x] reduce land degradation
- [ ] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

### Degradation addressed

**soil erosion by water** - Wt: loss of topsoil/ surface erosion, Wr: riverbank erosion

**biological degradation** - Bc: reduction of vegetation cover, Bs: quality and species composition/ diversity decline

**water degradation** - Hp: decline of surface water quality, Hw: reduction of the buffering capacity of wetland areas

### SLM group

- natural and semi-natural forest management
- improved ground/ vegetation cover

### SLM measures

**vegetative measures** - V1: Tree and shrub cover

**structural measures** - S6: Walls, barriers, palisades, fences

## TECHNICAL DRAWING

**Technical specifications**

Indigenous trees, a wall and Napier grass are installed between the agricultural land and the river. The wall prevents erosion at a very endangered spot. The trees and the grass provide fodder and wood.

Location: Naro Moru. Nyeri / Central Province

Technical knowledge required for field staff / advisors: moderate

Technical knowledge required for land users: low

Main technical functions: increase of infiltration, improvement of water quality, buffering / filtering water, sediment retention / trapping, sediment harvesting, stabilization of riverbank by trees and grasses

Secondary technical functions: stabilisation of soil (eg by tree roots against land slides)

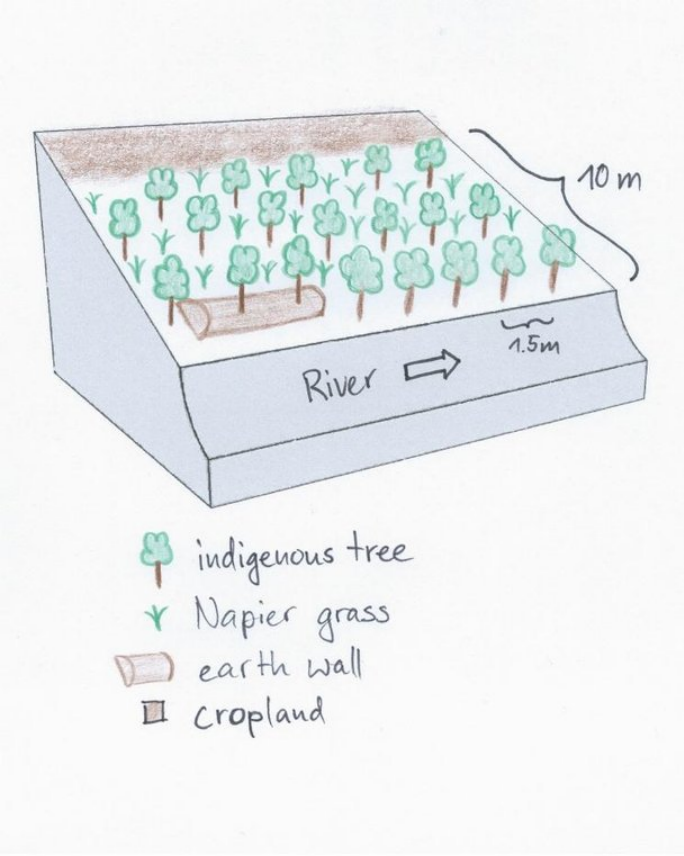
Aligned: -linear
Vegetative material: T : trees / shrubs
Number of plants per (ha): 200
Vertical interval between rows / strips / blocks (m): 0
Spacing between rows / strips / blocks (m): 1
Vertical interval within rows / strips / blocks (m): 1.5
Width within rows / strips / blocks (m): 2

Scattered / dispersed
Vegetative material: G : grass
Number of plants per (ha): 800

Trees/ shrubs species: Cypress, Grevillea, indigenous trees

Fruit trees / shrubs species: Napier grass

Wall/ barrier
Height of bunds/banks/others (m): 0.5m
Width of bunds/banks/others (m): 2m
Length of bunds/banks/others (m): 10m




Author: Manuel Fischer

## ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

**Calculation of inputs and costs**
- Costs are calculated: per Technology unit
- Currency used for cost calculation: **USD**
- Exchange rate (to USD): 1 USD = n.a
- Average wage cost of hired labour per day: 2.70

**Most important factors affecting the costs**
n.a.

**Establishment activities**
1. Setting up a tree nursery (Timing/ frequency: None)
2. Planting seedlings (Timing/ frequency: during rainy season)
3. Establishment of wall (Timing/ frequency: None)

