

Cassava Production and Utilization Manual



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Cassava Production and Utilization

Manual

For smallholder farmers

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Dr. Otim-Nape in Cassava Production Guide, 1994
Humanity Development Library in Sustainable Development and
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The manual was developed at an information repackaging workshop organised to repackaging agricultural information to meet the agricultural production information needs of the communities around the telecentres of Nabweru, Buwama and Nakaseke and indeed other small holder farmers in Uganda.

It will greatly contribute towards meeting the information needs of farmers and advisory services delivery agencies working in rural areas in Uganda.

I hereby acknowledge the afore- mentioned sources of reference from which the workshop drew much of the content.

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Market

Cassava produces more starch per hectare under relatively dry conditions than any other known crop. Production is likely to increase in Uganda, and it may substitute to some extent bananas in the local diets in traditional banana growing areas. Increasing urbanization is likely to lead to increase in consumption particularly where there is a need to supply the poor urban and local processing units. This will result in the increasing production. The overall prospects for international trade in cassava is currently limited. Any future increase in cassava production will therefore need to be utilised primarily in Uganda.

References

- NARO Cassava production guide, 1994
- FAO, Better Farming Series 16. Roots and tubers.
- Humanity Development Library in Sustainable Development and Basic Human Needs. HDL 2.0 Ed.

forage. They will eat more of the wilted forage than fresh forage.

When you first give cassava forage, you may find that the animals are reluctant to eat. Usually it takes two to three days before the animals readily eat it.

Use of cassava forage silage

You can make a silage with cassava forage in three ways:

- by using cassava forage alone
- by using a mixture of cassava forage and grasses
- by using a mixture of cassava forage and roots

When you mix the cassava forage with grasses available in your area and make a silage, you improve the quality of the silage. You will make a silage with more protein.

The method of making silage from cassava forage is similar to that used for making silage from cassava roots.

The forage and the grasses must be wilted first and then chopped. Wilting is done to reduce the water content in the materials. If you make silage with too much moisture, a lot of liquid will drain out of the silage. This liquid will remove nutrients. Too much moisture will also make the silage spoil.

You can avoid the problem of too much moisture by using layers of dry grass or straw between layers of chopped forages. Dried materials will absorb the excess moisture.

You can mix the chopped roots with the forage and make a silage. This silage will be well balanced. Roots will supply the energy and the forage will supply the protein.

Chapter 1

Cassava Production

Introduction

Common names:	<i>Cassava</i>
Botanical name:	<i>Manihot esculenta</i> Crantz syn. <i>M. utilissima</i> Pohl
Local names:	<i>Muwogo, omogo, ongura, ngura, mgbanda, emuwogo, Muhokho, Muhogo, Muoogo</i>

Cassava is a perennial shrub, which produces enlarged tuberous roots. There are over 100 cultivars and there is great variation in the form of the plant. The height ranges from about 1 to 3 m or more. The stems are usually slender and glabrous. The leaves are borne near the apex; the lower parts of the stems have nodes made conspicuous by prominent leaf scars. Branching is variable; some cultivars branch near the base and are spreading in form, others are erect and branch nearer the apex. Stems vary in colour, being grey or silvery, green, greenish-yellow, reddish-brown, or streaked with purple. The leaves vary in colour from green to reddish; the petiole and midrib may be deep red. Older leaves are shed leaving the prominent leaf scars mentioned above. Root tubers develop by a process of secondary thickening as swellings on adventitious roots a short distance from the stem.

There is great variation tuber number, shape and size and the angle at which they penetrate the ground. There are usually 5-10 tubers per plant. Hydrocyanic glycoside is present in varying quantity in all tubers. Cassava clones are often classified by taste as 'sweet' or 'bitter'. The toxicity of a cultivar varies according to environmental growth conditions. However, in any one location it is possible to find some cultivars 'bitter' and some 'sweet', so that a local separation between bitter and sweet can often be made.

Cassava (*Manihot esculenta*) is not known in the wild state. It must have originated from southern Mexico/Guatemala or north-eastern Brazil, or both. It was brought by the Portuguese to Africa in the 16th

Botany

Origin and distribution

century. Its spread slowly in Africa until the end of the 19th and first half of the 20th century, but Africa now produces almost 40 per cent of the world's total. The crop has become important throughout the tropics, under a wide range of conditions of climate and soil.

Cassava was first introduced on the East African Coast in the eighteenth century, spreading rapidly inwards in the twentieth century.

Originally introduced into Uganda as a famine reserve crop, it is now one of the major staple food crops contributing to basic food requirements countrywide. It is presently grown throughout Uganda. It offers over 60% of the basic food requirements in the North, Eastern and West Nile regions of the country. Cassava has gained importance due to its high yielding capabilities, ease of cultivation, it stores well in the ground for a period of up to three years, flexibility in farming and food systems and it has an increased value as a reserve against risk of famine. It is a source of income and raw material for the industrial sector. It has potential for export and in animal feeding.

Planted areas under cassava in Uganda increased from 511ha in 1994 to over 200,000ha in 1999.

However, cassava production is greatly constrained by poor cultivation practices, pest and diseases especially cassava mosaic and inadequate post-harvest handling, narrow utilisation base and poor marketing.

Varieties

Many local varieties are grown. However, mosaic resistant varieties are recommended.

New cassava varieties have been developed to address disease and pest constraints. Building plant resistance to such adversaries is the practice in research. Breeding is directed towards addressing social, cultural and market requirements. These new varieties have other desirable characteristics such as softness, sweetness, early maturing and high yields, which are all qualities that play a very important role in development of the final product that is acceptable to different end-users.

For the best results, use about 3 to 5% cassava leaf meal in your rations.

You have seen earlier some examples of chicken rations with cassava leaf meal. You have also learned that cassava leaf meal has a protein content similar to those of other meals. Therefore you can include cassava leaf meal instead of some oilseedcakes in chicken rations.

Use of cassava leaf meal in pig feeding

Cassava leaf meal can be included at levels of up to 10% in compounded pig rations. In a 10kg ration, you can use up to 1kg cassava leaf meal.

If you use higher levels of cassava leaf meal in rations for fattening pigs, they will not fatten well.

Rations also become powdery when you use high levels of leaf meal. But pig rations are normally mixed with water and fed. Therefore this is not a big problem.

Use of cassava forage in ruminant feeding

When grasses mature and flower, they become fibrous and have poor digestibility and low protein contents. During dry season, the grasses are dry and are more fibrous. Animals will not get much digestible feed or protein by eating them. They will not grow and may lose weight. To avoid this, you must feed quality forages with high protein, along with available grasses.

You can feed legumes that are high protein forages. In many areas, tree legumes are used to feed animals. Gliricidia, Leucaena, Sesbania and Acacia are some tree legumes that you may find in your area.

Cassava forage has a protein value equal to those of these tree legumes. Cassava forage includes leaves as well as the tender stems. It is a good supplementary feed for all ruminants.

To lower the cyanide level, you must wilt the forage for a few hours before feeding. Animals like the wilted forage more than the fresh

For pigs and chickens, this high fibre level can cause problems. This means that cassava leaves must be used within limits in pig and chicken feeding.

Cassava leaves are rich in pigments. This is useful in chicken feeding.

As with cassava roots, cassava leaves contain cyanide. In fact, fresh cassava leaves have more cyanide than the roots.

But simple drying of the leaves in the sun, can eliminate most of the cyanide present in cassava leaves. You have to chop and wilt the leaves before drying in the sun. While wilting, you must regularly turn the leaves over. Otherwise fermentation may occur and spoilage may start.

After wilting, the chopped leaves must be uniformly spread over a drying area. They will dry quickly.

Once well dried, they can be collected and ground into a meal. Meal can be stored in bags or gunny sacks.

Dried cassava leaves and cassava leaf meal have excellent storage qualities. Insects and moulds will not attack them. They can be kept in dry places for over a year and used when necessary.

Use of cassava leaves in chicken feeding

The chicken mash which you purchase from dealers usually has a leaf meal in it to supply the pigments and to improve the colour of egg yolk and colour of skin of meat birds. In a 10kg mash, 300-500g of leaf meal is usually included.

Cassava leaf meal can be used for this purpose. The feed value of cassava leaf meal for chickens is equal to that of alfalfa meal.

In some countries, Leucaena leaf meal is used to supply the pigments in chicken rations. Leucaena is a tree legume. But cassava leaf meal has a better feed value than Leucaena leaf meal.

The new and improved varieties available include: NASE1, NASE2, NASE3, NASE4, NASE5, NASE6, NASE7, NASE8, NASE9, NASE10, NASE11 and NASE12

Whereby the codes NASE stand separately to mean: NA= Namulonge and SE= Selection.

Nase1, 2,3 and 4 are tolerant to drought, resistant to mosaic and very high yielding. They are bitter due to the high levels of hydro cyanic acids in the fresh tuber, occasionally getting extremely bitter depending on the soil conditions. Bitter cassava is mainly grown in the East and West Nile region. While in the southern and central Uganda, the sweet types are grown and preferred.

Cultivation conditions

The optimum temperature range for cassava is between 25-30°C. The minimum temperature for growth is 18°C and yields are reduced above 30°C.

A well-distributed annual rainfall of 1000-1500mm is ideal, but the crop can be successfully grown in areas with rainfall ranging from 500 - 2500mm except at planting. Cassava can withstand prolonged periods of drought and is therefore a useful crop in areas of low or uncertain rainfall.

Light sandy loams of medium fertility give the best results. When grown on clay soils, the plant produces stem and leaf growth at the expense of the roots and many cultivars give poor yields. Saline and swampy soils are unsuitable. Cassava can tolerate soils of low fertility, especially if the feeder roots can penetrate to depths of 40-60cm; deep cultivation before planting is therefore recommended.

Although it responds well to fertilization, cassava will grow on relatively infertile soils that are unsuitable for other crops. However, it removes considerable quantities of nutrients from the soil. Thus continuous growing of cassava on impoverished soils leads to even more severe soil deficiencies. Potassium is often the limiting factor. Proper fertilizing practice will depend upon the soil in question (and on other limiting

Temperature

Rainfall

Soils

factors, such as rainfall) but a general basic recommendation is to use about 500kg/ha of a 12:12:18 complete (NPK) fertilizer. FYM at 20-30ton/ha augmented with 500kg/ha of rock phosphate and 300 kg/ha of muriate of potash has given good results with average yield of roots about 40 t/ha.

Altitude

Cassava can be grown from sea level up to about 1,000m in equatorial regions, though at the highest altitudes growth is slow and yields are reduced.

Soil preparation

To develop well, cassava roots need soil that has been loosened by the hoe or plough. So till deeply, to 20 or 25cm so that the roots can get well down. Till at the beginning of the rainy season, this breaks up the soil and it stores up water and the roots have plenty of loose earth in which to develop.

If fertilizers or manure are used, work them into the soil when it is tilled. Yields are high when the plant finds plenty of nourishment in the soil. Farmyard manure, compost and green manure are the best fertilizers for cassava.

For green manure, you can sow leguminous cover plants such as: *Crotalaria*, *Centrosema*, *Calopogonium*, *Phaseolus* or beans. Sow them a little before the rains, and dig them in after 5 to 18 months of leafy growth.

You can also use farmyard manure or compost. These organic manures enrich the soil with organic matter and mineral salts.

To complete the manuring, you can apply mineral fertilizers containing nitrogen, phosphorus and potassium.

Place in rotation

Usually, cassava follows several other crops. For example, first maize, vegetables, groundnuts, bananas, and then finally cassava. In other places, maize, beans or groundnuts is grown between the cassava plants. It is good to grow several crops together.

If you harvest the leaves too frequently, the roots will not enlarge. You will get few smaller sized roots. To harvest the leaves while the plant is growing, you must make sure that the root yields are not affected. This you can do in the following ways:

In early maturing varieties, harvest the leaves only once while the plant is growing. Then the root enlargement will not be affected and you can still get good root yields.

In late maturing varieties, you can obtain at least two leaf harvests while the plant is growing and still get acceptable root yields.

You can also plant cassava for the sole purpose of harvesting leaves. In parts of the world, e.g. Brazil, farmers plant cassava to produce leaves only.

Leaves are harvested, dried, ground into a meal and sold for mixing in compounded rations.

When you plant cassava for leaf production only, you can plant it with closer spacing. You can have about 60,000/ha. This is much closer planting than that used for root production.

You can start the first leaf harvest four months after planting and then harvest at three-month intervals. Yields of over 21,000kg per hectare can be. This is a high yield for any forage material.

Cassava leaves are a good protein feed. Even mature cassava leaves contain a lot of protein. Dried mature cassava leaves can give about 200g of protein per kg of leaves.

Young cassava leaves have even higher levels of protein. They can give 280-300g of protein per kilogram of dried leaves.

Cassava leaves are also a rich source of minerals and vitamins. We know that all leaves are fibrous. Cassava leaves have a lot of fibre. This fibre level does not cause any problems to ruminants. Ruminant animals can digest and use the fibre for energy. Cassava leaves are good feeds for ruminants.

Growing for leaves only

polyethylene sheets to cover. Then put some stones on the top.

Cassava peel silage will be ready in four weeks. It can be used for feeding of ruminants and pigs. Cyanide levels are far lower in the peel silage.

Cassava leaves as an animal feed

Did you know that cassava leaves could be used as an animal feed?

Cassava leaves can supply many nutrients that are necessary for animals. They are a good protein feed for ruminant animals; you can feed both the leaves and the tender stems. This is called cassava forage.

For pig and chicken feeding, you must strip the leaves, dry them and grind them into a meal. The milled product is called cassava leaf meal. By drying 100kg of fresh cassava leaves, you can prepare about 20-25kg of meal.

Leaf production

The amount of leaves that you can get will vary depending on the variety that you have planted. Some cultivars have more branches and produce more leaves than others.

The amount of leaves that you can harvest from a plant also varies, depending on age of plant, climate and soil fertility.

You can produce leaves in three ways. We will look at each of these possibilities.

Growing for roots

Farmers grow cassava mainly to harvest the roots. When you harvest the roots, you can save the leaves to feed animals. But you will not get many leaves when you collect them at root harvest. The leaf yields will be low.

Leaf & root production

You can also harvest the leaves while the cassava plant is growing and while the roots are being formed. In this way, you can increase the leaf yields. However, you must plan carefully when and at what intervals you should harvest the leaves.

How to propagate cassava

Cassava seed is difficult to germinate and is used only for breeding work. Cassava is propagated by cuttings, by planting pieces of stem. To make cuttings, choose stems 2 to 4cm thick, from the strongest plants which are not diseased and which have already produced tubers. After the harvest, tie the selected stems in bundles. Wait at least 10 days before planting them. Keep the bundles in a cool, dry place until planting time. But remember that the cuttings must not be made from the stems until you are ready to plant.

Cut each stem into pieces 20 to 30cm long. There should be 4 to 6 growth buds on each piece. The stake length depends on the purpose for which cassava is being grown. For root production, stake length of 25-30cm (5-7 nodes) is ideal.

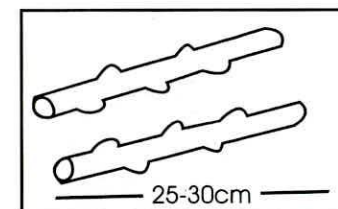


Illustration 1. stake ready for planting

Most cassava is still planted by hand. Planting is done at the start of the rainy season, often in flat fields, though planting on ridges is desirable in wet regions. The sticks may be cut obliquely or at right angles to the axis, and planted vertically or at an angle, with half their length in the soil, or flat below the surface.

In Uganda it is generally appropriate to plant one cutting horizontally in a flat seedbed to the depth of 10-15cm. However in swampy and rocky areas planting on ridges is recommended. Vertical or inclined planting is practiced in some parts of the country.

Effect of planting method

When sticks are planted vertically or inclined, tubers form only at the

Propagation

Stake length

Planting

Vertically

extreme end of the cut, forming a slanted cluster often of irregular size. When a stick is cut at right angles and planted vertically, the roots are evenly distributed around the circumference and are more uniform in size.

With vertical or inclined planting the roots penetrate more deeply and tubers may be formed at intervals along the planted portion, but in areas of low rainfall desiccation of the cuttings may occur. After 8-12 weeks the plants are usually earthed up to encourage tuber formation.

Horizontally-planted sticks produce tubers at each node, but lodging of the aerial part is increased and yields reduced.

Spacing

The plant density preferred varies greatly from country to country and within countries, and is affected by cultivars, soil conditions, local customs, and the use to which the roots will be put. But 7,000 to 10,000 plants/ha is the more usual range. If other factors remain

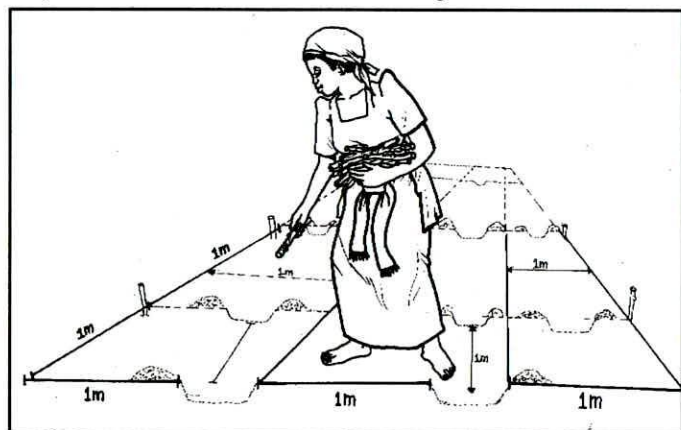


Illustration of 1m X 1m spacing for cassava

constant, closer spacing gives higher yields but smaller roots. High plant density tends to encourage certain fungal diseases.

Seed rate

In Uganda recommended spacing is 1m x 1m between rows and plants. This gives plant population of 10,000 plants per ha for medium to high or no branching varieties.

Cassava peels as an animal feed

Cassava peels may be used for feeding animals.

When you process 100kg of cassava roots, 10-15kg of cassava peel becomes available as a by-product. Cassava peel looks fibrous. You must know that it can supply many nutrients.

100kg of cassava peel, it will contain about:

6kg of protein

4kg of fat

6kg of minerals

You must limit the amount of cassava peel fed to pigs and chickens because it also has a lot of fibre. Fresh cassava peels have high levels of cyanide, much higher than the level present in the flesh of the roots. But you can effectively reduce the cyanide in the peels by simply drying in the sun.

For ruminant animals, peels are good energy feeds. They can be safely used. Peels can also be used to feed pigs and chickens, but they must be combined with other feeds. Do not use more than 2kg cassava peel meal in a 10kg ration.

You can also make silage using cassava peels, in the same way that cassava root silage is made.

You can use a small silo such as an oil drum. Line the oil drum with polyethylene sheets. Make holes at the bottom to drain the liquid coming out of the silage. Keep the drums on stones or on a concrete floor for easy drainage.

Peel silage making

Wilt the peels in the sun for a day to reduce the water content

Then pack the wilted peels in the drum and press them tight

Cover the top of the drum. You can use banana leaves, grass or

Steps

Use of cassava roots in ruminant feeding

Cattle, goats and sheep are called ruminants because they have complex stomachs. They ruminate. Ruminants are different from pigs and chickens because they are capable of eating and digesting fibrous feeds or roughages.

Grasses, legumes and tree leaves are all good roughages. Straws remaining after harvesting crops are also roughages, but of poor quality.

Ruminants can be reared on good quality roughages alone. These will give the nutrients to maintain the body and to grow. But there may be situations where you have to give supplementary feeds, one example of which is cassava roots, for good growth of animals.

Meat animals cannot grow fast on roughages alone. You can give cassava roots as supplementary feeds.

In milking animals, you are likely to get more milk when you can feed cassava roots to these animals, in addition to the roughages.

In the dry season, there may not be enough grass for the animals to eat. Animals will then lose weight and become thin. Cassava can be useful.

You can feed cassava roots to ruminants in several forms:

- as chopped fresh roots
- as dried chips
- as silage
- as cassava meal

You need not worry much about the cyanide problem when you feed cassava to ruminants. They can tolerate high levels of cyanide.

Silage is the best way to preserve cassava roots for ruminants. When you are making root silage for ruminants you can add chopped cassava foliage to the silage. Adding foliage will increase the protein content of the silage. This silage is a balanced feed for ruminants. Animals readily eat this silage.

Intercropping

In smallholdings cassava is frequently grown in mixed cultivations, e.g. intercropped with beans, groundnuts, vegetables. The first three months is critical for cassava growth. While intercropping cassava with legumes a spacing of cassava/bean or groundnuts of 1m x 1.5m x 20cm be planted at the same time. This combination gives maximum yields for both combinations.

Weed control

Weed control is extremely important during the early stages. It is good to interplant with cover crops such as beans during early stages to suppress weeds. The timing and frequency depend upon local conditions. Weed 3 to 4 weeks after planting. Weed a second time 1 or 2 months after the first. Earth up the plants at the same time; this greatly helps the formation of tubers, and prevents the wind from blowing the plants down. After this, Cassava tends to form canopy that smothers weeds during late growth stages. When rain spoils the mounds, they must be remade.

Chemical control gives excellent results: pre-emergence with subsequent application of the latest insecticides will prove successful.

Pests and diseases

Root knot nematodes (*Meloidogyne* spp.) are common but seldom of economic importance except when cassava is intercropped with good hosts for the nematode, e.g. bananas, egg plants *Pratylenchus* sp., *Helicotylenchus erythrinae*, *Rotylenchus reniformis* and a few other species have been found in cassava but are considered of little importance.

A number of insects may cause defoliation. In Uganda the grasshopper *Zonocerus variegatus* may be serious; Spider mites, *Mononychellus tanajoa* and *Tetranychus cinnabarinus*, sometimes affect the crop; in some areas rodents, baboons, monkeys and wild pigs are reported to cause severe damage, and smallholders sometimes plant bitter cassava around their areas of sweet cassava to discourage such predators.

Pests

Diseases

Cassava is subject to several virus diseases. In Uganda, the most important is African cassava mosaic disease. The cassava mosaic virus is transmitted by a white fly (*Bemisia tabaci*). The whitefly acquires the mosaic virus from infected plants from within the fields and outside sources. Once infected, it retains the virus for a long time and can transmit it to cassava plants in distant areas. