Pasture management with indigenous grasses and road water harvesting in arid to semi-arid lands (ASAL)

GREEN ROADS FOR WATER

KALRO

South Eastern Kenya university

NWO

Flood-Based Livelihoods Network Foundation

META META

Green Future Farming

This grass manual gives a speed course on why and how we should practice cultivation of grasses in the dry rangelands. It will tell you the basics on: the grass species that are most suitable to grow, essential management practices, road water harvesting, and on how to make money with grass production.

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1. Why cultivate grass like a crop?

What do we need for our livestock? Grass! Is grass commonly grown in your area? Most likely not, right? This situation is problematic, especially in dry times when there is not enough feed for your livestock. Overgrazing, overstocking, long drought and poor pasture management are the major causes of limited availability of grass.

Why there is not sufficient grass available:

Overgrazing by free-ranging livestock	Poor land and water management	Droughts and floods

A solution is to actively grow grasses, apply road water harvesting, fence off the field, harvest it and store it away so you can feed it to your livestock when there is no grass available in the field. A simple and very effective solution.

Livestock production is one of the most important economic activities for farmers in arid to semi-arid lands (ASAL). But the availability of pasture is one of the limiting factors in livestock production. If livestock are to be productive (meat, milk), it is important that they get suitable feed in sufficient quantities. Pasture establishment is an important strategy to ensure livestock feed and thereby sustain agro-pastoralist livelihoods. Indigenous pasture can thrive under dry and harsh conditions.

Indigenous pasture production therefore will contribute to:

- Supply enough and diverse forage for livestock, thus increased weight gains and milk yields.
- Increase household income through the sale of: healthier animals in the market, milk produce, and sale of hay and seeds.
- Rehabilitation of degraded lands, through reseeding, controlling soil erosion and retaining water in the soil.

Main benefits of grass production:

Supply enough + diverse livestock feed	• Weight gains • Meat + milk production
Sales of healthier animals + produce	• Increased household income
Provide better ground cover with reseeding grass	• Control soil erosion • Retain water in the soil

2. Which grass species to choose?

Indigenous perennial grass species are critical in sustaining rangeland production. The choice of grass seeds depends on: forage value for livestock (nutrient content), drought resistance, palatability, biomass and seed production, and marketability of produce.

The grasses suitable for these functions are: (latin name, common name, Kikamba name)

1. Eragrostis superba, Maasai love grass, Mbeetwa
2. Cenchrus Ciliaris, African foxtail grass, Ndata Kivumbu
3. Enteropogon macrostachyus, Bushrye grass, Nguu
4. Chloris gayana, Boma Rhodes
5. Chloris roxburghiana, Horsetail grass, Kilili
6. Panicum maximum, Guinea grass, Mbwea

The infographic (figure 1) is provided to guide you on which grass species to choose and tables 1-6 give detailed information per grass species.

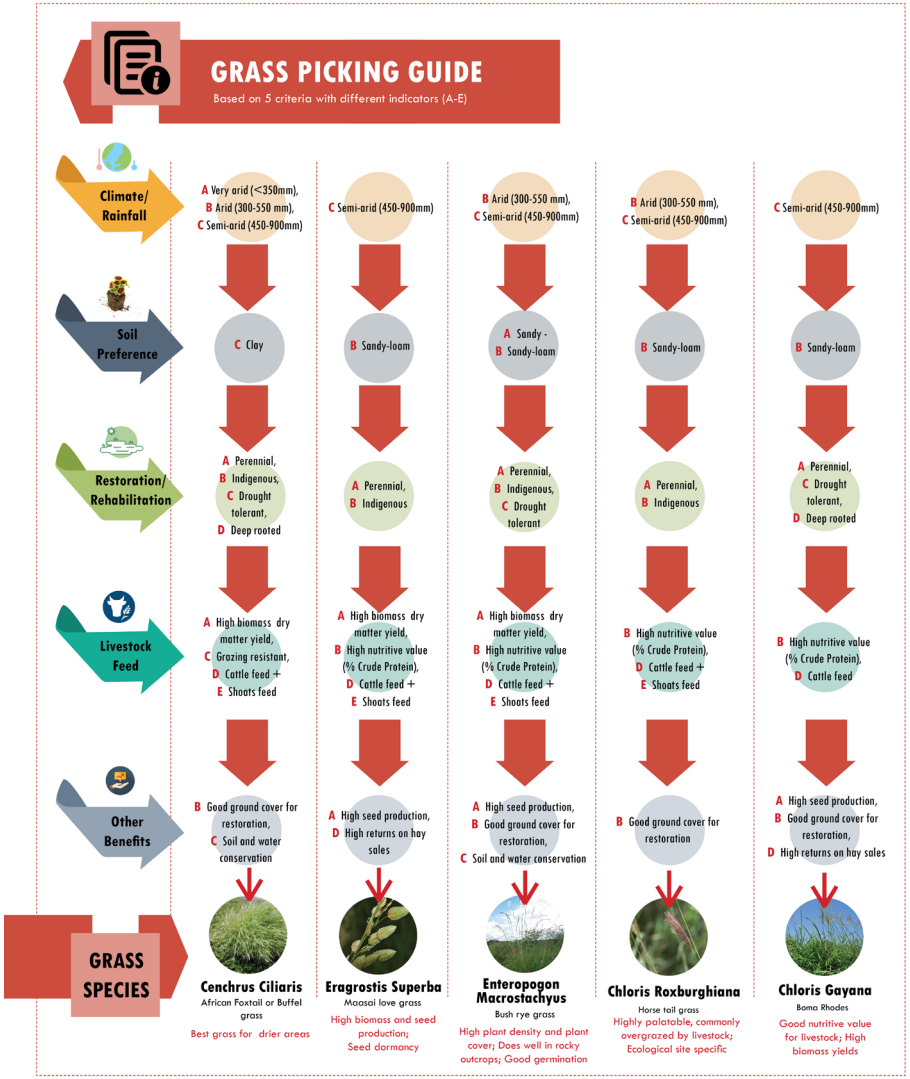


Figure 1. Grass selection guide

Point of attention! If you want grass with high nutritive value for livestock:

- Pastures for animals is related to the choice of suitable grass and legume species to the soil and climatic conditions of a given region and possessing high nutritive value
- It is important for grasses to have higher leafy biomass, as forage quality is higher in leaves, compared to the stem.
  - Animals which graze would by default select the leaves to eat, so they get the highest nutritive value out of the grass.
  - Grasses with higher leaf biomass are: African foxtail, Bushrye, Horsetail, and Rhodes grass.
- High moisture concentration in pasture is favourable for livestock feeding of ruminants.
  - High moisture in pastures as Rhodes grass and Maasai love grass are therefore best suited to be fed as hay.