**Establishment inputs and costs**

| Specify input | Unit | Quantity | Costs per Unit (USD) | Total costs per input (USD) | % of costs borne by land users |
|---|---|---|---|---|---|
| **Labour** | | | | | |
| Setting up a tree nursery | Persons/day | 5.0 | 3.3333 | 16.67 | 100.0 |
| Planting seedlings | Persons/day | 25.0 | 3.3333 | 83.33 | 100.0 |
| Establishment of wall | Persons/day | 5.0 | 3.3333 | 16.67 | 100.0 |
| **Total costs for establishment of the Technology** | | | | **116.67** | |
| *Total costs for establishment of the Technology in USD* | | | | *116.67* | |

**Maintenance activities**
1. Replanting trees that dried up (Timing/ frequency: None)
2. Cutting the Napier grass and pruning trees (Timing/ frequency: during the rainy seasons = 4 months a year. 3 times a month)

**Maintenance inputs and costs**

| Specify input | Unit | Quantity | Costs per Unit (USD) | Total costs per input (USD) | % of costs borne by land users |
|---|---|---|---|---|---|
| **Labour** | | | | | |
| Replanting trees | Persons/day | 3.0 | 3.3333 | 10.0 | 100.0 |
| Cutting the Napier grass and pruning trees | Persons/day | 12.0 | 3.33333 | 40.0 | 100.0 |

| Total costs for maintenance of the Technology | 50.0 | |
|---|---|---|
| *Total costs for maintenance of the Technology in USD* | *50.0* | |

## NATURAL ENVIRONMENT

**Average annual rainfall**
- [ ] < 250 mm
- [ ] 251-500 mm
- [x] 501-750 mm
- [ ] 751-1,000 mm
- [ ] 1,001-1,500 mm
- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

**Agro-climatic zone**
- [ ] humid
- [x] sub-humid
- [ ] semi-arid
- [ ] arid

**Specifications on climate**
Name of the meteorological station: NS-Daten Eliza
Thermal climate class: subtropics. source: http://en.climate-data.org/location/103473/

**Slope**
- [ ] flat (0-2%)
- [ ] gentle (3-5%)
- [x] moderate (6-10%)
- [ ] rolling (11-15%)
- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

**Landforms**
- [ ] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [x] footslopes
- [ ] valley floors

**Altitude**
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [ ] 1,001-1,500 m a.s.l.
- [ ] 1,501-2,000 m a.s.l.
- [x] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

**Technology is applied in**
- [ ] convex situations
- [ ] concave situations
- [ ] not relevant

**Soil depth**
- [ ] very shallow (0-20 cm)
- [ ] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [x] very deep (> 120 cm)

**Soil texture (topsoil)**
- [ ] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

**Soil texture (> 20 cm below surface)**
- [ ] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

**Topsoil organic matter content**
- [ ] high (>3%)
- [x] medium (1-3%)
- [ ] low (<1%)

**Groundwater table**
- [ ] on surface
- [x] < 5 m
- [ ] 5-50 m
- [ ] > 50 m

**Availability of surface water**
- [ ] excess
- [x] good
- [ ] medium
- [ ] poor/ none

**Water quality (untreated)**
- [x] good drinking water
- [ ] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

*Water quality refers to:*

**Is salinity a problem?**
- [ ] Ja
- [ ] Nee

**Occurrence of flooding**
- [ ] Ja
- [ ] Nee

**Species diversity**
- [x] high
- [ ] medium
- [ ] low

**Habitat diversity**
- [ ] high
- [ ] medium
- [ ] low

## CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

**Market orientation**
- [x] subsistence (self-supply)
- [x] mixed (subsistence/ commercial)
- [ ] commercial/ market

**Off-farm income**
- [x] less than 10% of all income
- [ ] 10-50% of all income
- [ ] > 50% of all income

**Relative level of wealth**
- [ ] very poor
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

**Level of mechanization**
- [x] manual work
- [ ] animal traction
- [ ] mechanized/ motorized

**Sedentary or nomadic**
- [ ] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

**Individuals or groups**
- [x] individual/ household
- [ ] groups/ community
- [ ] cooperative
- [ ] employee (company, government)

**Gender**
- [x] women
- [x] men

**Age**
- [ ] children
- [ ] youth
- [ ] middle-aged
- [ ] elderly

**Area used per household**
- [ ] < 0.5 ha
- [x] 0.5-1 ha
- [x] 1-2 ha
- [ ] 2-5 ha
- [ ] 5-15 ha
- [ ] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

**Scale**
- [x] small-scale
- [ ] medium-scale
- [ ] large-scale

**Land ownership**
- [ ] state
- [ ] company
- [ ] communal/ village
- [ ] group
- [x] individual, not titled
- [ ] individual, titled

