

*REF: ENHANCING BELIZE RESILIENCE TO ADAPT TO
THE EFFECTS OF CLIMATE CHANGE*

HOW TO IMPROVE THE FEEDING METHODS OF OUR LIVESTOCK...

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...MAINTAINING A WELL BALANCED ANIMAL NUTRITION!!

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The purpose of this guide

This guide contains important aspects which are necessary to be considered when establishing protein banks, improved pasture, improved ponds and energy banks or to successfully prepare silage and multi-nutritional blocks. Also for the purpose of guaranteeing and improving the feeding program for cattle during the entire year, especially in critical periods such as the rainy season or dry season.

The purpose of this guide is to remind cattle producers the most important points and steps, at the time of implementing or putting into practice the techniques that were dealt with during the capacity building sessions as part of the project: Participatory Training of Cattle Producers of the Belize District in Preparation for Extreme Weather Events.

The importance of having a good feeding regime for livestock

What does a livestock farmer/rancher desires when he wants to improve the genetics of his cattle? Possibly the production of more meat or milk and maybe he is not satisfied with what he is producing. However, improved genetics requires better management or improve the nutrition among other things. Therefore, should he be aiming to improve genetics or first of all, he should observe what he has, the condition of what he has and how much he has? It is therefore from these observations that he will be able to find the best way of improving production.

The nutrition of cattle here in Belize is based mainly on pasture, given that most of these are degraded or in the process of deterioration. Such situation affects the productivity of cattle, in return affecting negatively the family livelihood and the environment. In recent years this situation has been compounded due to variations in the climate, some which are much more intense and critical in certain seasons of the year. Climatic variations can be evident in such a short period but of course we can adapt ourselves to produce better under those conditions. The major impact of these climatic changes is reflected on the nutrition of the cattle, especially when the nutrition of the animal is solely dependent on grass or pasture.



Degraded Natural Pasture – feed is insufficient & not adequate



Degraded Pasture – competition from weed, broad leaf vegetation

The flooded or dry area in the first instance affects the pasture directly which then affects the cattle and consequently affecting the family income. However, in order to be better prepared, it is necessary to be knowledgeable in a few principles of animal nutrition.

The first step is to observe the condition of the animal, not from the health standpoint but whether the animal is comfortable, in good, regular or bad condition which can be the equivalent of fat, lean or regular.

The nutritional requirements of cattle

The cow/cattle needs nutrients such as **water, protein, energy, minerals** and **vitamins** in order to grow, produce milk or meat, reproduce, carry out physical activity and maintain itself in good condition regardless which season of the year. Therefore, questions to be considered, that can help to improve the situation are the following:

1. Is the cow receiving the quantity and quality of nutrients with what it is eating?
2. How can these elements be given to the cow?
3. Which feed are available in the farm during the rainy season?
4. Which feed is available in the farm during the dry season?
5. How can this feed be combined to improve the condition of the cow?

The following techniques presented will focus in providing the first 4 elements listed. Why have protein banks on the farm?

Feeding adequate forage and supplement will increase productivity



Improved Pasture Grass



Supplemental Feed – Energy & Protein

The cow can eat of everything but not everything is the best that the animal can eat. Before answering the question, what should the cow eat; ask yourself, **why do I have cattle?** The answer could be, because you like to have animals or because it is a means of generating income. If the latter is closer to your answer, you therefore should carefully review what the cow is eating and what it should eat so that you can accomplish your objective of generating profits.

Benefits of having protein banks - legumes



Harvesting Leucaena – Protein rich diet, up to 20 – 24% Crude Protein



Legume Root Nodules – Bacterial Symbiosis to convert Nitrogen into protein rich foliage

Protein rich leguminous plants

Legumes are plants with a higher concentration of protein in the leaves much more than grass. The reason is that these plants have small nodules on the roots in which bacteria live. These bacteria have the ability of trapping free nitrogen from the air and transfer it to the plant which uses it to produce protein.

Advantages of planting legumes

Among the forage type leguminous plants, a few grow trailing on the surface such as the forage peanuts (*Arachis pintoi*) and others are the shrub type legume (Eg. *Leucaena*). The shrub type legumes have the advantage of a deep root system which allows it to thrive well even in the dry season, though not as fast as in the rainy season.

When the cow consumes legumes, its diet contains a higher percentage of protein much more than when it eats only grass. For this reason the cow can produce more milk and meat.

3 types of protein banks in cattle rearing

1. Plant the shrub type legumes (eg. *Leucaena*) in rows at a distance of 5 feet apart; cut the leaves and thin branches 2 to 4 times per year. These are then chopped or shredded into small pieces and given to the cattle in feeding troughs solely or mixed with grass (cut and carry type, eg. Taiwan, Cameroon or Maralfalfa). This type is called: **protein banks for cut and carry**.
2. Plant the shrub type legume in rows at a distance of 6 feet apart and allow the animals to enter and feed on the leaves of the legumes for 3 – 4 hours daily for 5 days consecutively. This type of planting is called: **protein banks for grazing or browsing**.
3. Plant the shrub type legume in rows at a distance of 10 to 20 feet apart. Once these legumes have reached a height of 3 feet or more, an improved pasture grass variety or cultivar is planted between the rows but combined with the forage type peanuts (*Arachis pinto*). In this type of planting system the cattle can graze for the entire day and this type of planting is called: **legumes in alley with pasture**.



Foto 23. *Leucaena leucocephala* lista para ser pastoreada



Leucaena

2 – Legume & Grass

3 - Legumes in alley
with grass & Arachis

Leguminous and non-leguminous species that can be used

In Central America there are experiences with species such as Madre Cacao (Gliricidia sepium), Leucaena (Leucaena leucocephala), Ramon (Brosimum alicastrum), and Pito (Erythrina spp).



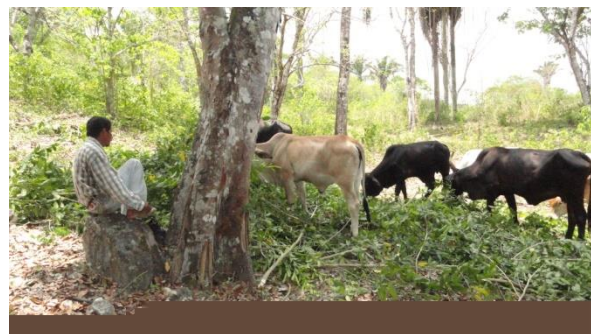
Madre Cacao Plant - flowering



Ramon or Wild Breadnut Field – 3 yrs.



Cattle Feeding on Leucaena leaves



Cattle Feeding on Ramon leaves

Each farmer should select a shrub type legume which thrives well in this climate and the soil type, and one which will serve the management he intends to practice. Before planting it is recommended that each farmer should consult with other farmers or technician to verify experiences within the area or even visit existing plots.

It is also important to consider the following:

1. None of the shrub type legume thrives well in water logged soils, though the Erythrina (Pito) and Madre Cacao can withstand poorly drained soils to a certain degree, once established.
2. Leucaena does not thrive well in excessively wet or flooded areas.
3. Erythrina (Pito) does not grow in extremely dry areas.
4. Leucaena and Erythrina (Pito) can withstand grazing or browsing but Madre cacao does not because the limbs or branches break off easily.
5. Erythrina (Pito) is not recommended for the "cut and carry" system because the branches are too woody and has spines (prickle).
6. It is not recommended that animals less than 6 months old consume large amounts of Leucaena leaves because the rumen (stomach) is not well developed as yet and cannot digest the leaves properly.