Other important points of attention:

- Bush rye grass has larger seeds, allowing them to come up from deeper soil depths where there is more moisture. Therefore, Bush rye can establish well in rangeland ecosystems.
  - Also, African foxtail grass is suitable for this due to its extreme tolerance to drought and hardiness.
- Seed production is highest in Rhodes grass (173 kg/ha), followed by Maasai love (140 kg/ha). This shows their great potential to fully cover bare patches of soil once they have established. And provide good source of seeds for selling purposes. Horsetail grass produces the lowest amount of seed (35 kg/ha).
- Anyone considering maximizing the use of grass must ask and find sufficient answers to these questions:
  - What kind of livestock will be fed by forages?
  - How many animals will need to be fed?

- What type of feed is important to the livestock?
- Which grasses can provide the needed feed qualities?
- Which grasses are best adapted to the location?
- Should the grass be used in combination with other species such as legumes?
- Will other feed be needed for part of the year's feed ration?
- What types and how much harvested feed is needed?
- What management practices will help the grass remain healthy?

Table 1: Maasai love/Eragrostis superba/ Mbeetwa

Grass species	Description	Ecology	Agronomy	Feeding value + seed production	Main benefit
Maasai love **Eragrostis superba** **Mbeetwa**	Perennial, quick growing, up to 1m tall. Green, often flushed purple when young. Naturally occurs in ASALs.	Prefers sand soils, but also does well on clay loams and clays. Needs a 500-800mm rainfall. Tolerant to salinity, alkalinity and droughts. Less tolerant to waterlogging and shade.	Weed control is important in the first year. Do uprooting by hand or with a hoe. Easy to harvest seeds, up to 1 ton/ha. Harvest the seeds when they show signs of browning (straw-like colour) before the start of seed-fall by stripping.	Nutritive value: Crude protein of 7-12% DM and crude fibre of 30-35% DM. Fairly palatable and readily grazed but it gets rough and unpalatable near maturity. Dry matter Yield: up to 13.5 t/ha/year equivalent to 898 bales of hay each at 15kg Seed production: 140 kg/ha	High seed production and biomass yields. Can do well on poor soils.
					

Table 2: Cenchrus Ciliaris - African foxtail / Buffel grass and seeds.

Grass species	Description	Ecology	Agronomy	Feeding value + seed production	Main benefit
African foxtail / Buffel grass **Cenchrus ciliaris** **Ndata Kivumbu**	Perennial, extremely variable. Deep, strong, fibrous rooting systems to more than 2m. Spreads well by seed, easily covers the ground.	It forms the under layer of vegetation in bushlands. Prefers black cotton soils. Extremely drought tolerant. Can do well with only 100 mm rainfall. Tolerant to grazing pressure and fire. Less tolerant to salinity, waterlogging and shade.	Weed control is important in the first year. Do uprooting by hand or with a hoe. A good seeder. The seeds are harvested when they show signs of browning (straw-like colour) before the start of seed fall by stripping. Does not reach complete ground cover. Establishes fast and can out compete other grasses/weeds.	Nutritive value: protein content (CP) of 6-12 percent of dry matter (DM) when young. Crude fibre of 35-45% DM. Highly palatable. Yield: between 2-18t DM/ha. Can yield over 2.5 t/ha per cut when fertilizer is added. Moisture content in grass is usually low. Seed production: 91 kg/ha	Extremely drought resistant – best suited for very dry areas Very strong, can easily be grazed. Deep and strong roots, provides good ground cover. Responds quickly after the rains
					

Table 3: Bushrye /Enteropogon macrostachyus/Nguu

Grass species	Description	Ecology	Agronomy	Feeding value + seed production	Main benefit
Bushrye **Enteropogon macrostachyus** **Nguu**	Perennial, can grow up to 120 cm tall. Feathery and pale green or purple when young. Occurs in open grasslands in ASALs.	Common grass in dry areas, wide adaptation. 500mm rainfall. Drought tolerant. Prefers loose sandy soils, loams and alluvial silts.	Weed control is important in the first year. Do uprooting by hand or with a hoe. The seeds are harvested when they show signs of browning (straw-like colour) before the start of seed fall by stripping.	Nutritive value: Crude protein 7-14%, up to 16% at early flowering stage. It is highly palatable especially when young. Yield: biomass of 10 t/ha/year. Up to 600 bales of hay weighing 15 kg/ha/year. Seed production: 108 kg/ha	Good for soil and water conservation and rehabilitation of degraded land. High plant density and plant cover. Best for rocky areas
					

Table 4: Boma Rhodes/Chloris gayana

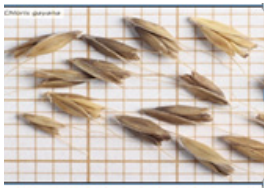
Grass species	Description	Ecology	Agronomy	Feeding value + seed production	Main benefit
Rhodes grass **Chloris gayana**	Perennial, 1-2 m tall, with long leaves Found in open woodlands and grasslands.	Drought resistant. Requires about 600-750mm rainfall Widespread in tropical and subtropical areas. Deeply rooted, so can withstand long periods of drought. Not tolerant to waterlogging. Does not like shade.	The seeds establish readily on a well-prepared seed bed. Mulching might help establishment after sowing. Short and controlled grazing may help to keep the grass in leafy and highly nutritive condition. No grazing during first year of cultivation. In order to improve stand longevity through seedlings, newly established stands should be allowed to flower and set seeds before being grazed	Nutritive value: Crude protein 8-10% DM. Crude fibre 35-40%. High moisture content and leaf biomass. More palatable and nutritive to livestock. The nutritive value peaks before bloom and then quickly declines. Not suitable for silage. Yield: 10-16 Ton of Dry Matter (DM)/ha. Seed production: 173 kg/ha	Good nutritive value for livestock. High leaf biomass High seed production. Very suitable as cover crop, establishes within 3 months, and provides good water holding capacity and soil stabilization.
					

Table 5: Horsetail/Chloris roxburghiana/Kilili

Grass species	Description	Ecology	Agronomy	Feeding value + seed production	Main benefit
Horsetail **Chloris roxburghiana** **Kilili**	Perennial, about 90cm tall. Frequently found in bushy and rocky land.	500mm rainfall. Drought tolerant. Prefers loose sandy loam / loam, but can also grow on alluvial silts and rocky soils. Not so adaptive to other ecologies. Rather low leaf biomass production.	Due to high germination capacity, the species fully covers the ground within a few seasons. Thus low weed infestation in subsequent seasons. Harvesting is done when the seeds show signs of browning before the start of seed fall. Carried out during dry conditions.	Nutritive value: Crude protein 10-15% DM, crude fibre 25-30% DM. It is highly palatable and is normally commonly overgrazed due to high preference by livestock. Seed production: 35 kg/ha	Good for reseeding. Highly palatable by livestock
					

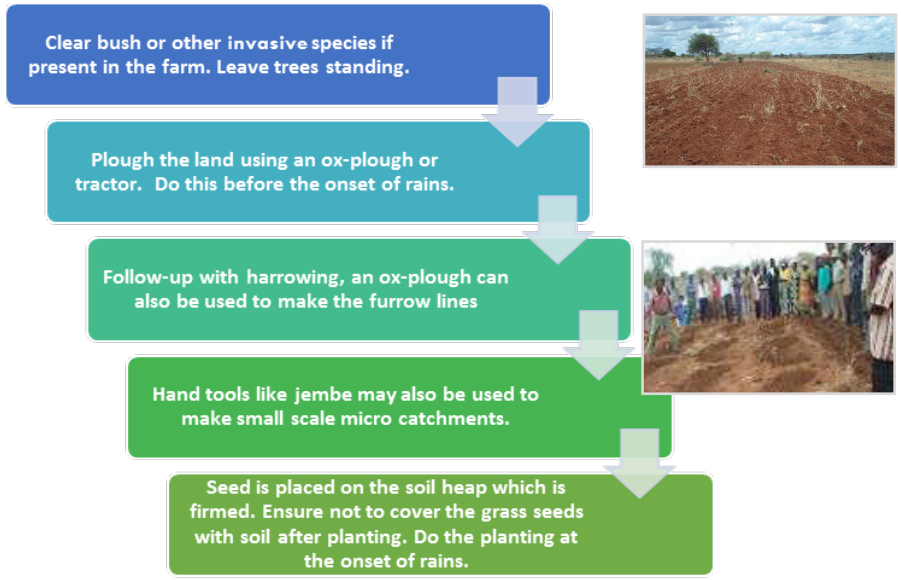
Table 6: Guinea grass/Panicum maximum/ Mbwea

Grass species	Description	Ecology	Agronomy	Feeding value + seed production	Main benefit
Guinea grass **Panicum maximum** **Mbwea**	Perennial grass, grows up to 2meters tall.	650-1800mm rainfall. Grows in light (sandy) and medium (loamy) soils, prefers well-drained soil and can grow in nutritionally poor soil Grows in full shade (deep woodland) semi-shade (light woodland) or no shade. It prefers dry or moist soil.	The plant is a very effective coloniser in ungrazed areas, particularly where some form of soil disturbance has occurred It is well adapted to sloping, cleared land in rain forest areas. It can be an aggressive invader of annual and perennial crops They are propagated by seed, and normally seeds have dormancy of about 18 months	Nutritive value: 16+ % protein, 0-15 % oil The grass dies quickly if put under continuous grazing. But it is also highly palatable and very nutritious. 6-60 tons per hectare Seed: 200kg/ha	High quality feed. High leaf biomass High production potential. Readily eaten by all livestock. Suited to grazing and cutting. Drought tolerant.
					

3. How to start growing grasses?

3.1 Land preparation

Land preparation and minimal soil disturbance is needed to: loosen the soil surface, reduce runoff, enable better water infiltration into the soil, ease the penetration of roots into the soil, and prevent grass seeds from being blown away by wind.



3.2 Planting

- Use 3kgs per acre
- When seeds are hard, you can do pre-soaking of seeds in water to make them soft. Another method is to do rubbing of seeds with sand to make them softer. After softening the seeds you can do the planting.
- There are 2 main planting methods:

1. Broadcasting: The seeds are spread in the field while considering the direction of the wind for even distribution.
2. Furrow planting: The seeds are hand drilled into furrows of about 2 cm depth or ox plough furrows.
3. Beware! The grass seeds should be planted very shallow or not covered at all. No more than 2 cm of soil to cover the seeds. Otherwise the grass seeds will not germinate.

- Use manure before planting and harrow this into the soil. Also apply manure after harvesting.
- The best planting season for grasses in South-East Kenya is near the October-December rains. This will ensure that the young established grasses have a short period of drought before the March-May rains. 2 seasons will provide a good basis for the grasses to establish well, after that they are more hardy to survive long periods of drought.
- It takes about 3 months between planting of the grasses and for them to reach maturity.

4. Road water harvesting with deep trenches

Why harvest rainwater?

- In dry areas rainfall is low (less than 700 mm per year) and poorly distributed.
- Available rainfall is not enough to support growth of many crops or good quality pasture.
- Most of the rainwater is lost as runoff due to lack of sufficient vegetation cover.
- Runoff can cause erosion and loss of soil.

- Simple methods are available that reduce runoff, prevent erosion and allow more time for rainfall to soak into the soil and be available to crops and pasture.

Rainwater harvesting is one of the best options to adapt to climate change. Road water harvesting is one of the ways of harvesting your surface run off for a sustainable water management strategy to increase agricultural production. Pasture farming can be considered as one the crops that do well in the ASAL areas since they require less amount of rainfall. Harvesting the road runoff increases the soil moisture in your farming, thereby increasing the germination rate of your grass resulting in increased survival and yield.

The basic principle is to: ensure that all rainwater and runoff water is held within the farm. Rainwater is trapped and not allowed to move and flow away. And moreover, the water stored in the trenches infiltrate more slowly. This makes that water can also move to the sides, so it increases soil moisture over a large area. Soil moisture is very essential, because it gives water to the grass at rooting depth. Soil moisture is the primary source of water for crops to grow. Higher soil moisture availability through trenches, will result in your grass growing faster, higher survival rates, it stays green for longer, and yields will be higher.

What are the benefits?

Harvesting water using roads has many benefits. These include:

- Improved soil and water conservation
- Reduce runoff and soil erosion
- Reduce soil loss and improve soil fertility
- Reseeding of denuded lands, groundcover ensures soil protection and retention of soil moisture
- More productive and healthier grass

What are the requirements?

- Land with a gentle slope
- Tools: hoes (jembes), forks, spades, machetes (pangas)
- Labour
- Desire to increase pasture production
- Technical knowledge to make safe and sound designs (or with advice from extension officer or experienced farmer)
  - See table 7 for a quick course on how to determine slope in order to lay a trench in your field.