**Land use rights**
- [ ] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [x] individual

**Water use rights**
- [ ] open access (unorganized)
- [x] communal (organized)
- [ ] leased
- [ ] individual

### Access to services and infrastructure

| | | |
|---|---|---|
| health | poor | good |
| education | poor | good |
| technical assistance | poor | good |
| employment (e.g. off-farm) | poor | good |
| markets | poor | good |
| roads and transport | poor | good |
| drinking water and sanitation | poor | good |
| financial services | poor | good |

## IMPACTS

### Socio-economic impacts

| | | | |
|---|---|---|---|
| Crop production | decreased | increased | |
| fodder production | decreased | increased | Napier grass yield has increased |
| wood production | decreased | increased | Before, there was only little wood production |

### Socio-cultural impacts

| | | |
|---|---|---|
| SLM/ land degradation knowledge | reduced | improved |
| Aesthetics | decreased | improved |

### Ecological impacts

| | | |
|---|---|---|
| surface runoff | increased | decreased |
| excess water drainage | reduced | improved |
| soil cover | reduced | improved |
| soil loss | increased | decreased |
| beneficial species (predators, earthworms, pollinators) | decreased | increased |
| flood impacts | increased | decreased |
| Riverbank erosion | increased | decreased |

### Off-site impacts

| | | |
|---|---|---|
| reliable and stable stream flows in dry season (incl. low flows) | reduced | increased |
| downstream siltation | increased | decreased |
| groundwater/ river pollution | increased | reduced |
| damage on public/ private infrastructure | increased | reduced |

## COST-BENEFIT ANALYSIS

### Benefits compared with establishment costs

| | | |
|---|---|---|
| Short-term returns | very negative | very positive |
| Long-term returns | very negative | very positive |

### Benefits compared with maintenance costs

| | | |
|---|---|---|
| Short-term returns | very negative | very positive |
| Long-term returns | very negative | very positive |

## CLIMATE CHANGE

### Gradual climate change

| | | |
|---|---|---|
| annual temperature increase | not well at all | very well |

### Climate-related extremes (disasters)

| | | |
|---|---|---|
| local rainstorm | not well at all | very well |
| local windstorm | not well at all | very well |
| drought | not well at all | very well |
| general (river) flood | not well at all | very well |

### Other climate-related consequences

| | | |
|---|---|---|
| reduced growing period | not well at all | very well |

## ADOPTION AND ADAPTATION

### Percentage of land users in the area who have adopted the Technology

- [x] single cases/ experimental
- [ ] 1-10%
- [ ] 11-50%
- [ ] > 50%

### Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- [ ] 0-10%
- [ ] 11-50%
- [ ] 51-90%
- [x] 91-100%

**Number of households and/ or area covered**
1 household

**Has the Technology been modified recently to adapt to changing conditions?**
- Ja
- Nee

**To which changing conditions?**
- climatic change/ extremes
- changing markets
- labour availability (e.g. due to migration)

## CONCLUSIONS AND LESSONS LEARNT

**Strengths: land user's view**
- There is a recreational aspect of the riparian zone. Especially during hot days the farmer is enjoying the slightly colder temperatures because of the canopy and the cooling stream. The aesthetic aspects of the riparian are also enhanced.

  How can they be sustained / enhanced? If the canopy of the riparian is maintained, it can serve still as recreation area and convince with beautiful looks.
- Long term benefits in terms of wood and timber provided by the trees.

  How can they be sustained / enhanced? If trees are not chopped too early, they will have a good price on the market.
- The maintenance of the riparian is not tiring and still gives a good harvest.

  How can they be sustained / enhanced? Benefits can be sustained by continuing the management practices.
- Diversification: Formerly, there was maize at the river, but it died due to cold temperatures. Forests do not die due to frost.

  How can they be sustained / enhanced? Every plant has its special needs that should be kept in mind.

**Strengths: compiler's or other key resource person's view**
- Wood production through selective felling is sustainable.

  How can they be sustained / enhanced? No widespread felling of trees, only selective intervention.
- Fodder production enables the keeping of cattle.

  How can they be sustained / enhanced? Before dry periods, some fodder should be stored to ensure fodder supplies.

**Weaknesses/ disadvantages/ risks: land user's viewhow to overcome**
- There is less crop yield, because an area of the plot was formerly used for maize production and now it is part of the riparian. The productive and protective benefits of the riparian overcome decreased size of the agricultural plot.

**Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome**

## REFERENCES

**Compiler**
Manuel Fischer

**Editors**

**Reviewer**
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**Date of documentation**: Feb. 6, 2013

**Last update**: Junie 3, 2019

**Resource persons**
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**Full description in the WOCAT database**
https://qcat.wocat.net/af/wocat/technologies/view/technologies_1580/

**Linked SLM data**
n.a.

**Documentation was faciliated by**

Institution
- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project
- n.a.