The establishment of protein banks or the system legumes in alley with grass

Establishing banks – seeds and vegetative cuttings

Generally it is recommended that the protein bank be established with seeds because plants germinating/sprouting from seeds, normally and in general have a deep root system. However, in areas where the dry season is not too severe and has deep top soil, Madre cacao and Erythrina (Pito) can be planted with vegetative cuttings. The advantage of planting with vegetative cuttings is that the initial growth of the plants is a bit more rapid.

Scarifying seeds to enhance germination

Seeds can be soaked in water at normal temperature for 1 day. Leucaena seeds can be dipped in boiling or hot water for 3 minutes prior to planting, a process called "scarification".

Evaluating seed quality

Placing seeds in water will allow non-viable seeds to float after 15 minutes. After which the seeds that sink to the bottom is taken and a germination test is carried out. Use the following procedure: take 100 seeds and plant into a seed tray or box and at 10 – 15 days count how many have germinated, ensuring or considering the following:

1. Less than 40 seeds germinated means the seed is of bad quality.
2. More than 70 seeds germinated are indicative of good seeds.



Germination test – wet paper towel



Germination test – seed tray

Other Germination Test Procedures – testing for viability of seeds



(Ensure that the seed tray or box is always moist but not excessively wet).

Recommended methods of planting – in a nursery or direct

It is almost always cheaper to plant the seeds direct but the weather is not easily predictable hence the issue of having to be prepared for replanting. When the seeds are of a regular quality, have limited seeds or when the rain is quite irregular then it is worth making a seed nursery.

Selecting vegetative cuttings for planting

1. These should have between 1.5 – 2 inches thickness.
2. The cuttings should be strait.
3. They should not have damaged bark or cortex (woody part).
4. Do not hammer on the ends of the cuttings so as not to damage it.
5. Some cuttings such as Madre cacao should be left standing and making contact with the ground for at least 1 – 2 weeks before planting.

Recommended plant spacing

1. In the “cut and carry” protein banks, 3 to 5 feet spacing should be left between rows and 1 to 1.5 feet between plants.
2. In protein banks for “grazing”, 3 to 5 feet spacing should be left between rows so that the animals have more space to move around.
3. If grass is to be planted between the rows of “shrub type legumes”, a spacing of 10 to 12 feet should be left between the rows and 1 to 2 feet between plants.

Alley Cropping – Leucaena & Grass



Foto 11. Leucaena leucocephala sembrada a 75 cm como banco

Plant Spacing – Weed Control in Protein Bank



Source: Manual de manejo agronómico de Leucaena leucocephala, (Fundación PRODUCE), Michoacán por Francisco Javier Solorio Sánchez y Baldomero Solorio Sánchez – Morelia Michoacán, Mayo 2008.

Caring for the immature (young) plants

1. Since young plants grow slowly, weeds are the main competitors. For this reason the land should be cleaned properly before and after planting so as to have good control of the weeds that will germinate or emerge.
2. To reduce the cost of cleaning during the first year, the land can be utilized to plant grains (corn or beans), as long as these do not interfere with the growth of the plants.
3. For the plants to grow faster, it is recommended to apply either manure or fertilizer when the plantlets (young plants) have a height of 15 to 20 centimeters (6 to 8 inches) and a second application when the plants are about 1 foot in height. For each plant, 2 handfuls of dry manure (cattle) should be applied about inches away from the base of the plantlet. The other option is to apply commercial fertilizer (complete formula) such as NPK – 10-30-10 or 15-15-15; a soft drink cap full for each plant is placed or planted about 3 inches away from the base.

4. There are various pests and diseases that affect the plantlets such as crickets, leaf cutter ants (wee wee), worms, etc. The plot (protein bank) should be observed a number of times during the week, in the early morning or late in the evening and take the necessary measures if any pest is affecting various plants.

The management of protein banks for grazing in alley type systems (legumes in alley with grass or pasture)

Preparing for initial grazing

The cattle can enter or graze when the legumes have reached a height of at least 5 to 6 feet and when the stems have a thickness of at least 1 inch at a height of 1 foot off the ground.

Recommended methods for the use of protein banks

The cattle should be taken out whenever they have grazed on all the leaves of the shrub type legume. Never allow more than 5 days of grazing so as to avoid or prevent the animals from grazing on the new or fresh sprouts. The **resting period for the protein banks** depends on the growth rate of the legumes; for this reason, sometimes it can be for **1 month** and at other times it can be 2 months or more. But the animals should never be allowed to enter the area if the legume does not have enough foliage or leaves.

Prune legumes if necessary

When the protein banks are used appropriately, pruning of the legumes is hardly necessary. If after the cattle have grazed and several branches with leaves have not been consumed then it is recommended that you prune the shrubs at a height of 1 to 2 feet. After pruning, the legume needs a long resting period so that the plant regenerates or produces new sprouts.

Fertilizing with manure or commercial fertilizer

When the protein bank is used just for a few hours per day, there is need to **fertilize it every year** so as to replace the nutrients that have been used. This is the only way in which the productivity of the protein bank can be maintained. Because the farmer needs to remember that with this type of management, the cattle replace very few nutrients through the droppings of feces (manure) and urine on the same site.

For most soil types, it is recommended that **50 bags (30 to 35 lbs. bag)** of dry manure be applied every year for **each acre**. If commercial fertilizer is utilized, then it is recommended that 75 pounds of complete formula – NPK – 10-30-10 be applied for each acre. And in potassium deficient soils, also apply 50 pounds of potassium chloride – NPK – 0-0-60.

When the cattle remain for the entire day on the site, there is not much nutrient loss from the soil hence fertilizing the area once every 2 to 3 years.

REMEMBER

The establishment of a protein bank can be very successful but the management will determine its productiveness and shelf life or usefulness!

In many places, during the rainy season the production of forage is optimum, for this reason it is an opportune time to produce hay, silage, multi-nutritional block, etc., which can be useful during the dry season.

The management of protein banks for the “cut and carry” system

Timing and method of cutting

These legume shrubs can be cut between **2 to 4 times per year at a height of 2 to 3 feet** above the ground. Cutting is recommended 2 to 3 months before the dry season so that a good quality of new sprouts can be obtained. Additionally, in this manner trees such as Madre cacao will not lose its leaves naturally. Generally, 2 cuttings can be made, one at the beginning of the dry season at which time a good quantity of forage is obtained. And another at the end of the dry season, though at this time less forage is produced.

Other uses for excess material produced during the rainy season

The material or leaves harvested during the rainy season can be stored as silage in combination with grass (Taiwan, Cameroon or Maralfalfa) and then use during the dry season. It can also be left on site as a source of green manure or feed to the cattle as fresh forage.

Managing soil fertility

Every harvest (cut) extracts huge quantities of nutrients from the soil. In order to avoid draining the soil of its nutrients and the ability of the legumes to produce forage, the protein bank should be fertilized at the end of the dry season with **40 to 50 bags of dry manure per acre**. Manure can either be that of cattle, horse, sheep or chicken. If commercial or inorganic fertilizer is used, apply 125 pounds of a complete formula (NPK – 10-3-10) per acre per year. One half of this amount can be applied at the beginning of the rainy season and the other half in either October or November.