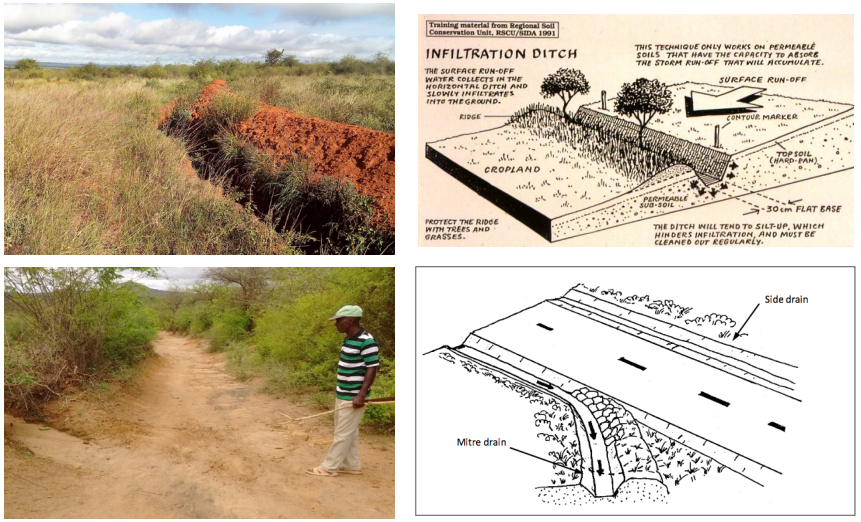


Figure 2: examples of road water harvesting and trenches

Figure 3: (a) Newly done trenches and (b) old trenches

Design steps: how to construct a deep trench in your farm

1. Identify the location on the farm
   a. On the upper part of the farm
   b. Along the contour
   c. In case of steep terrain, combine with terraces. Lead the trench down along the terraces.
   d. Divert water from the road into the trench
2. Dig the trench in the farm
   a. Use the soil that you dig to make the bund/ridge.
   b. Protect the bund/ridge with trees/ tree-crops / grasses
3. The trench should have a depth and width of 60-90cm (about 2-3 feet). The length can be as long as needed.
4. Ensure the water in the trench to flow along the contour. You want the water to stay, so it should have minimal flow, slope should be below 1%.

Table 7: Explanation on how to determine slope in your field for laying trenches

How to determine slope in the field:

1. First we need to mark where the trenches can be located. This is done with a level board method: you use 2 wooden boards of even height of 150cm length. A notch is made in each board at exactly the same height (say 1.4 m above ground level) and the ends of the string tied around these notches.
2. You indicate each 10 cm on both boards with a marker/pencil.
3. You span a cord in between of 10m length. On that cord you tie a spirit level.
4. The centre of the string (5 m from each end) is marked and the level itself is suspended there.
5. When all is in place you start the measuring exercise.
6. Operator A stands exactly upslope of Operator B. Ensure the cord is spun tightly. You adjust the string moving it along the board, until the spirit level gives you a level reading.
7. Now you can read from the upslope board how many centimetres the cord has gone down. For example 20 cm. This would mean that this part of land has a slope of 2%. (See calculations on the right).
8. With this method you can also make sure that your trenches itself have 0% slope. The cord should therefore be at the same height at both poles and be spirit level.

Determination of % slope

- (10 X 100%) /1000 = 1%
- i.e. a 10cm drop when using a 10m string gives us 1% slope drop
- Convert ALL units to be uniform (cm to metres or metres to centimetres)

For making terraces:

Vertical Interval (V.I): the difference in elevation / height between two structures

Horizontal Interval (H.I): the distance between / from one structure to another

i). V.I =(%slope + 2 feet)/4 X (0.3 metres)

ii). HI= (V.I X 100)/ % slope= (metres)

For example: a farm is having a slope of 4% calculate the V.I and H.I

V.I= (4% + 2 X (0.3m))/4=

This is to say, the difference in elevation of the will be 0.45m.

H.I= (0.45m X 100)/4 = 11.25m

Hence the distance between the structures in this case would be 11.25m

5. Grass cultivation management and practices

5.1 Weed control and grass management

- Weed control is very important during the first year to minimise competition for water and nutrients. Done by hand by either uprooting or using a hoe or use of selective herbicides. Be sure to remove weeds before they are able to set seed. Once the grass has established weeding is no longer necessary.Weeds like Sodom Apple should be removed from pasture fields while beans, peas and other leguminous weeds should be left as they are nutritious.
- Grass can remain productive in your field for 5-10 years, depending on proper management.
- Cutting of grass for hay or harvesting the seeds can happen multiple times in a season, depending on the weather conditions. Normally cutting happens within the rainy season, or shortly after, based upon the maturity of the grass.
- Controlled grazing can be done once the grass has established well (normally after 1-2 years). Livestock can graze after the grass was cut, in this way cows can graze the low grass stumps, can trample the soil a bit and provide manure.
- Grass can be well intercropped with other grass species, crops and trees. Systems that combine grass and (fodder) trees are especially recommended. As they support forage production for a long time and animals can be reared in the shade, in a controlled manner. Bush rye does well under trees while the other grasses prefer open spaces.
- Intercropping of grass with different grass species, beans, peas and other legumes has 2 advantages:

1. It is good to mix different varieties of grass since they also have different tastes to the livestock, thus enhancing a balanced diet for animal feed. It is also good to mix legumes into animal feed in order to include more proteins in the diet.
2. Especially planting legumes, like beans and peas, contributes to nitrogen fixation and balancing of minerals in the soil.
3. If you have a mixed pastureland, ensure to harvest the grass seeds separately. It is important to keep the seeds pure per species.

- Fence your pasture lands to avoid animals interfering and eating/ destroying the grass.

6. Harvesting and storage

On average an acre of grass can produce 200 bales in a year (sold at 250-300ksh per bale) and 150-200kg of seed (sold at 800-1000ksh per kg). This chapter will discuss why and how to harvest hay and seeds. Ensuring proper harvesting, cutting and storage techniques to ensure long-lasting quality.

Light Grazing: This chapter does not discuss grazing, however we advise to do light grazing on pasture fields especially during the dry periods or shortly after harvest. Light grazing in these situations ensure that livestock can graze from the leftovers and stumps. The idea is to ensure that much of the grass stumps are not eaten up. Normally where grass is well established for grazing, a cow should graze a quarter acre per week. Additionally, livestock will trample and provide natural manure, which is beneficial for grasses starting to come up.

6.1 Hay harvesting and conservation:

- Hay can be stored for a long time without nutrient loss.
- Hay often meets the nutrient requirement of many classes of livestock. Different crops and grasses can be stored to ensure a varied diet.
- Provides feed reserve for periods of shortage.

How to make hay?

