Technical Manual
Augmenting fodder during dry spells & improved cattle management
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1. Background

Under USAID’s India-Africa Agriculture and NRM Innovation sharing platform initiative, as part of the US Government’s Feed the Future program, a pilot project was initiated during 2016 and 2017 in the Kajiado County of Kenya, to address the issue of fodder during the dreaded dry spells affecting the main livelihood occupation of the area i.e. cattle rearing. Ashwattha Advisors Pvt Ltd or AAPL (a wholly owned subsidiary of TechnoServe Inc and which operates under the brand TechnoServe), along with Outliers Development Services (hereafter referred as Outliers) has worked with TechnoServe Kenya and the Kajiado Women Dairy Cooperative for augmentation of fodder supply during the dry spells.

Kajiado Maasai Women Dairy Cooperative Society

Kajiado Maasai Women Dairy Cooperative Society (KMWDCS) is a collective effort to provide a reliable livelihood option for the pastoralist Maasai community. The Cooperative has membership of about 4500 women engaged in cattle rearing. It has reduced the drudgery of women by establishing seven milk collection centres for pouring milk and has been able to pool in a significant volume of milk in excess of 25,000 litres. KMWDC has tie up with New KCC (New Kenya Co - Operative Creameries Ltd earlier it was known as KCC) for selling the collected milk from its members.

Problem Statement of the project

The dry-spells in the Kajiado country of Kenya can be fatal for the cattle reared by the Maasai farmers. Every year owing to dearth of fodder and water, about 2 to 5 animals die during the dry season, per dairy farmer. While milk productivity is low, the concept of good management practices, for improved milk production, is almost absent.

Further, low hygienic upkeep of animals results in low milk and meat production. The current production of milk per animal is about 2 to 4 litres a day (and is generally for 3 to 5 months only), which is about 20% of the optimal production capacity, as per many studies conducted in the region.

Seasonal fluctuations of milk production in Kajiado are high and dairy operation get adversely affected for a few months prior to onset of the long rain season. The low
productivity of milk during the dry season adversely affects the Maasai farmer on regular basis.

Activities undertaken in the project

In this project, Maasai farmers were provided with solutions that would improve availability of nutritious fodder for their cattle and improve milk yields. The project demonstrated paddocks – prepared using PRADAN’s popular 5% model of cultivation - to augment fodder availability during the dry season. Under this pilot, 5 acres of land, each, was converted into fodder paddocks at 18 sites with 18 lead dairy members identified by the KMWDCS. The Indian innovation of water harvesting in 5% of the land was adapted to the context. In each paddock, 16 micro ponds, supported by field bunds, were dug to store between 0.5 and 0.8 million litres of rainwater, at full capacity. Fodder paddock areas were generally fenced using local material such as branches of trees and bushes, apart from a few who did fencing with barbed wire. Once ready, paddocks were ploughed with a disc harrow keeping strips of natural grasses in between. Suitable legume fodder crops (pigeon pea and cowpea) and fodder trees (Mulberry (Ndare), Chinaberry (Morbaini), and Leucanea (Mtini)) were planted on such paddocks. On-field technical and handholding support were provided to the lead dairy members during the construction and cultivation of the demonstration paddocks. Two stage trainings on improved dairy management and fodder production were provided to the Maasai farmers. Free grazing was restricted inside the fodder paddock and farmers were advised to harvest the fodder crops; chop the fodder and only then feed to their animals. This combination of fodder crops could counter the dry spells by providing nutritious fodder for five to 10 lactating and pregnant cows.

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1 PRADAN is one of India’s leading NGOs. They have been credited with introducing the 5% cultivation model in India. This model was adopted for a fodder purpose in this intervention. Outliers Development Services (the Indian Knowledge Partner) is an offshoot of PRADAN.
2. Why this technical manual?

Now that the Indian innovation has been demonstrated in the field, this needs to be replicated for other farmers of the cooperative. This document is an attempt to share the basic concepts of better management practices and fodder production as well as details of the 5% method of paddock creation, so that the Maasai farmers would be able to replicate on their own. As the cattle management practices need to be improved substantially, this is an attempt to cover current challenges faced by the farmers.
3. Who should use this manual?