If the soil is deficient or lacking Potassium, then it is recommended that 50 pounds of additional potassium such as NPK – 0-0-60 is applied along with the NPK – 10-30-10.

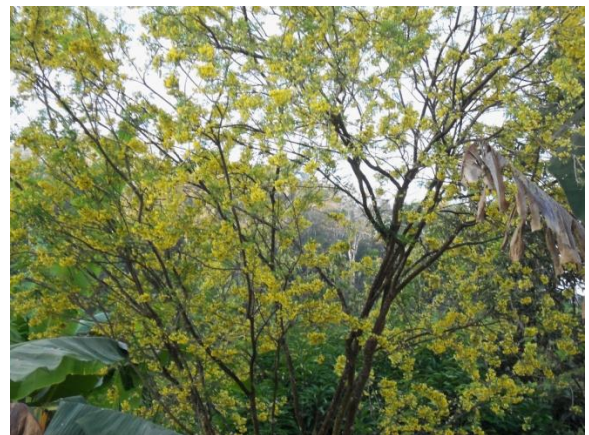
REMEMBER

A protein bank of 1 manzana (about 2 acres) for cut and carry purposes, well managed can easily produce twice as much protein than 1 acre of improved pasture. And this protein can be utilized during the dry season but can be lost in a short period if not managed properly.

Other Native Species of Forage Recommended:

1. Bay Cedar (*Guazuma ulmifolia*), also known as Pixoi or Caulote – non-leguminous. It regenerates easily after pruning. Even the seeds can be used as a source of energy in multi-nutritional blocks.
2. Wild Rue (*Diphysa carthaginensis*), tolerates both alkaline and acid soils - leguminous and can be used for “live fence”.
3. *Sesbania* spp – a leguminous shrub that tolerates excess moisture. Seen growing in wet areas of the Belize River valley and Maskall.
4. *Desmodium* spp – a leguminous shrub that tolerates both alkaline and acid soils.
5. Red Ramon (*Trophis racemosa*) – a non-leguminous medium-sized tree that regenerates after pruning and has a moderate amount of protein.

Bay Ce	Wild Rue (<i>Diphysa carthaginensis</i>), leguminous tree
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<i>Sesbania</i> spp – Annual leguminous shrub, yellow flowers
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<i>Desmodium</i> spp – Annual leguminous shrub



Madre Cacao (Gliricidia sepium)
Legume



Sources of energy for livestock

Livestock (cattle) production in Belize is based on grazing all year round. However, the majority of pastures have lost its productivity due to different reasons. Among these reasons are bad selection of pasture grass species or cultivars used, the inadequate or improper management of pastures which has contributed to low productivity and consequently a protein deficient nutrition for the cattle.

Pasture rotation is minimal due to insufficient improved pasture systems and pasture sub-divisions. This practice favors an increase in both ticks and internal worms (ecto-parasites and endo-parasites), besides the problem of overgrazing which contributes to pasture degradation and eventually soil erosion. **Rotational grazing contributes to breaking parasite life cycle.**



Overgrazing of Natural Pasture

Following are few aspects presented which can contribute to improve decision making on the farm, so as to provide the cattle with the required energy.

Selecting the best pasture for livestock

When a pasture is established it is with the intention or hope that: it thrives well, it produces sufficient feed, that it adapts well to the soil type or the climate, that it has sufficient protein, that it is appealing to the cattle, that it helps the animal produce the product we expect whether it be milk or meat, that it recovers fast, it is resistant to the dry period, likewise resistant to the pests and diseases. Whatever is expected from these pastures will depend on the soil type at the farm, the surrounding climate; the types of animals reared and even the same pasture. Considering the previous aspects, there are a few that can be modified and others in which the decision has to be adapted, for instance, the climate and the soil cannot be changed but in the case of the cow/cattle, these can be changed and to a certain degree the type of pasture. These are the factors in which efforts can be oriented so as to make a better selection.

What can we change? The following aspects are presented:

1. The land or soil
2. The climate
3. The cow/cattle
4. The pasture

It was discussed that the things which can be changed are the pasture or the animal but the soil and climate cannot be changed. (The soil can be modified but can be costly).

The following question is asked. Therefore, what should be observed first in order to select a type of pasture grass? The things that can be changed or the things which you cannot change – indeed the climate and the soil cannot be changed.

After selecting a good pasture grass, what comes to mind, before establishing a pasture? The possible or likely answers will be:

1. Soil/land preparation
2. Seed germination
3. Planting method
4. Timing or planting season
5. Weed control
6. Pest control
7. The animals
8. The age (as time goes by the pasture will become degraded – becomes less productive).

The following aspects are discussed:

Soil or land preparation:

From this moment weed control is initiated, factors that should be considered in order to accomplish good land preparation:

1. Use the adequate product; ensure complete elimination of the weed on the land.
2. Leave the area free from weed.
3. Allow the adequate time lapse after applying the herbicide so that the product takes effect.
4. Take care that improper mixtures are not made so as to avoid negative reactions from other products utilized.

Seeds

Seeds should be tested or carry out a germination test. After planting we always complain that the seeds are not good. But we never knew if the seeds were good hence it is important to carry out a germination test. The test can be carried out in the following manner:

From the seeds purchased, take 100 and place it in a seed tray or on an old newspaper or paper towel and wet it daily. Take time to check seed on a daily basis to see and count how many have germinated. Seeds that have sprouted or germinated should be taken out. After about 8 to 10 days we should be able to know whether the seeds are good; a good rule of thumb is that if more than 75 percent of the seeds germinate then it is adequate.

Treat seeds properly. If the seeds are good or viable, there is need to treat it so that insects do not damage or eat them.

A few chemical products that can be used to treat the seeds:

1. Gaucho: dosage – 2 grams per kilogram (2.2. lbs) of seeds.
2. Semevin, more or less 1/8 litre (125 cc or 8 Tablespoon or 5 Bayer cup) is enough for 6 to 12 kilograms of seed.
3. Marshal

Note: 1 Bayer cup has 25 milliliter (ml) or 25 cubic centimeter (cc). The Bayer cup holds about 1 ounce equal to 28.4 grams.

1 Tablespoon is equal to 15 ml. 2 Tablespoons is equal to 1 fluid ounce.

Planting method used.

A commonly made mistake is planting the seed excessively deep. A factor we need to consider is that a seed should be sowed or buried not more than 3 times its size. Very small seeds should be sowed on the soil rather than burying, for example, Mombaza.

Planting of seeds can be done by:

1. Broad casting or scattered with hands (not always uniform).
2. Direct planting but not too deep.
3. Use a manual planter.
4. Mechanical planter for large areas.



Broad casting & Manual planting



Using a Manual Grass Planter

The control of weed begins during planting or better said, it has to do with the amount of grass seed we use or sow per acre, hectare or manzana. Sometimes we tend to save on seeds and use less seed per acre or manzana. The result of such practice is that the seeds are scattered sparse and this allows more space for weeds to grow and prosper. The recommended quantity is to use or sow 3 to 4 kilograms (about 6.5 to 8.75 lbs) of grass seed per manzana (about 2 acres).

Pests

The most common pests that show up after establishing pastures are **“army worms”** (Spodoptera frugiperda), **“striped loopers”** (Mocis spp.) and can be controlled with either a contact or systemic insecticide recommended by any certified agro-chemical store. Other pests of concern are **“frog hoppers”** (Aeneoloma and Prosopia specie).

Source: www.daff.gld.gov.au, brookerpestcontrol.com



Army Worms



Loopers – Mocis spp



Frog Hopper - Spittlebug

A good cultural control for “frog hoppers” is to intensify grazing so grass foliage is reduced therefore allowing the entry of more sunlight and air into the pasture. Intensive grazing will also permit physical destruction of the insects by trampling. Chemical control is another option if the situation is serious and critical but animals will not be able to graze the pasture for a number of weeks.

The age or maturity of the pasture

We are aware that most of the time, after a certain period the pasture does not remain the same; it deteriorates because the soil becomes nutrient poor. One way in which this can be avoided is to frequently apply commercial fertilizer but this of course has a high cost. The other method is to incorporate a legume into the pasture, for instance, forage-type peanuts (*Arachis pintoi*).

In this case other legumes types can be used, such as:

1. Stilozanthes, which does not survive in poorly drained soils or where water logged soils.
2. Calopogonium: this one survives in wet areas.
3. Perrenial Soy bean: requires fertile soil and are not water logged.
4. Kudzu.
5. *Arachis pintoi* (forage-type peanuts): this can tolerate water logged and sandy soil.

The animals

In many occasion we achieve good planting and pasture establishment but due to negligence the animals enter newly established paddocks, enter on their own or we allow them to graze before the

grass is mature enough. The end result is that the animals damage the newly established pasture and recovery can be impossible.

One way to know whether the pasture is ready for grazing is by grabbing a bunch and pulling hard. If only the leaves break off then it is good but if it roots out, the grass is not ready and requires more time to mature. Usually good establishment can be achieved at about 3 to 4 months after planting. The first grazing should be quick and careful not to overload with animals.

Characteristics of the pasture

Now let us look at the characteristics of a few pasture grasses and what they require for good development.



Cameroon & Taiwan Grass



Caiman Grass - Brachiaria



Brachiaria humidicola cv Llanero



Mombasa – Panicum maximum

Note:

1. **Caiman grass** tolerates acid soils such as pine ridge soil with low fertility and can survive in water logged areas.
2. **Dictyoneura grass** survives in soils with low to medium fertility, fire tolerant and can cope with short lived flooding.
3. **Cameroon and Taiwan grass** does not tolerate water logged areas for too long and is mostly used as a source of non-leguminous protein bank but can be combined with other legumes.

4. **Mombasa grass** prefers well drained soil with medium to high fertility. It is fire tolerant but does not survive in water logged area.

5. **Brachiaria decumbens** tolerates soil with low fertility but cannot cope with water logged areas. It tolerates fire but it can be affected by “frog hoppers”.

Legumes:

1. **Kudzu (*Pueraria phaseoloides*)** require soils with medium to high fertility, has up to 23% crude protein and can be used as a cover crop, pasture and protein bank.
2. **Calopogonium (*Calopogonium muconoides*)** tolerates soils with low fertility, resists dry season; has between 16 – 20% of protein in dry matter and can be utilized as pasture, hay and green manure.
3. **Forage - type peanuts (*Arachis pinto*)** has optimum development capabilities in diverse soil types including sand and clay texture with high or low fertility. It has between 15 – 22% crude-protein and can replace 60 to 150 kilograms of nitrogen per hectare per annum.

The following tables are presented, with details of the characteristics of the different grass species or cultivars:

Adaptation of different pasture grass species and *Arachis pintoi* to a few site characteristics and tolerance to a few pests and diseases

Common Name	Scientific Name	Growth				Disease tolerance related to periods of high humidity	Tolerance to Frog Hopper (<i>Aeneloamia</i> spp. y <i>Prosopia</i> spp.)
		Dry Season	Poorly drained soils	Acid Soils	Nutrient poor soils		
Marandú	<i>Brachiara brizanta</i>	Good	Bad	Regular	Regular	Medium	Very high and resistant
Toledo	<i>Brachiara brizanta</i>	Good	Regular	Regular to Good	Regular	High	High to medium
Decumbens	<i>Brizanta decumbens</i>	Regular	Bad	Good	Regular to Good	Medium	Very low
Mulato	<i>Brachiara híbrido</i>	Regular	Bad	Regular	Bad	Low	High
Tanner	<i>Brachiara arrecta</i>	Bad	Very Good	Bad	Regular	High	Medium
Braquipara o Para Caribe	<i>Brachiara spp.</i>	Regular	Regular to Good	Bad	Regular	Low	Low
Star grass	<i>Cynodon nlemfuensis</i>	Good	Bad	Bad	Regular	Medium	Low
Angleton	<i>Dichanthium aristatum</i>	Bad	Regular to Good	Bad	Regular	Medium	Very low
Swasi	<i>Digitaria swasilandensis</i>	Regular	Regular	Bad	Bad	High	Low
Alemán	<i>Echinochloa polistchya</i>	Bad	Very Good	Bad	Regular	High	Medium
Jaragua	<i>Hyparhenia rufa</i>	Regular	Bad	Bad	Regular	Medium	Low
Retana	<i>Ischaemum indicum</i>	Bad	Regular to Good	Good	Good	Medium	Very low

Guinea o Asia, Tanzania y Mombasa	<i>Panicum maximum</i>	Regular	Bad	Regular	Bad	High	Low
Common grass	<i>Paspalum notatum</i>	Bad	Bad	Regular	Regular to Good	High	Medium
Sour grass	<i>Paspalum conjugatum</i>	Bad	Regular	Regular	Regular to Good	High	Medium
Forage peanuts	<i>Arachis pintoi</i>	Regular	Regular to Good	Regular to Good	Regular	High	Does not attack this peanuts

Source: Serie técnico. Manual técnico No. 82. La Siembra de Pastos Asociados con Maní Forrajero (*Arachis pintoi*).
 Andreas Nieuwenhuysen (et al.) 1 ed. Managua, NI: CATIE, 2008.
 Proyecto CATIE – Noruega/Pasturas Degradadas.

Establishment of pasture grass combined with forage type peanuts (*Arachis pintoi*).

One method of increasing the amount of nitrogen in the pasture is by combining pasture grass with a forage type legume. Among the leguminous plants which cattle like to eat, there is a forage type peanuts called *Arachis pintoi* that stands out.

The importance of planting pasture grass with *Arachis pintoi*

1. The protein content of natural pasture grass is low.
2. When the forage type peanuts is planted in combination with pasture grass, the nitrogen within the *Arachis pintoi* functions as a fertilizer for the pasture. For this reason, the pasture recovers quickly after grazing and can sustain more animals in the pasture.
3. When the cattle feed on pasture grass and *Arachis pintoi*, its diet contains more protein rather than just grass. That is why the cattle can produce more milk and meat.
4. The grass and the peanuts compete for light, water and the nutrients in the soil. For this reason, less space and opportunity is allowed for weed to grow.