- Cut when 20-30% of grass plants have flowered
- Cut at 5 cm above ground or slightly higher for most grasses.

1. This is to ensure you get the good leafy biomass, and not the hard stems without nutritional value.
2. Also, this ensures that the grass can easily grow again from the basic stems that are left in the field.

- Bale the hay with a hay box (figure 4)
- Do not make hay from the first harvest, better to do light grazing, so as to give the grass a chance to establish completely. Light grazing helps to trample the soil a little bit, to have the grass stumps ready to grow and the seeds to spread out and cover completely.

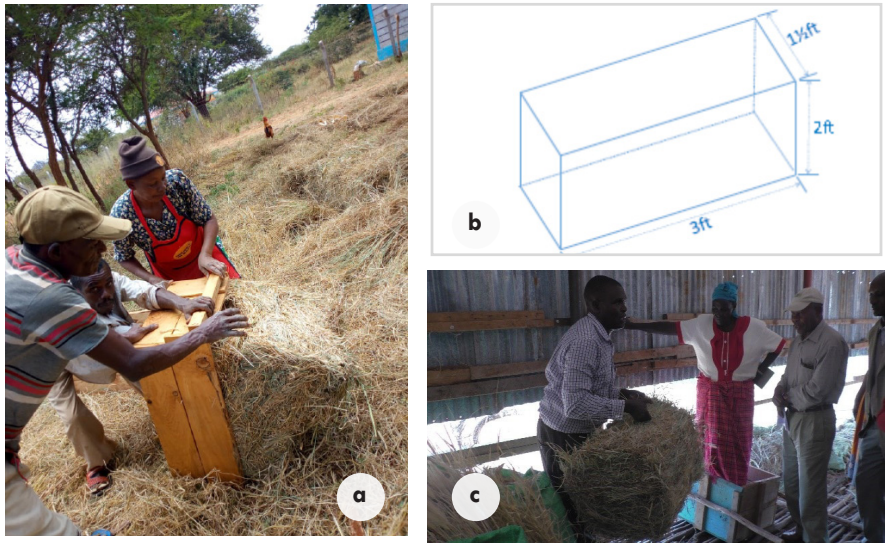


Figure 4: Examples of (a) hay baling, (b) the dimensions of a typical hay box for 15kg and (c) locally bailed grass

➔ **Timing is key** – when you want to harvest hay, be sure to harvest at the right time. i.e vegetative stage, before the grass matures and becomes coarse (due to high lignin and cellulose content). In this scenario you can only harvest 20-30% of seeds. The development of seeds is the best indicater, they should be few (20-30%) as at this level, the hay has the most of nutrients. If you want to focus on seeds, do know that your hay will be of low quality. A thumb rule, if you need quality hay, you forgo seeds and vice varsa.

How to store hay?

- A good hay conservation structure should protect hay from: rainwater, direct sunlight, pests, and animals. And it should allow for good aeration, so make sure air can go through the structure.
- If not baled, collect dry forage material and store in a dry shed.
  - Storing unbaled hay requires keeping them in alternating layers, to ensure aeration is guaranteed within the storage place. The structure should also be built with the long sides facing against the wind direction.
- The moisture content of the hay should be less than 20% to avoid mould growth! When the grass has been baled and stored, it needs regular checking for increase of temperature. An increase in temperature indicates presence of high moisture content. When this is noticed, a farmer can move the baled hay in the open to ensure aeration. The bales can be stored under shade for a while to ensure moisture is lost then stalked later.

The structure should be placed in a manner to ensure that wind blows along the length. This will ensure there is enough circulation and the structure is safe enough.

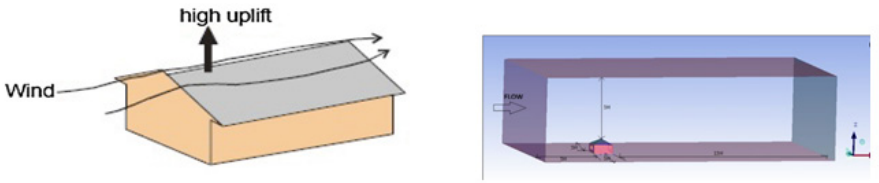


Figure 5: Design of the storage structure against the weed

Figure 6: Example of a hay storage structure in (makindu) and (b) Mwingi

How much hay to store?

To estimate the space needed for hay conservation, determine:

- Dry matter needed per day (A)
- Days the hay will be needed (B)
- Weight of dry matter in the bales (C)
- Volume of the bales (D)

Example 1a:

For a typical cow living in tropical conditions the weight is around 300 kg.

The dry matter needed per month for each cow is determined at 80% of its bodyweight. This means 240kg per cow per month.

Assuming each bale is 15kg, you need 240/15kg = 16 bales of hay per month for one cow.

With this you can calculate how many bales you would need for x amount of cows and x amount of months. For example to bridge the dry months from May to November.

Example 1b:

I am a farmer with 5 cows. So each month I would need (5*16) = 80 bales of hay.

The dry period is from May to November and is normally 5 months in which I do not have enough feed. In this calculation I assume I feed them on bales completely for 4 months. The other month they still have somewhere to graze, maize stalks or other feed.

In my case I need a total of (80*4) = 320 bales to sustain my 5 cows.

On average I can get 200 bales from 1 acre. In order to sustain my 5 cows I would therefore need 1.6 acre of grassland.

6.2 Seeds harvesting:

- Timing is crucial. Seeds are mature when the colour/appearance of seed heads turns golden-brown (straw-like colour).
- Harvest when most (over 60%) of seeds have matured. Before the seeds will be shed. To test whether the grass seed is ready for harvesting strip (kuvuua) one of the stalks, if the seeds come out without struggle, the seeds are mature for harvest.
- Harvest only during dry conditions.
- Different methods can be used depending on the type of grass seeds:

1. Seed hand stripping – for larger seeds (Maasai love)
2. Cutting/Detaching/Breaking the entire grass – for smaller, light seeds (African foxtail, Bush rye). The grasses once detached are kept until they are well dried and then stripped.

- Do so by stripping the seeds from the seed head.
- Other methods are to harvest the entire plant, after which they should be stalked for 2 weeks in the field after binding the seed heads. This allows seeds time to mature, and thus attain higher quality. Beating the heads will result in separating the florets/seeds.

Important points:

Do not harvest the first seeds after grasses have established. Let the seeds pour and germinate. This helps in ensuring that all the ground is well covered by grasses. The seeds produced from those grasses in the field will establish better, compared to new seeds in case of reseeding.

- The main reason for this is that grasses need to adapt to the new situation. So instead of directly harvesting the first seeds, let those fall down and let them cover the open spaces. The grasses grown now in the second season will all be better adapted, with far better germination and pollination characteristics. From the 2nd season you can harvest seeds.
- For harvesting seeds, do this when the seeds naturally fall down and have a golden-brown colour. If seeds are not yet ripe, the quality is lower. So make sure you only harvest seeds when ripe.

Figure 7: example of harvesting seeds and drying

Seed processing and storage:

- Clean the seeds, remove all other material, and dry the seeds. Spread the seeds in a thin layer on mats that do not allow ground moisture to come through. Then leave to dry in the shade for 3-5 days. Ensure a moisture content of 8-12%, this can be tested in a nearby lab from KALRO.
- Seeds should be stored airtight, dry, cool, and outside the reach of pests.
- Metal/tin containers or sisal bags can work well (not polythene). Check your seeds regularly.
- Store the seeds in airtight and dry conditions, away from moisture and rodents.
- Hay can stay for ages without losing its nutritive value if kept within the right conditions. To ensure quality is maintained, the hay should not be left to be rained on or get into contact with moisture.

Figure 8: Good examples of storage materials for grass seeds

7. Livestock production

Livestock production in Kitui county, Kenya dates back to old times since it is cultural practice for the Akamba to keep animals since is seen as agro-pastoral community. The common animals kept are mostly indigenous cows, goats, sheep, donkey and chicken. For each of these animals there are ready local markets, where animals are being sold weekly. Annex 2 provides a comprehensive overview of the average prices of different types of livestock. This can help you in decision making.

Livestock farming when integrated with crop farming provides efficiency in production where animals use crop residues as feeds, while animal manure is used as fertilizer on crops. Ange (1994) put out that one ton of cow dung contains about eight kilograms of nitrogen, four kilograms of phosphate and 16 kilograms of potassium oxide which are useful for crops to thrive. Livestock farming therefore offers more stability and it can be relied on and that is why it's become a more preferred livelihood choice compared to crop farming.

Milk is still on high demand within the county and the few organized cooperatives are making good milk sales. Milk trading within inter-county has

been banned and left to the big organizations in the sector, while trading within the county of production is open. Farmers can tap into this opportunity. Although for milk production one should look greatly into the nutritive value of grass for dairy cows specifically. This is quite different from the grasses suitable for meat production. Overall, the grass species that can grow in dry areas are more suitable for meat production.

7.1 Nutritive value for livestock

For fodder production, good to have a variety of grass species and legumes. This would give animals all the required nutrients. If the grasses in this set up has to be harvested, then different people can pick a particular species to harvest at the same time to ensure they are not mixed up.

- In general it is good to have a mixed stand, so combine different pasture species with legumes. Legumes fix nitrogen in the soil and are generally good for soil fertility, grasses often have deeper roots so may hold the soil better together, reducing risk of erosion.
- You do have to check the preference of certain species, some want to be in shade, some species in open sunny areas, those species should not be planted together as they need a different area. Bushrye does well under trees for example.

Best species for high nutritive value for cows are:

- Bush rye
- Boma Rhodes

7.2 Opportunities and recommendations to improve livestock production

- **Specialise:** focusing on one specific aspect within the livestock value chain can give greater production and higher profits. Specialize for example in production of: seeds, hay, meat or milk.
- **Land rehabilitation to improve climate change resilience:** it is very important to do reseeding and establish ground cover with grasses. This greatly reduces soil erosion and improves water retention in the soil. Take for instance the 'Kenygoni' communal lands, these can well be reseeded and improved for livestock grazing.
- **Organise:** Farmers need to form cooperatives that can buy inputs in bulk, and stand strong together in determining good prices to sell at the local markets. Also, these coopartives can share knowledge and learn from each others' practices.
- **Harvest water:** each farmers needs to harvest all the rain and runoff waters in her vicinity. It is essential to retain water in the soil through trenches and soaking pits, this greatly helps grasses to grow, produce more grass multiple times a year and to sustain longer.

Professionalization of different parts of the pasture value chain and value addition options:

- **Pasture production:** increase land size, consider mechanisation, invest in quality seeds, implement road water harvesting, fence off land and make bales of the hay.
- **Seed production:** focus on seeds in high demand, ensure quality (through testing) and sell in appropriate containers/sacks.
- **Animal fatteners, meat production:** e.g. do timely purchase, fattening and sales of animals according to market dynamics.
- **Dairy production:** e.g. through production of sour milk (mala) which fetches higher price than normal milk.

8. Business model

This cost benefit analysis compares the costs for the production of three typical food crops (maize, green grams and pigeon peas) with two grass species (African foxtail and Maasai love grass).It becomes very clear that the profit and income you can make from grass is much higher compared to these three crops. Especially when you think of the reduced costs for grass in the continuing years, as grass can remain for 5-20 years. So land preparation and weeding only take place in the first and second years. Grass can give you an average income of **63375 KSH** on a yearly basis. Maize, green grams and pigeon peas have a highest possible income of **12900 KSH**. Showing the big potential of grass, especially because it can do much better under dry conditions with scattered rainfall.

Table 8: Cost Benefit Analysis of food crops and pasture

Annual yield and income comparison for a 1 acre field					
Activity	**Crop type**			**Grass species**	
	Maize	Green grams	Pigeon peas	African Foxtail	Maasai Love grass
Input costs					
Land Preparation	2500	5000	0	2500	2500
Seed purchase	1500	2200	100	3000	3000
Sowing labour	2000	2000	500	1000	1000
Weeding labour	1500	1500	0	1000	1000
Chemicals	1500	3000	1000	0	0
Fertilizer/manure	3000	6000	0	0	0
Harvesting and storage					
Harvesting	3000	6000	2000	0	0
Post Harvesting	2000	4000	2000	0	0
Hay cutting and baling	0	0	0	4000	4000
Activity	**Maize**	**Green grams**	**Pigeon peas**	**African Foxtail**	**Maasai Love grass**
Seed harvesting	0	0	0	5000	5000
Gunny bags (90kg)	500	600	200	1000	1000
Total input costs	17500	30300	5800	17500	17500
Output and sales					
Produce					
Seeds in kg	-	-	-	35	50
Hay in bales of 15 kg	-	-	-	200	250
Cereals/pulses in bags of 90 kg	10	12	4	-	-
Sales (KSH)					
Seed sale (800 ksh/kg)	-	-	-	28000	40000
Hay sale (250 ksh/bale)	-	-	-	43750	50000
Cereals/pulses sale (30, 40, 20 ksh/kg respectively)	27000	43200	7200	-	-
Total sales	27000	43200	7200	71750	90000
Total income					
Total income (KSH) (total sales – total input costs)	**9500**	**12900**	**1400**	**54250**	**72500**

* the rates on input costs for grasses are here described as annual costs, however perennial grasses can remain for 5-20 years at same production levels. Therefore the total income on grasses will only increase with years to come.

** For green grams it is possible to get 2 harvests in one year, for maize and pigeon peas you would get 1 harvest per year.

*** Pigeon peas are nearly always intercropped with another main crop, mostly maize, therefore the costs for land preparation coincide with the preparation costs of maize.

9. Take-away lessons

- Plant a grass which fits your climate and soil conditions.
- Start by growing a small acreage of grass like ½ acre, with the seeds you get, you can easily expand once this ½ acre has established and you can harvest seeds for reseeding.
- Fence off your area and avoid grazing young grasses which are not yet established.
- Look at what you need, if you want beef or milk production the type of grass makes a big difference.
- Combine pasture management with road water harvesting and fodder tree planting e.g Leucaena leucocephala(Leucaena)
- Construct deep trenches to increase soil moisture to spur grass growth.
- Ensure that much of the rain water is retained in your farm, and give it time to infiltrate into the soil slowly, for example with trenches. Moisture is key for pasture development.
- Share your experiences, challenges and successes with your neighbours and other farmers.

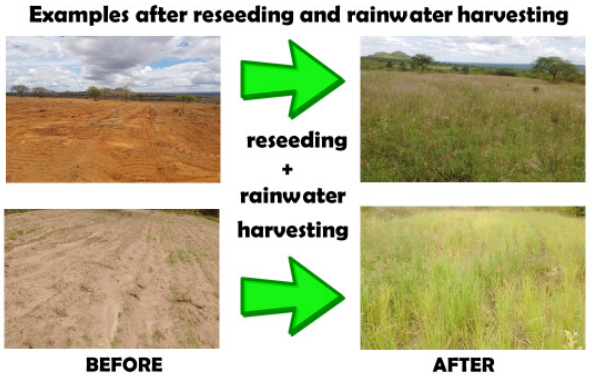
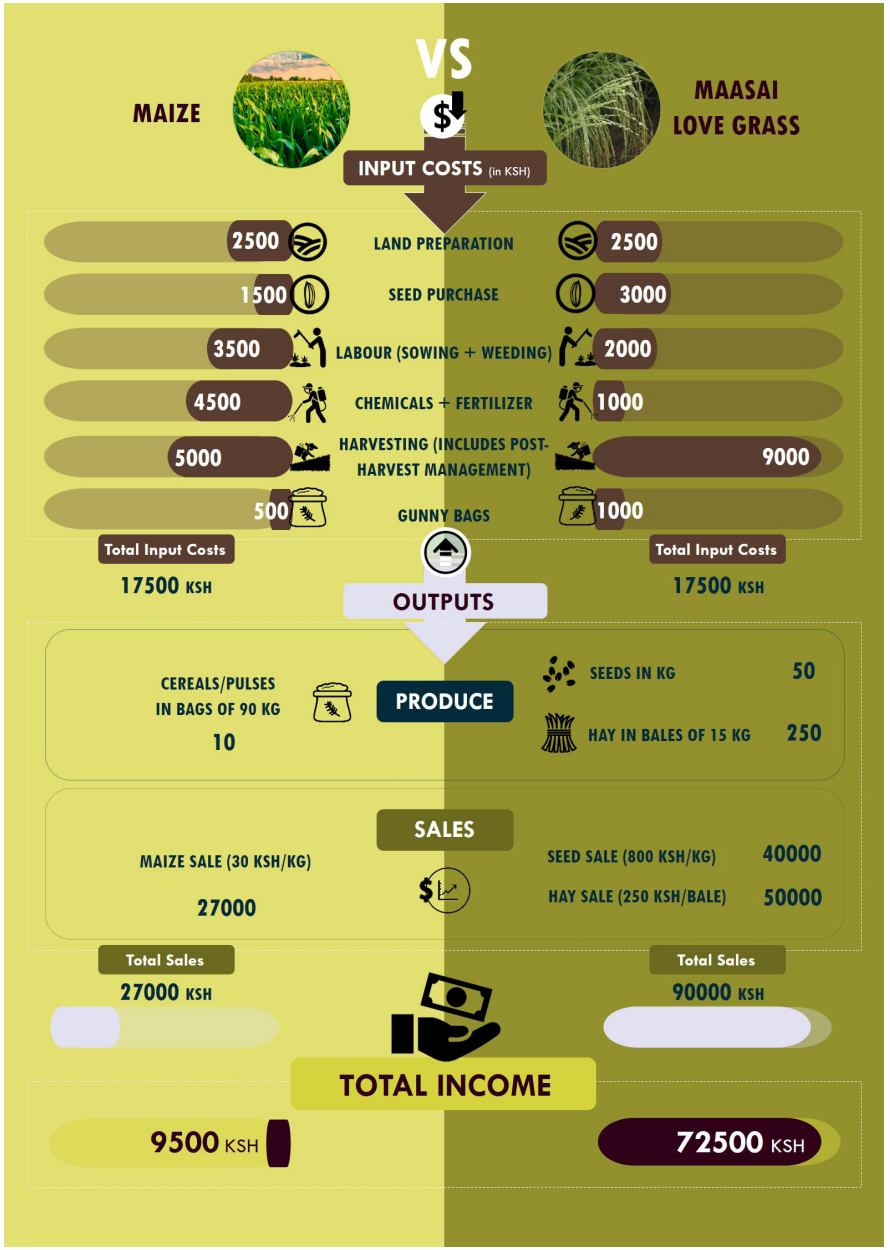


Figure 9: Examples after reseeding and rainwater harvesting (source: SEKU demo plot)



10. Annexes: Farmer stories and livestock market

Annex 1: Jackson "My retirement plans taking shape!"

Jackson, farmer in Kyangwithya West, learnt about pasture production and narrates his story:

"When I retired from the police force, I wanted to venture into animal fattening where I would buy young and weak bulls and graze them for a period of about 2 years and sell them. When I started I noticed that I did not have enough feed for the animals. It is during this time when I met people from the county and MetaMeta who taught me two key things which resonated well with my long term plans. They taught me on road water harversting and growing of indeginous grasses. Doing the typical maize, beans and sorghum was a challenge since rainfall has not been enough in our area. Harvesting road runoff would help me increase the moisture levels in my farm and crops would reach maturity when there is moisture still available. For me I wanted to make a difference by doing crops which every other farmer was not doing. I therefore went for pumpkins, they establish easily and don't need much weeding or spraying. At the same time, the county was opening up rural roads and the one from my home towards the river was being done. I asked the machine operator to divert all the water to my farm.

Figure 10: ackson showing point where water is diverted to his pasture land

Figure 11: Jackson showing his harvested seeds of Masai love grass

When water was diverted to the farm, I repaired my farm trenches and that is where water was now directed. It was amazing for me since after that, the pumpkins would grow with vigour and produce well. I dedicated two trenches of my farm for pasture production. This was to grow the grass seeds. As other farmers were ploughing their farms to grow maize and beans, I planted grass and pumpkins.

I waited for the grasses to establish in the first season but the establishment was poor. Amazingly, the next season the grasses established well. I now would boast of having enough feed for my bulls. There was crop residues and grasses for my animals and they would feed well and they became fat just like I envisioned. The bulls you see now here are a second batch after I already sold the first. I plan to continue doing this and I am contented when after a few months I get KSH 10,000 shilings from fattening a bull.

I am greatful for this timely ideas I learnt and look forward to making it better. I learnt a lot when we visited Jeremiah's farm and I would like to follow his steps. Actually I have already started harvesting grass seeds for my Eragrostis superba.

Annex 2: Elizabeth, a pasture farmer in Kitui Rural sub-county

I am Elizabeth, a pasture farmer in Kitui Rural in the larger Kitui County. I ventured into grass production because here the rains are erratic and unreliable. I learnt this by observing how the small pasture field I had dedicated for pasture behaved after every season, Maize and beans would fail, but I would always get some pastures for my livestock. When through the extension officer I heard about this project, I wanted to join and learn how to cultivate grasses. However, I had a small piece of land due to family subdivisions. I had few options, either to dedicate more portion of land to grasses or intercrop with maize. I choose to intercrop maize and grasses. This was because maize takes 3 months only in the field while grasses are perennial. I did this the first season and I was happy how it turned out, I harvested my maize and left the grasses to continue establishing. My grasses were in a clean field since I did weeding for both maize and grasses. During the dry period, I had to cut the grasses to feed my animals at home.

Figure 12: Elizabeth showing the difference between the local and improved Cenchrus ciliaris grass in her farm

There is some difference between the new and old cenchrus ciliaris grass species but it really takes time and experience to tell the difference. You see this is short, can't grow to knee high (local variety) and the other one is tall (improved variet). This particular one (improved) seems larger compared to the other (indigenous), the indigenous looks lighter **(Figure 12)** .The improved Cenchrus ciliaris I was given by the agricultural officer Mr David Nguta, a senior vertinary officer from Makueni County who had come to pay me a visit. He asked me to harvest and sell to him a Kilo at Ksh 1200. Now I am planting more so that I will have to sell the seeds to him.

Figure 13: (a) covering grass seeds lightly (b) Raking weeds from establishing grass

When ploughing, after the lines have been done by ox plough, I plant along the lines all the way to the end then I cover the seeds lightly with soil to ensure the seeds are not carried by wind **(figure 13a)**. If it is in the same piece of land I am planting grass and maize, first, I plant the whole portion with maize, then later I would come and plant the grasses, you can't plant grasses as maize, they would be covered by so much soil and will not germinate. This because maize requires proper covering with soil, unlike gasses which require light covering. If covered deeply, it won't germinate. Planting of grass with other crops such as maize, sorghum and pigeon peas enhances grass protection and security. It gives the grass time to the grass to grow well without being eaten by animals. I use a rake and a sickle to remove the weeds and give the grass room to grow **(figure 13b)**.

Figure 14: Elizabeths's bulls grazing in her farm

Much of the grass is for my cows **(figure 14)** but sometimes I also sell. For example, during ploughing time, people need to buy grasses for their oxen, so I will be selling a bale at Ksh 100. I also know how to bale the standard way.

My last message to the farmers: Farming requires one to act dumb and not to listen to naysayers. If you argue you may feel discouraged.

Annex 3: Cattle prices at local markets in Kitui County

Animal type	Male				Female			
	Age of animal			Price (Ksh) per unit	Age of animal			Price (Ksh) per unit
Cattle	Steer (Never ploughed)	Breed	Kamba	18,000	Heifer (Young cows that have never given birth)	Breed	Kamba	11,000
			Somali	20,000			Somali	15,000
		Weight	Thin	15,000		Weight	Thin	11,000
			Fat	20,000			Fat	15,000
		Type of horns	Long horns	19,000		Type of horns	Long horns	14,000
			Short horns	20,000			Short horns	15,000
	Young bulls (Just starting to plough/ have not matured fully	Breed	Kamba	25,000	Heifer (Young cows that have only given birth once)	Breed	Kamba	18,000
			Somali	35,000			Somali	20,000
		Weight	Thin	20,000		Weight	Thin	15,000
			Fat	35,000			Fat	20,000
		Type of horns	Long horns	34,000		Type of horns	Long horns	19,000
			Short horns	35,000			Short horns	20,000
	Bull (Fully mature)	Breed (Big/huge size)	Kamba	45,000	Cow (Fully mature after several births)	Breed (Big/huge size)	Kamba	30,000
			Somali	60,000			Somali	40,000
		Breed (medium size)	Kamba	40,000		Breed (medium size)	Kamba	25,000
			Somali	50,000			Somali	35,000
		Weight (Big/huge size)	Thin	40,000		Weight (Big/huge size)	Thin	25,000
			Fat	60,000			Fat	40,000
		Weight (medium size)	Thin	35,000		Weight (medium size)	Thin	20,000
			Fat	50,000			Fat	35,000
		Type of horns (Big/ huge size)	Long horns	58,000		Type of horns (Big/huge size)	Long horns	38,000
			Short horns	60,000			Short horns	40,000
		Type of horns (medium size)	Long horns	48,000		Type of horns (medium size)	Long horns	33,000
			Short horns	50,000			Short horns	35,000
Goat	Young (Small in size)			3,500	Young (small sized/Never given birth)			3,000
	Mature (Mature but middle sized)			8,000	Mature (Mature but middle sized)			5,000
	Mature (Big/huge in size)			13,000	Mature (Big/huge in size)			7,000
Donkey/Camels	Young (Small in size/)			7,000	Young (Small in size)			6,000
	Midlife (middle sized/can carry 20-liter jerry cans)			11,000	Midlife (middle sized/can carry 20-liter jerry cans)			10,000
	Mature (Medium to large in size)			15,000	Mature (Medium to large in size)			13,000

GREEN ROADS FOR WATER

KALRO

South Eastern Kenya university

NWO

Flood-Based Livelihoods Network Foundation

META META

Green Future Farming