This manual is meant for use by farmers, community leaders as well as resource organizations such as the Kajiado Maasai Women Dairy Co-operative and TechnoServe. This manual talks in detail about the 5% model but just introduces basic cattle management practices, since they were not the prime focus of the intervention. Detailed understanding of cattle management and other aspects can be had from existing technical manuals (covering aspects of health and management) that are available with the International Livestock Research Institute (ILRI), Food and Agriculture Organization (FAO).
4. Understanding the profits with milk

Do you know?

In the context of Kajiado County:

- The average milk yield from a cow per day is 2 to 4 litres, translating to ~300 to 400 litres per lactation period.

- If reared properly, a cow (Sahiwal crossbred) can give about 10 litres of milk per day on an average during the lactation period, translating to **2000 litres of milk in a lactation period**! One cow has a lactation period of about 200 days or about 6 to 7 months.

- If a litre of milk is KSh 25, income from a cow currently is KSh 7500 to 10,000 per lactation period. However, with proper care and management, the income can be increased to KSh 50,000 per cow, from milk alone.

- If a person rears **10 cows** with improved management practices, the income from those 10 cows can be **500,000 KSh in a year**!

In order to achieve this income, one farmer needs to follow **five doctrines**

![Diagram showing the five doctrines model](image)

This manual is based on the 5 doctrines model and would be discussed individually
A. Provision of shed to the animals

Making a shelter provides a comfortable environment without unrest and stress for the animal. This increases the immunity against diseases and therefore the yield of milk increases.

- Provide shade to the animals, it would provide protection against predators, parasites and adverse weather conditions like rain, wind, cold, and intensive sunshine.

- A shelter should have proper fencing so that animals can roam around and do not need to be tied. It should have space to accommodate calves and cows in a proper way (not congested). An adult cow requires foursquare metres of area. **Always, quarantine a sick animal.**

- For construction of the cowshed, local materials such as grasses for thatching, mud, poles and sticks can be used. Start with a few animals and gradually increase the shelter so that it does not hurt your pocket!

- The shed should face west to get proper sunshine (it kills harmful microbes) with proper ventilation. In summers, it should be well ventilated; in winters, well covered, in the rainy season, it should be well drained.

- Height of the shed should be at least 12 feet with slanted floor. A slight slope is also preferable so that urine and other wastewater can drain off easily. Well-cleaned floor can keep flies and mosquitoes away from animals.

- Mud floor is more comfortable for animals, but needs more cleaning and care. Cemented floor is less on maintenance, but not comfortable for animals, and more water is required to keep them neat and clean. As per family’s affordability, one can choose which type of flooring one wants to have,

- Equip the house with feed and water troughs so you can feed your animals indoors.
Milking space

Milking place and night shelter should be different. This helps maintain the cleanliness of milk from dung and urine and its smell. This also helps avoid mastitis. Animals should be fed before milking. A proper feeder and water manger should be used at the milking place too.

Cleanliness of the shed

Cleanliness increases immunity, prevents diseases, and increases milk yield. Application of lime in the paddock eliminates the parasites and harmful microbes. The problem of ticks is also addressed.

Therefore, **clean the paddock every day**.

- Clean the paddock with a shovel and store it outside for selling or applying on fodder paddock.

**Know.** Cleanliness increases immunity, prevents diseases, and increases milk yield.

Application of lime in the paddock eliminates the parasites and harmful microbes. The problem of ticks is also addressed.

B. Clean feed, fodder, and water for improved cow rearing

In order to have improved production of milk, there is a need to feed the cow with a balanced ration. The food should be a combination of carbohydrates, protein, and fats. The
feed should also have adequate amounts of vitamins, minerals, and micronutrients for a sound health and immunity against diseases.