Planting *Arachis pintoi* in combination with grass

1. The peanuts can be planted together with the grass in newly established pasture with seeds or by using vegetative cuttings (branches). Whenever vegetative cuttings are used, these should be mature enough.
2. It is recommended that the peanuts be planted at a distance of 2 to 3 feet square.
3. In order to obtain sufficient peanut vegetative cutting, it is recommended that each farmer establish his or her own seed bank.
4. To establish a pasture in combination with *Arachis* and grass manually, will cost anywhere between 3 to 4 days wage more per acre, rather than planting a new pasture with grass alone. If there is machinery, the peanuts can be planted by using a harrow on mechanized land.

Planting *Arachis pintoi* in a pasture with grass

1. A few months before planting the peanuts, the weeds are eliminated completely.
2. A few days before planting the peanuts, the pasture should be grazed heavily (allow a lot of animals in the area or allow the animals to remain for a long period in the pasture).
3. If the pasture grass is a surface runner (eg. African Star); it is recommended that herbicide be applied in strips of 2 feet wide spaced at 3 feet distance.

4. If the pasture grass grows in separate stands or clumps (eg. Mombaza); the peanuts are planted in the empty spaces between the stands where no grass has grown.
5. The pasture is then left to rest for at least 2 months so that the peanuts can make a good establishment.

Managing a pasture combined with the peanuts (*Arachis pinto*)

1. In pastures that have separate grass stands such as Mombaza or Tanzania, the first grazing should be before the grass produces seeds, otherwise the shade from these tall grasses can out-compete the peanuts and eliminate it. The grass along the rows of peanuts should be pruned at the top whenever it has reached a height of 2 to 3 feet which will allow sunlight to reach the plants.
2. In pasture with surface runner type grass such as African Star or Decumbens; do not allow the newly established grass to form a thick mat but prune just after the grass starts to close in towards the rows of peanuts.

In order to maintain a good mixture of grass and *Arachis pinto* (forage type peanuts) in old pasture; it is important for the livestock producer to be observant:

1. If there is too much *Arachis*, then the pasture should be rested for a longer period so that the grass can recover.
2. If there is too much grass, then the pasture should be grazed heavier so as to reduce the grass and allow more sunlight for the *Arachis* (peanuts).
3. Space to plant *Arachis pinto*.





Pasture with excess Arachis, less grass



Pasture with excess grass, less Arachis

Forage Banks for “cut and carry” purposes



Cameroon Grass (*Pennisetum* spp) – Mr. Juan Herrera’s Farm
Isabella Bank, Belize District

The establishment of “cut and carry” grass as energy bank:

Forage banks for cutting purpose

During the dry season, pasture for cutting purpose is used as a cheap source of nutrient to maintain cattle, however it is difficult to maintain good milk production or the growth of the animals with solely “cut and carry” pasture. Besides the “cut and carry” pasture, a good nutrition should include other sources of feed that are high in protein such as legumes or urea (nitrogen) and feed that are high in energy, such as molasses or sugar cane. Concentrate can also be administered but these will have a high cost.

Recommended grass specie for “cut and carry”

1. There isn't any specie that will do miracles; each has its strengths and weakness.
2. Each farmer should analyze which specie will perform better in each parcel of land, taking into consideration the soil type available and the uses planned.
3. A variety of species can be planted in the farm; for example, a parcel with Cameroon to feed animals at the initial stages of the dry season and another with sugar cane, to supplement the animals towards the end.



Non Leguminous Protein Banks –
Cameroon Grass



Nacadero Protein Bank – *Tricanthera gigantea* – 15 to 20% Crude Protein



Mulberry – *Morus alba*
– up to 23% Crude Protein

Important considerations when selecting a site for “cut and carry” pasture

1. The distance to the spot where the cattle are supplemented and the accessibility of the road to be used.
2. The presence of large trees which can cast too much shade and reduce the growth of the grass.
3. If the land is prone to water logging during the rainy season, the grass will not thrive well, though sometimes this type of land can serve a purpose to the farmer since in the dry season the grass will remain green for a longer period.
4. If the land has shallow top soil and rocky; it is possible that the grass will dry quickly during the dry season and that soil fertility is low and the grass will grow less.

Land preparation

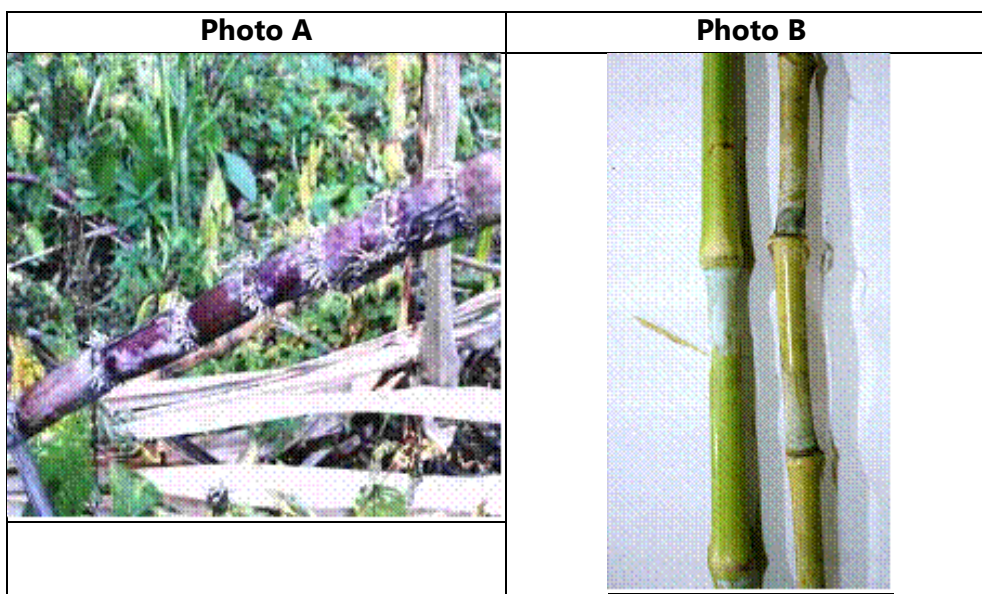
Before planting the land should be cleaned properly because it is easier and less expensive to have good control of the weeds **before** planting rather than **after**.

1. If cleaning is done by chopping only, a number of plants remain alive and can regenerate (re-sprout).
2. If herbicide such as glyphosate is applied, then the majority of the weed is eliminated.
3. If cleaning is done by using glyphosate and additionally, apply a pre-emergent herbicide on the bare ground, no weed seeds will germinate for several weeks.

Selecting a good planting material for “cut and carry” pasture

1. It is always recommended that the material (stem or cuttings) to be planted is fresh, not more than 2 days old.
2. Stems to be planted should be from 4 to 5 months old re-growth; avoid using tender or old stems.
3. Avoid planting very thin stems because these have minimum vigor.
4. The buds should be visible but not too swollen.
5. The distance between the nodes should be equal.
6. The planting material should be free from pests and not damaged or chewed by rodents (rat).
7. The stem should not be cleaned; it is better to transport with all the dry leaves on it. The dry leaves protect it from bruises and do not dry up too fast.

In the following photographs observe the case of an old stem (Photo A), in which several of nodes are already rooting and the buds are too mature. In the case of photograph B, a thick stem can be observed, of good quality, not too old also. The buds (Photo B) have not opened as yet neither are they too swollen and the nodes are spaced uniformly (have not suffered water stress). The thin stem will probably not have much sprouting vigor.



Plant spacing – “cut and carry” grass

Sugarcane: The rows are planted at 1.5 meters apart (about 5 feet). It is important to select cuttings that have viable buds (not too old or too young).

Cut and carry grass: The rows are planted at 1 to 1.2 meters apart (about 3 to 4 feet apart). The planting density can be increased but there is the risk the grass will grow weak and needs to be fertilized more frequently.



Establishing “Cut & Carry” Protein Bank and Weed Control – Taiwan grass

Planting methods – vegetative material

Stems measuring 30 to 40 centimeters (12 to 16 inches) long can be planted in a slant manner or the same way cassava is planted. The distance from one plant to the other along the row is 30 centimeters (12 inches). 1 or 2 buds can be buried and 1 bud is left out of the ground or soil. Care should be taken not to plant the stems with the buds upside down.

The stems can also be placed horizontally or laid along the row or furrow. Single or double stem can be planted so as to obtain more plants per acre or manzana. Sometimes the stem can be planted in a continuous manner so that it overlaps in the furrow, end to end so as to obtain uniform germination. The stems can also be separated at about 20 centimeter apart (8 inches). Initially, it is recommended that complete stems are distributed within the row then these stems should be cut in small pieces having 3 buds each so as to avoid few buds germinating at the end of each stem. Finally, the stems are covered with 3 to 5 centimeters (1 to 2 inches) of soil.

When planted as “cassava”, less seed (cuttings) are required per acre or manzana. This method of planting is easier in areas where mechanization is not possible and helps to avoid soil erosion on slopes or hillside. However, stems planted in this manner have a weaker root anchor because the roots do not go deep and the plants can topple over. Moreover, when this method is used “cassava planting style”, less plants per acre or manzana is obtained most of the time.

Fertilizing the “cut and carry” forage bank

With chemical fertilizer: The application of 2 bags (100 lb bag) per manzana (about 2 acres) of a fertilizer that is high in phosphorus such as 10-30-10 or 18-46-0 is recommended. In the case of planting in furrowed row; it is better to apply the fertilizer in the bottom of the furrow then place the stems after which it is immediately covered with soil to avoid “burning” with the fertilizer.

With manure: Dry coral or chicken manure can be used. Manure works much slower but for a longer period than the chemical fertilizer. For this reason it is recommended that the manure be applied all in one time to the plants, at least 40 bags (100 pound bag) per manzana (about 2 acres) in the bottom of the furrowed row. If it is applied after planting, the manure should be placed about 6 inches away from the base of the grass (along the row) so as to avoid “burning”.

Management of the “cut and carry” forage bank during the first 120 days after establishing

1: Replanting: If there are spots where the seed material germinated sparse, replanting is recommended 6 to 8 weeks after planting, hence the reason for obtaining or using a good quality of seed.

2: Weed control: This can be done manually or with herbicide. If herbicide is used the following is to be considered:

1. The use of herbicide is not recommended if the grass is less than 1 foot in height.
2. Above all, if mostly broadleaf weed germinates, herbicides such as 2-4 D, picloram or metsulfuron can be applied.
3. If most of the weed is graminoid (grass type), then the use of herbicide is complicated. Note that the herbicides that control grass also affect the "cut and carry" grass, likewise sugar cane. With much care some glyphosate or paraquat can be applied but when there is minimal wind and with the aid of a shield for the spray pump.

3: Fertilization: Fertilization using a formula that is high in nitrogen such as urea, ammonium sulfate or ammonium nitrate at the rate of 2 to 3 bags (100 pound) per manzana (about 2 acres) is recommended between 45 to 60 days after planting. The fertilizer should be placed close to the base of the grass or sugar cane but not making contact with the plant. It is better to apply the fertilizer when the soil is moist or wait until it rains.

4: Pest management: Sugar cane and most "cut and carry" type grass are quite tolerant to pests, however, when pests such as locust, loop worms or shoot borers are severe, some insecticide can be applied.

5: Mulching: When planting is done in row, mulching is recommended at 45 to 60 days after planting because:

1. It improves the growth of the grass because it avoids the problem of rain water getting stagnant in the rows.
2. It improves the growth of the roots and the sprouting of more "side shoots" of the grass or cane.
3. It eliminates most of the weed that grows between the rows.
4. If mulching is done shortly after fertilization, it can improve the effect of the fertilizer.

If all of this is carried out manually; it is hard work hence the reason, better to do it with a tractor or oxen.

The establishment of sugar cane

Forage type sugar cane serves the purpose of supplementing feed for the cattle during the critical period, either during the dry period or rainy season when pastures get flooded. Sugar cane has an annual harvesting season (cut once a year) but produces a substantial amount of forage. One hectare (about 2.5 acres) can maintain 30 heifers for 5 months.

The variety to be planted should be able to adapt itself to the area, resistant to pests of the region and in order to maintain its quality, it should not be allowed to flower.

Establishment of sugar cane

Land preparation should be done during the dry season and consists of mechanization (plowing and harrow). The rows should be separated about 4 to 5 feet apart with furrows about 10 inches deep.

Planting

To increase plant density and maximize germination, entire stems can be placed along the length of furrows and allowing ends to overlap. Then the stems are cut in lengths of about 16 inches long. For 1 hectare (2.5 acres), about 10 – 14 tons of seed is required. The age of seed material is important, 7 to 9 months of re-growth. **Old seed material will have a lot of dormant buds.**

Weed Control

This can be done manually (chopping) or with the use of herbicide (systemic or contact spray). Harrowing twice during the dry season will eliminate a considerable amount of weed.

Fertilization

If commercial fertilizer is used (can be expensive), 1 hectare will require 230 kg urea (506 lbs) during the first year. A second application is required 2 months later with a complete formula (618 lbs). The use of manure is a better option since this adds organic material to the soil thus improving its texture. A minimum of 50 bags (100 lb bag) of dry chicken manure per hectare (2.5 acres) can suffice a good "energy bank" but adding more will boost the production of forage. **Annual application of manure is essential if the bank is to be maintained quite productive.**

Note: Sugar cane does not tolerate water logged soil therefore a good drainage system is necessary.

Storing feed for livestock as "silage"

Silage is a method of conserving green forage through good fermentation.

In order to produce good silage, the air should be eliminated from the silage pile or heap. This can be accomplished through proper compaction of the heap. The silage heap is then sealed with plastic so that air does not enter.

Types of forage that can be utilized:

1. Grains such as, corn or sorghum (stem and leaves).
2. Grass for cutting such as Elephant, Cameroon or King Grass (*Pennisetum* spp).
3. Other grass such as Asia, Tanzania, Mombaza, Marandu or Toledo.
4. To improve the quality of the silage, it recommended that a combination of grass and legumes such as Madre cacao and *Leucaena* leaves.



Chopping Silage material - grass



Polythene Plastic used to cover Silage

Selecting the adequate forage material for silage preparation

In the case of corn or sorghum, it is recommended that the grains are semi-solid but still milky – at least 65 – 70% maturity of the plant leaves and stem.

1. If grass such as Elephant, Cameroon, etc are used, these should be from re-growth that are 50 – 70 days old.
2. If regular pasture grass such as, Asia or Toledo are to be made into silage, these should have a re-growth of at least 40 – 60 days.
3. Legumes to be used in silage should not be too young or too old – $\frac{3}{4}$ maturity. The branches of these shrub can be used especially those that are about $\frac{1}{2}$ inch thick.



Compaction of Silage pile with tractor



Silage pile is sealed & covered with soil

Important factors to be considered when preparing silage

1. Do not prepare silage when it is raining.
2. Chop the forage in fine particles – about 1 inch.
3. Carry out the "handful forage" test so as to ensure that the material used has good moisture: If the forage used is too dry, water needs to be added (with honey) and in the case of forage that is too moist; the material should be aired out.

4. When both grass and legume (Madre cacao or Leucaena) are used for silage, the ratio of 3 equal piles of grass to 1 equal pile of legumes is recommended. The pile should be mixed properly before compaction of each layer.
5. The silage heap should be filled in layers of 30 centimeters (1 foot) each of chopped material. Each layer should be compacted properly before chopping the other layer.
6. In order to produce good fermentation it is recommended that the proper amount of molasses be added. In a silage heap measuring 3 X 3 meters (about 10 x 10 feet), add 2 to 4 gallons of molasses for each layer that is compacted.
7. In corn or sorghum silage there is no need to add molasses.
8. Seal the silage heap with plastic so as to avoid the entry of air; ensure that it is free from "air pockets".
9. Place weight such as soil, rocks or pieces of heavy log on top of the silage heap, ensuring that the plastic does not get torn.
10. Keep away cattle, pigs or chicken so as not to damage the plastic.
11. Ensure that rain water run-off does not wet the silage heap; dig a drainage canal.
12. Wait at least 45 days before opening the silage heap.

Analyzing the quality of silage and feeding to livestock

Checking and testing the suitability of silage

A: Check the odor of the silage:

1. Good silage smells enticing, appealing or pleasant: such as the smell of sweet butter or yogurt.
2. Silage that is a bit bad smells like vinegar.
3. Silage that is not good smells like rancid butter. Another disagreeable odor is that of a moldy smell – fungal growth. Bad silage can also smell of urine or ammonium. When sugar is used for silage it can smell like liquor, one which is not desirable.
4. The worst is rotten odor, which indicates that silage is not good and has been lost.

B: Observe the color of the silage: Good silage has a greenish and yellowish coffee color. Dark coffee and black color indicates that there was excess or overheating of the silage heap and a lot of nutrients were lost.

C: Feeling the silage with the fingers: It should be firm. If the silage disintegrates (shreds away), this indicates that fermentation was bad and possibly infested with molds (fungi).

Providing silage to the animals

The silage can be utilized in any season of the year when feed is scarce; mainly during the dry season but can also be fed when there is excess rain or flooding and prefer to keep animals away from wet pasture.

Rationing silage to the animals

If the silage is of good quality, a cow weighing 400 kg (800 lbs) can eat up to 25 kg (50 lbs) of silage per day if no other forage is available. In the event the animals have access to other

forage, it is recommended that the amount be reduced. For example, cattle grazing on pasture that still has a bit of feed, a ration of 15 kg (30 lbs) per day per cow can be given.

Lookout: Never give cattle silage of bad quality!

Feeding the silage to livestock

When starting to feed silage, the cattle have to get used to it first. The first few days it will eat very little but within 1 week it will get used to eating the silage.

Reducing silage losses once the heap is opened

As the silage heap is opened, a portion of the silage comes into contact with the air. To avoid mold or bacterial growth and loss of a portion of the silage, it is recommended:

1. Prepare silage with a certain size such that the cattle on the farm can consume all within 2 to 3 weeks. It is better to prepare 4 silage heap that will last 2 weeks each, rather than doing a huge one that will take 8 weeks for it to be consumed.
2. Take out the silage in slices and then cover the remainder once more.
3. After taking out the silage required for the day, it is covered with the plastic once more and place the same weight on top.

Multi-nutritional blocks, an alternative supplement for cattle



Multi-nutritional Blocks for storage



Supplementing Multi-nutritional Blocks

Multi-nutritional block – a supplement

A multi-nutritional block is a supplement used to feed cattle, one which is easy to prepare in the field. It is administered or offered as a hard block for the animals so that it is eaten in small amounts. It is rich in protein, energy and minerals.

Multi-nutritional block formula

To prepare 100 pounds mixture, different formulas can be used as shown in the following table:

Ingredients	1	2	3	4	5	6	7	8	9	10
Molasses	43	44	44	40	40	40	40	35	35	30
Urea	10	10	10	5	5	10	5	10	10	10
Minerals	3	3	3	3	3	3	3	3	3	3
Common salt or table salt	3	3	3	3	3	3	3	3	3	3
White lime or cement	6	5	10	9	9	14	9	9	14	14
Bran (Rice, wheat)	0	0	0	0	0	30	0	10	35	15
Ground sorghum	0	0	0	0	0	0	20	10	0	0
Ground corn (in grain or with cob)	20	10	10	0	20	0	20	20	0	25
Dry leaves of Leucaena or Madre cacao	15	0	0	0	0	0	0	0	0	0

Ingredients required to prepare block



Dried Leucaena leaves & ground corn



Mixing the ingredients with molasses

1. A sheet of thick plastic (nylon) to mix the ingredients without getting dirty.
2. A measuring scale to weigh all the ingredients.
3. Have at least 4 plastic buckets used to weigh ingredients, to store molasses and also to use as molds.
4. A compacting tool (a piece of 2 x 4 board or 4 x 4 lumber) or even a piece of wood that has about 2 to 3 inches diameter.

Preparation of the multi-nutritional blocks

- 1: **Sift/sieve ingredients** that may have thrash, for instance chicken manure.
- 2: **The ingredients are weighed**, according to the formula of the block desired.
- 3: **The solid ingredients are mixed, (without the cement)** in a plastic bag or on top of a sheet of plastic spread on a clean hard surface floor.
- 4: **The urea is mixed with the molasses.** The urea can be dissolved in a bit of water and then mix this solution with the molasses. If you do not wish to see the urea granules in the molasses, then prepare this mixture 1 day before.
The cement is added to the other solid ingredients just before introducing the molasses. Ensure uniform mixture of the cement
- 5: **The molasses** with urea and the solid ingredients are mixed manually until everything is uniformly wet with the molasses – there should not be any dry portion or lumps. (Sometimes there can be excess dust; use goggles or respirator).
- 6: **The mixture is placed into the bucket or wooden mold in small amounts.** The first half of the mixture in the mold can be compacted with the hands after which the heavy tool is used to complete compaction. A good compaction is very important so that the blocks do not crumble when removed from the mold or after. If the block crumbles there is the risk the cattle will eat excess of the supplement and can get urea poisoning. Moreover, a well compacted block has less exposure to fungus or mold.



Compacting ingredients in metal mold



Ensure good compaction of the block



Wooden mold

7: The block is taken out of the mold. The block is left to set for at least 1 day until it is properly dry so as to avoid crumbling when transported.

8: The block is stored. The storage area for the blocks should be dry in order to avoid problems with mold or fungi and should not allow the entry of rats or any other rodent.

Supplementing animals with multi-nutritional blocks

Feeding livestock with multi-nutritional blocks

Multi-nutritional blocks improve rumen function in cattle, such that it can make better use of dry forage and crop by-product which is used a lot during the dry season. Moreover, the block facilitates an easy way of providing mineral that the cattle require.

Bear in mind that in order to get the best response from the animals towards multi-nutritional block supplement, the animals should never be out of forage.

Similar results can be achieved with mixtures of molasses and urea including minerals but the management of this type of supplement can be much more risky and complicated.

The best time to provide multi-nutritional blocks

Multi-nutritional can be used all year round but its use as part of the supplementation strategy during the dry season is much more frequent. In dairy animals the block is easily given during milking in the corral or in the area where the animals rest.

If the blocks are used during the rainy season in the pasture, the use of feeding troughs with roof is recommended so as to avoid washing away by the rain.

In large pastures, the multi-nutritional blocks can be from spot to the other, so as to ensure that the cattle consumes all the available grass in the pasture.

Daily requirements of an animal – 400 kg

An adult cow (400 kg body weight) should eat 1 to 2 pounds of the block per day. Animals with less body weight will consume less.

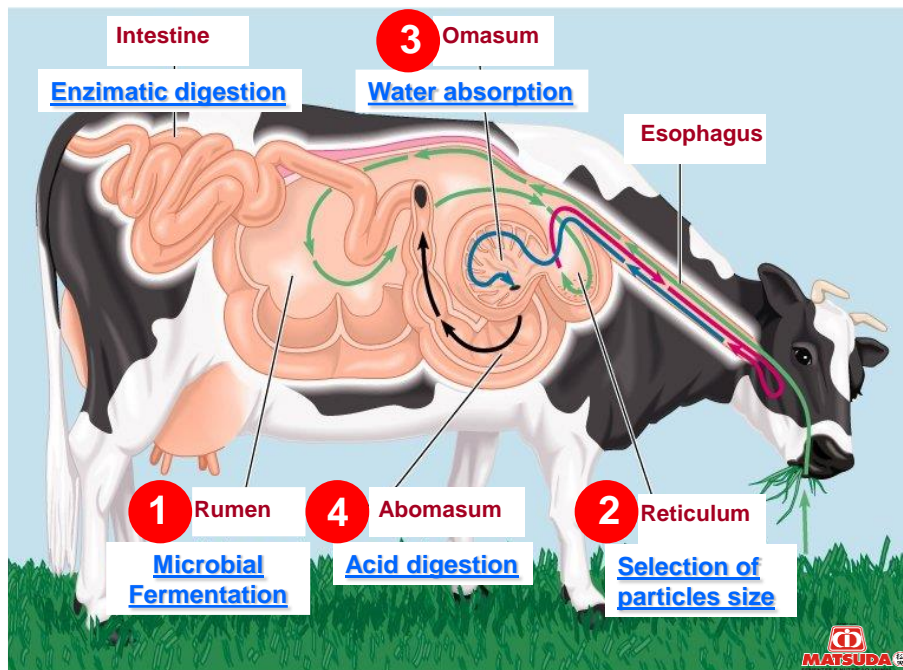
To regulate the level of consumption we can play a round with the hardness of the block which is determined by the proportion of White lime or cement added. Likewise the degree of compaction used to prepare the block. To a lesser degree, the amount of salt used in the

block can help regulate consumption. But it is important to work with the recommended formula since these have been tested.

Avoid feeding multi-nutritional blocks to young animals

Since these blocks contain urea and sometimes chicken manure, it is not recommended that calves less than 6 months be fed with it. At this age the rumen (large stomach) of the calves are not fully developed, therefore are not able to digest the nitrogen (urea) in the blocks.

Source: Credits to Dr. Eric Yudi Matsuda Fugisaki, Animal Nutrition Department, **MATSUDA.**



Digestive System of Ruminants – Highly functional in a healthy cow

Constructing improved ponds for livestock

During the dry season a lot farms do not have water for the cattle in their pastures; constructing ponds or water catchment areas can better the situation. Even though the construction of ponds is not cheap; the problems of losing animals due to death or selling animals due to water shortage is avoided. Additionally, when water is available in different parts of the pasture, all the sub-divisions can be grazed and the pastures can be better cared for.



Water Catchment Pond with Polythene
Plastic – San Antonio, Cayo

Improved Pond - Concrete



Appropriate for rocky surfaces and slopes
– E. Palma's Farm - Peten

It is not always easy to construct a pond or maintain it in good condition, for several reasons:

1. If a suitable spot cannot be located to construct the pond, it is likely that the pond will never hold water or even get destroyed with torrential rains.
2. Sometimes the pond is too small and will not hold enough water for all the cattle.
3. If the pond is not deep enough, it can dry up during the dry season.
4. When the animal walks into the pond, the water is contaminated with mud and excrement (feces & urine) and the animal can get stuck in the mud.
5. There can be water seepage due to infiltration.

In constructing ponds, the following points should be considered:

1. The amount of water required by the cattle should be calculated, so as to be able to design an adequate pond for the farm. In one month, a cow weighing 400 kg (just over 800 lbs) needs 320 gallons of water, in as much, a calf weighing 200 kg (440 lbs) needs half this amount.
2. Take into consideration that during a dry period of 4 months, due to the heat and wind, the pond loses between 60 – 80 centimeters (about 2.75 feet) of water from the surface. For this reason, the pond should have a minimum depth of at least 1.2 meters (about 4 feet).
3. It is not recommended to construct a pond on the lowest spot but on a slightly higher spot. In so doing the water can be transported with poly-tube hose by gravity to the lower spots where a plastic or concrete water trough is installed. (FOTO BEBEDERO).

4. Some ponds get filled only by rain water; others get additional water from surface run-off from higher areas when it rains. In this case, care must be taken not to construct ponds where water run-off is strong so as to avoid damage. Therefore, it is essential that this higher area is protected so that the water remains clean.
5. Where ever possible, the pond should be constructed where the soil is deep, clay-type and without stones or rock. The bottom and borders of the pond should be compacted properly so as to avoid water seepage or damage to the borders.
6. It is recommended that an overflow pipe (4 inches diameter) be installed on the border of the pond, so that it drains when filled and not flow over the border which can cause damage.



Improved Pond with Geomembrana Plastic & Overflow
Gutter – G. Choj's farm

7. When the site where the pond is to be constructed has too many rocks and sand, the pond cannot be compacted well, the water infiltrates. In this case it is recommended that plastic (nylon) be used to cover the bottom and borders. The plastic should be black so as to inhibit the growth of fungus or algae and have a thickness of at least 0.6 millimeters in order to last. In 2011 this plastic was marketed for \$0.60 U.S (\$1.20 BZ) for 1 square meter. Better plastic type materials such as "geomembrana" is now available and are more resistant (eg. It does not get damaged easily by wild animals which will frequent the ponds for water) but can cost up to \$5.00 U.S. per square meter.
8. Check valves or a float (such as a toilet float) can be used to automatically fill water troughs.



Water troughs with float

9. It is recommended that the ponds be fenced so that the cattle do not enter into the ponds.
10. It is important to give the pond good maintenance: at the end of the dry season when the pond is almost empty or dry, the sediments should be removed to keep the water clean; moreover, the borders should be inspected so as to detect any leakage.



Cleaning Improved Pond at the end of Dry Season -
Check for leakage

Dedicated to the 3 Farmer Field Schools of the Belize District:

Belize River Valley Livestock Farmer
Field School



Crooked Tree United Farmer Field
School



Maskall Cattle Producers
Farmer Field School