Table 1 Nutritional sources for Cattle

<table>
<thead>
<tr>
<th>Carbohydrate</th>
<th>Forages, pasture, crop residues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>Leguminous fodder, young grass</td>
</tr>
<tr>
<td>Fat</td>
<td>Oil cakes, cotton seed cake. While not necessary for non milch animals</td>
</tr>
<tr>
<td>Vitamins</td>
<td>Green pasture, fresh or dried leaves, calcium is essential for milking and pregnant cows.</td>
</tr>
<tr>
<td>Minerals and micronutrients</td>
<td>Mineral licks, dried leaves, bark, herbage, shrubs</td>
</tr>
</tbody>
</table>

Ideally, the daily balanced ration should have both green and dry fodder. The amount of dry fodder should be at least 40% of the total food given in a day. Provide chopped fodder in a clean manger to the milch and pregnant animals. Grass should be chopped for easy digestibility. Give an animal at least 25 to 40 kg of fodder, mixed with mineral mixture, feed (at least 2 kilograms for a milch animal, which should always be cooked), and calcium. Animal should be provided fodder 2-3 times a day at home. Mineral blocks, or Urea Molasses Blocks (UMB) should be provided in the shelter, which the animal can lick whenever there is a need. As salt is an important component of our diet, cattle must be given salt to lick. The animals lick salt, UMB or lime, whenever there is a need of it. Pregnant and lactating animals should be given extra food for better birthing and milk production. Zero grazing or minimum grazing in nearby area should be practiced for at least lactating and pregnant cattle.

http://theorganicfarmer.org/sites/default/files/field/image/fodder%20chopper.JPG

http://nzdl.org/gsdl/collect/hdl/index/assoc/HASH01a1/c526b88a.dir/p014.png
Know Feeding the animal at the paddock/shelter itself reduces stress and metabolism, promoting good health and better milk production. Free grazing decreases the milk production.

Alert! When you observe that the animal is licking the soil, trying to drink its own urine, then, there is a need of micronutrients, salt, or calcium.

Caution: If only green fodder is given to the animal, there is a chance of tympani or bloat, which can prove fatal for the animal by causing cardiac arrest. Consult local veterinarian for more details.

Remember: Clean the feeder everyday in order to avoid microbial infections and disease prevention. It should be placed in a position, where there should not be any contamination with faecal material. Avoid use of common feeder as it can spread deadly diseases like Foot and Mouth Disease. All the milch animals should have their separate feeder. Calves should have their separate feeder too.

Table 2 Guide for feeding animals (in kg)

<table>
<thead>
<tr>
<th>Milk capacity of the animal (litres per day)</th>
<th>Feeding during</th>
<th>Green Fodder</th>
<th>Dry Fodder</th>
<th>Concentrate $^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 to 7</td>
<td>Lactation days</td>
<td>20 to 25</td>
<td>5 to 6</td>
<td>3.0 to 3.5</td>
</tr>
<tr>
<td></td>
<td>Dry days</td>
<td>15 to 20</td>
<td>6 to 7</td>
<td>0.5 to 1.0</td>
</tr>
<tr>
<td>8 to 10</td>
<td>Lactation days</td>
<td>25 to 30</td>
<td>4 to 5</td>
<td>4.0 to 4.5</td>
</tr>
<tr>
<td></td>
<td>Dry days</td>
<td>20 to 25</td>
<td>6 to 7</td>
<td>0.5 to 1.0</td>
</tr>
</tbody>
</table>

Supplementary feed for calves

Even one young animal lost is a huge loss to the progeny and probable future income. Therefore, it is profitable to invest on supplementary feed of the calves during the dry period and especially heifers, so that they grow as a quality animal, producing the optimum

$^2$ Concentrate feed is a mixture of various concentrate feed ingredients in suitable proportion. Commonly used ingredients in compound cattle feed include grains, brans, protein meals/cakes, agro-industrial by-products, minerals and vitamins. [http://nddb.org/services/animalnutrition/cattlefeed](http://nddb.org/services/animalnutrition/cattlefeed)
amount (i.e. 2000 litres) of milk. Experiments conducted in the Kajiado region, have projected income to increase by 44%, and reduced mortality by 80% (Grandin et al, 1989)³.

Table 3 Quality of Grass

<table>
<thead>
<tr>
<th>Good grass</th>
<th>Poor grass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young</td>
<td>Mature</td>
</tr>
<tr>
<td>Rainy season</td>
<td>Dry season</td>
</tr>
<tr>
<td>Dark green colour</td>
<td>Light green or yellow colour</td>
</tr>
<tr>
<td>Mainly leaves</td>
<td>Many stems</td>
</tr>
<tr>
<td>Not flowering</td>
<td>Flowering</td>
</tr>
<tr>
<td>Very tasty, high intake</td>
<td>Less tasty, low intake</td>
</tr>
<tr>
<td>High protein and energy</td>
<td>Low protein, average energy</td>
</tr>
<tr>
<td>Covers maintenance and requirements</td>
<td>Does not cover maintenance requirements</td>
</tr>
</tbody>
</table>

Clean water for the cows

Water is essential. Without water, animals may die in a couple of days and if they cannot drink enough water, their feed intake will be reduced as well. Dairy cows need permanent access to clean and cool drinking water. If this is not possible, they should be offered drinking water at least twice a day. A 300 kg cow may drink 30 to 40 litres per day, depending on her production, water content of the roughage and climate.

Animals should always have access to plenty of water to survive. However, milk contains about 87% water too. Therefore, when the animal is not allowed to drink sufficient water, it will not be able to produce a good quantity of milk. An average cow requires about 30 litres water per day to maintain its body. This amount depends highly on the season and the prevailing temperatures. For milk production, the cow needs in addition 3 litres of water for each litre of milk it produces. In general, a farmer should plan with a requirement

of about 30 - 40 litres of water per day for one cow, depending on season, type of fodder and feed, body weight, age and milk production. When it is impossible to give cattle permanent access to water, the animals should be watered at least 2 to 3 times per day.

**Avoid** use of contaminated water, use fresh borehole or harvested-rain water. Like feeder, the water troughs must be separate for each animal to avoid contagious diseases.


C. **Proper health management and first-aid**

Regular deworming and vaccination promotes immunity and increased production of milk. The unwanted worms in the cattle stomach cause anaemia and weak health. These conditions can be fatal for the animals. In a largely pastoralist society and free mixing of large and small livestock, and wild herbivores, it is wise to keep the animal vaccinated against fatal diseases. Apart from hygiene a few things, which are required for better milk production, are

- **Deworming regularly:** Maasai farmers know about the benefits of deworming of sheep and goats; similarly, the cattle and calves need to be given commonly available dewormers available in the market for improved productivity. The common ones (Fenbendazole, Albendazole, and Ivermectin) available in Kajiado County can be purchased at any Agro-Vet shop. The most common dewormer used for calves is Piperazine Hexahydrate.

<table>
<thead>
<tr>
<th>Deworming guide</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fenbendazole</strong></td>
</tr>
<tr>
<td><strong>Albendazole</strong></td>
</tr>
</tbody>
</table>

* Broad-spectrum dewormer, also used to dispel ecto-parasites such as tick
<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivermectin</td>
<td>80 to 100 mg</td>
</tr>
<tr>
<td>Piperazine Hexahydrate (for calves)</td>
<td>15 ml for less than one month old calf, and 30 ml for one month to 1 year old calf</td>
</tr>
</tbody>
</table>

* With inputs from Dr. Mahesh Ch. Sharma, Veterinary Surgeon, Government of Rajasthan, India

- **Caution!** Never use Albendazole for the pregnant animals; it can result in stillbirth or death of the foetus. The dewormer should be given at an interval of every 3 months for both large animals and calves.

- Consult the local veterinarian for existing contagious diseases and time for vaccination and the schedule. This reduces the mortality and increase profitability in cattle rearing. The most common highly contagious diseases are Food and Mouth Disease (FMD), Black Quarter (BQ), and Haemorrhagic septicaemia (HS) among others.

**First-aid**

- For treating common wounds and scratches, use common antiseptic like Dettol. A solution made with Potassium Permanganate (KMnO₄) and water is a cheap and effective alternative.
- Use cooking soda mixed with water to treat bloat
- If an animal has pain and has a fever, give normal Paracetamol bolus available for livestock in an Agro-vet store.

**Reducing calf mortality**

- Ensure colostrum (first milk after birth) feeding to newborn to increase immunity.
- Disinfect umbilical cord immediately after birth with an iodine solution to avoid infection.

**Always!** Consult a qualified veterinarian for medication.
**Milking a cow**

- Always wash hands before milking the cow.
- Clean udder with warm water and dry with a clean piece of cloth.
- Use full-hand method for milking. Milk into a clean container by squeezing (not pulling) the teats with clean hands.
- The container should be clean for collection of milk.

**Common issues with cows**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin animals, Slow-growing calves</td>
<td>Worms</td>
<td>Deworm animals as recommended. Ask the local veterinary officer, which dewormers to use and follow manufacturer’s instructions carefully.</td>
</tr>
<tr>
<td>Inflamed udder (mastitis)</td>
<td>Unhygienic and incorrect milking practices</td>
<td>Follow recommended milking practices</td>
</tr>
<tr>
<td>External parasites</td>
<td>Fleas, ticks, mites and lice</td>
<td>Use recommended sprays, and powders, Put lime powder on the cattle paddock.</td>
</tr>
<tr>
<td>Low milk production</td>
<td>Inadequate feed</td>
<td>Ensure you are feeding sufficient forage and supplements for the level of production</td>
</tr>
</tbody>
</table>
D. Establish sources of fodder for supplementation during the dry spells

Issue of fodder during the dry spells

Rearing cattle is the mainstay of Maasai pastoralist systems and source of employment in rural areas for centuries. While the animals are, free grazing in the Savannah grasslands of the Central Rift Valley. There is no alternative system for the farmers to augment the shortage of fodder and water during the dry months, and result for about 10% mortality of a herd. Low rainfall during recent years has caused fodder shortage leading to less milk production. Moreover, land fragmentation has led to less land availability per farmer that adversely affected cattle rearing and management.

The 5% model

The 5% model, advocated by PRADAN\(^5\), is a practical alternative in such a context. The 5% model is essentially pro-poor in nature, and suited to meet the needs of small and marginal farmers in the upper reaches. The water harvesting structure localizes water availability to meet the individual farmer’s needs and, when undertaken in large numbers, improves the soil and moisture regime of a landscape. In the 5% model, a farmer in the uplands/ midlands is advised to allocate at least 5% of his/her total landholding for the construction of a Water Harvesting Tank (here after WHS). A WHS is technically suited for terrains in which the land slope is under 15%. This assured, it hardly matters if the farmer allocates the most degraded part of his/her plot for the WHS. A WHS is usually 3 to 3.7 m deep and ideally 15 m by 12 m in length and breadth. However, the length and width varies in proportion to the total landholding of the farmers—7 m by 9 m and 12 m by 11m are some of the other dimensions adopted where the landholdings are small.

A WHS is a soil-excavated structure and does not have any cement work or stone revetment. This makes the design easily achievable, within the limited capacities/resources of the local farmers. The sides of a WHS are stepped in a manner to ensure a slope of 1:1. The steps make it easier for both livestock and humans to access the water of the WHS once it recedes in summer.

\(^5\) [http://pradan.net](http://pradan.net)
E. Intention
The last and most important thing has to have an intention to succeed in life. Do good work and get rewarded.
5. Indian innovation on rainwater harvesting and fodder production

Taking cue from the 5% model an Indian innovation in Natural Resource Management for harvesting rainwater, demonstration fodder paddocks of 5 acres’ area (20,000 m²) have been constructed in several places of Kajiado County. The paddocks have in-situ soil and rainwater conservation by systematic land treatment based on the 5% model, which would utilise the moisture for cultivation of fodder crops as well as fodder trees. It would help feed at least 10 milch and pregnant cows, improving the milk yield and income for the farmers, apart from providing drinking water for the animals.

A. The Design Principle behind the intervention:

The core principle behind the design was to develop a paddock over approximately 10 acres of land which can address adequate water and nutrition requirement of 10 milch cows during the stress months. The template was designed so that it can be used on a modular manner to accommodate more number of animals by increasing the size of the paddock or vice versa.

### Nutrition Demand in 1 paddock for 10 cows

<table>
<thead>
<tr>
<th>10 cows demand on 10 acre paddock for maintenance</th>
<th>ENERGY REQUIREMENTS MJ ME/DAY</th>
<th>PROTEIN REQUIREMENTS KG CP/DAY</th>
<th>ENERGY REQUIREMENTS MJ ME/Year</th>
<th>PROTEIN REQUIREMENTS KG CP/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>In terms of DM in kg</td>
<td>216</td>
<td>2.88</td>
<td>126,200</td>
<td>3,051</td>
</tr>
<tr>
<td>Availability from grasses supplying that DM @ 7%</td>
<td>31.5</td>
<td>2.2</td>
<td>11,481</td>
<td>804</td>
</tr>
<tr>
<td>In terms of DM in kg</td>
<td>3.5</td>
<td>2.2</td>
<td>11,481</td>
<td>804</td>
</tr>
</tbody>
</table>

Additional ration for milk (each cow yielding 5 kg/day)

| 24%                                              | 4.05                         | 89,425                         | 1,478                         |
| In terms of DM in kg                              | 27.3                         | 1.6                            | 8,130                         | 569                            |
| Availability from grasses supplying that DM @ 7% | 1.5                          | 8,130                          | 569                            |

So, total fodder production demand (DM) for maintenance + Milk

| 19.610                                           | 1,157                        |

So per hectare fodder production demand (DM)

| 4,902.61                                         |

Additional protein reqd.

**Note:**
- The dry cows also need feeding to make those productive in time; having similar demand thereby doubling the demand.
- In addition there will be additional demand for Milk production. (As DCP is much low in grasses and need supplements with legumes / concentrates)
Based on the above mentioned design principle, calculations as well as the field conditions the following design was finalised.

<table>
<thead>
<tr>
<th>Drinking water demand on for 100 cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Free water intake</strong></td>
</tr>
<tr>
<td>FWI (in Litre) =</td>
</tr>
<tr>
<td>Demand for water in litre / cattle / day with DMI 8 kg &amp; yielding 5 lit milk/day</td>
</tr>
<tr>
<td>Thus annual demand for 100 cattle (in cubic metres)</td>
</tr>
</tbody>
</table>

5 acre paddock = 20,000 sq. meter = 110 m x 185 m

- Run off collection pits (12 m x 3 m x 1 m)
- Field bunds / embankment
- Fencing and plantation
- Field bund / embankment
- Fodder trees at with a plant to plant spacing of 3 m (pit size 45 cm x 45 cm x 45 cm)
B. Salient features of the innovation

- In-situ water conservation on the slope of the flow of rainwater, capable of storing about 0.5 – 0.80 million litres of water.
- The small ponds cover 5% of the paddock (of the 5-acre area); the stored water/moisture can be used in dry spells to help cultivate fodder crops.

Steps of the pilot explained

1. The level of engagement at the beneficiary level happens at several steps, besides the pre-scheduled trainings:
2. Site selection — This is done in based on the slope of land, soil depth, density of forest cover, catchment area, proximity to house and experiences of the household members concerned regarding the water flow etc.
3. Family interaction — This is essential to clarify roles as what HH is expected to do and what agency will do, what will be their contributions, engagements and outcomes
4. Clearing of the land of bushes, dead roots at least before ploughing
5. Setting up fence using locally available materials or wire fencing if family can afford,
6. Family interaction — a second round of such an activity is recommended after ploughing to ensure the beneficiary is not the lone person from the family when it comes to learning about sowing and putting in some labour
7. Sowing
8. Digging of pits, arranging water and human resource and plantation of fodder tree by HH
9. Harvesting and storing
10. Annual maintenance

C. Selection of the site for paddock

As explained earlier, the field should have a gentle slope, it is better if the site has less number of trees, as it would not be required to clear those during construction of the site. The site should have some free space even after the mandated cross section of 110 metres to 185 metres (which is near about 5 acres of area). The paddock should be laid out along the slope, i.e. where the water flows.

Understand! We need to collect the rainwater along the slope; therefore, the length of 185 m should be along the slope and not across the slope.
6. How to create such a paddock?

A. Slope, Site Mapping and Water Structures

Marking straight lines of 185 metres length and 110 metre width

In order to create such a paddock we need to understand what is slope. Slope, is nothing but the direction of water flow, from the upward side to the downward direction. Observe the direction when the water flows.

**Caution!** A field can have many different slopes. It is wiser to construct the paddock in fields, which have one or two slopes and not more than that. If there are more slopes, the design is tricky, what we need is ease of operation.

In the field, take a cross section of 110 metres to 185 metres.

**Always** keep the width of 110 metres and a length of 185 metres. Mark this by rope, and if needed use of a rectangular shape (can be a local wooden stick made device of one metre length) to arrive at 90° angles at the edges. While making a straight-line, put ash or lime powder to mark.
Along the length of the paddock, mark an interval of 40 meters, find the exact opposite points at both ends of the paddock and join them. Mark with ash or lime.

Making a right angle at the paddock

A micro pond with bund and middle markings
Contour reduces the speed of rainwater

Along these straight lines along the width, mark the middle point, with a straight line of lime powder or ash.

Along the two halves, make two micro ponds (i.e. 4 micro ponds in a row with dimensions of 12 meters length, 3 metres in width, and 1 metres of depth). At the interval of 40 metres, make four micro ponds on a line. The paddock thus had 16 micro ponds micro pond. The micro pond should be constructed near the flow of water (where there is marked line, where water generally passes through); this ensures maximum capture of water.
The excavated soil should be put across the slope along width of the paddock, which should be 1 metre high and about 2.5 metres wide at the base; the width at the top of the bund is about 45 cms. Try to maintain a straight line of such bund, along the paddock width.

In-situ water conservation on the slope of the flow of rainwater is capable of storing about 0.8 million litres of water (~0.6 million litres of water in 16 micro ponds of 36 cubic metre capacities; along with the bunds created across the slopes of 100 m length).

**Remember:** If the slope is too high and velocity of water is high, consider digging a trench across the width of the paddock of 1 m width and 1 m depth before starting of fodder paddock on upper side. The construction can be done with machines or use of shovels and spades.

After construction of the paddocks, clean the paddock by removal of stones, shrubs; however, do not destroy big trees.

**B. Fencing**

The paddock after layout, should be fenced with use of local material such as tree branches, bushes, or live fencing with planting of trees. One farmer may chose to use barbed wire to ensure zero grazing inside the fodder. The fodder harvested from the paddock must be used by chopping and with stallfed condition.
C. Ploughing

In order to do fodder cultivation, the paddock must be ploughed with disc harrow. A tractor with the plough can be used to make furrows of about 1 m to 1.5 m width across the slope and along the contours is better. A strip of 2 m width in between the furrows must be left unploughed, as that would be used for re-growth of the local grasses.
**D. Sowing legume crops for fodder**

Across the paddock, plough the soil and make furrows of 2 metres width by disc plough while leaving one row after each row of ploughing. The cultivated furrows have a length of 100 m and width of 2 m in the paddock.
Seeds of legume plants, i.e. pigeon pea and cowpea can be procured from the market (some sellers are KALRO, Kenya seeds among others).

The seed sowing can be done with dibblers or *Panga* (machete) by making a hole in the soil and putting the seed at a depth of 5 to 6 cms. Put only one each seed per hole and cover with soil after putting the seed. It is wiser to put cow dung or goat droppings on the soil for better nutrient availability and fodder production. Hands must be cleaned while putting the seeds, as those are primed and might contain poison.

Two consecutive rows of cowpea (with a plant-to-plant spacing of ~30 cm) are followed by a single row of pigeon pea (with a plant-to-plant spacing of 1 m). This enumerates to about 18,400 cowpea plants and about 4800 pigeon pea plants. Uncultivated strips in between are left out for regrowth of indigenous local grass. The paddock should be fenced to ward off grazing animals and protect the fodder plants.
Legume plants provide protein, energy and minerals, to enhance milk production for 5 - 10 milch animals, and even supplement fodder during the drier months.

The legumes would supplement fodder during the dry months.

Apply manure at the beginning of the long rains every year.

As a feed for livestock, the green leaves can be plucked regularly or the whole crop can be harvested when the pods are green. The complete plant can be incorporated in silage or be dried as hay. The seeds can be dried, ground, and fed as a meal. In addition, pods can be fed completely, either fresh or dried. Cowpea is an excellent fodder crop for smallholder dairy farmers.
E. Planting the fodder trees

Across the boundary of the paddock Blackthorn, tree (Oiti) to be planted along with proper fencing to avoid grazing of animals. The other fodder plants Mulberry (Ndare), Chinaberry (Morbaini), and Leucanea (Mtini) can be planted in rows with single specie on a row or can
be mixed. The distance to be maintained for plant to plant should be 3 metres. Total trees planted are 600 in number (150 from each species). The saplings can be procured from Thika or nearby horticultural nurseries.

A hole should be dug at with dimension of 45 cm depth, 45 cm length and 45 cm width (45 cm x 45cm x 45cm). It can be done with shovel and spade. Carefully remove the plastic outer cover with a sharp object such as a blade, be careful, to not break the stem of the plant. Place it in the middle of the hole, cover it with soil, leave some space, so that water can be accumulated and the plant can be irrigated during the dry period. In the absence of rains, water the plants every week in case of small plants below the height of one foot (a litre of water is enough). Provide water to bigger plants every fortnight.

- Trees provide essential nutrients, such as protein, energy and minerals, to support milk production.
- With deep roots can withstand longer dry spells.
**Remember**  The sowing and planting must be completed before the start of the rains, ideally 7 days before the rains. Putting manure over the already established plant before the plants enhances the growth of the plant.

**How to manage fodder trees?**
- Harvest trees at a uniform height of about 1 meter (3ft) using a sharp machete (*Panga*) or a sickle.
- Harvest trees every 10 - 12 weeks, i.e. 4 - 5 cuttings in a year.
- Cut the plants back to about 15 cm (6 inches) after 6-7 years to promote new growth.
- Apply manure using a 1 kg per tree at the beginning of the long rains every year.

**Other benefits of planting fodder trees**
- When eaten by livestock, these produce good manure.
- Provide stakes for supporting vegetable crops, like tomato and beans
- Provide forage for bees to make honey
- Source of good firewood
- The fallen leaves and roots improve the soil
- Mark boundaries and provide privacy Prevent soil erosion

**It can support 5 to 10 milch animals**

By these interventions, 6 months of fodder scarcity would be tackled; nutritious fodder would be provided for the cattle.
F. Annual Maintenance
The structure requires minimal maintenance, and ideally needs to be started 2 years after construction. The first 2 years the soil needs to settle down and compact properly. Allowing a good grass cover to build also increases the soil retention largely. After that only desiltation is required every year before rains arrive. It is a simple process and can be done manually. This will improve the soil nutrition. However, de-silting of ponds and bunds repairing may need to be done if require as and when especially on sites having loose soils and more runoffs.

There is also a need to check the condition of the fencing, as the probability of wild animals making a beeline for the water pits and fodder crops are very high.

7. Partners
Ashwattha Advisors Pvt Ltd (AAPL)
AAPL partners with international development organizations and grant-making foundations to execute large-scale, multi-year programs, with staff deployed at the frontlines. It also is associated with multinational and Indian firms to directly implement customized Corporate Social Responsibility (CSR) programmes based on our core areas of expertise, which are

1. **Strengthen Value Chains**: enable smallholder farmers to grow high-value products, engage with private-sector companies, and sell to profitable markets.

2. **Foster Skills Development and Entrepreneurship**: provide business training and skills development to people in poor communities who want to create sustainable enterprises.

3. **Promote Sustainable Local Economic Development**: increase incomes in target communities and in turn further catalyze economic and social development.

4. **Support Gender-Inclusive Communities**: integrate custom support for women into our programs to expand their capacity and opportunity for sustainable livelihoods

In 2014, the USAID funded an innovation transfer programme from India to Africa in agriculture and natural resource management (NRM) as part of the US Government’s Feed the Future initiative to improve food security in Kenya. Spearheading the program,
Ashwattha Advisors Private Limited (AAPL), launched this fodder pilot initiative in Kajiado County.

**TechnoServe (Kenya)**
TechnoServe (Kenya) has been working with the Kajiado women’s dairy since 2011 and has been helping them strengthen their services for the members. They have implemented fodder cultivation programs in other ASALs in Kenya. In this program, the organization provided support during implementation and training.

**Outliers Development Services**
This is a consortium of experts with decades of experience in fodder management and other aspects related to dairy sector. The team members have worked extensively with smallholder dairy to improve the backward and forward linkages and introducing better management practices in dairy management. Acting as the Indian Knowledge Partner, this organization assessed the existing challenges in fodder cultivation and management in Kenya, and worked alongside TechnoServe (India) in designing an intervention suitable in the local context. It was also involved in meeting local agricultural experts to select the most suitable crops. It was also part of the team overseeing the construction of the water conservation structures, the planting and harvesting. The team also suggested broader cattle management practices.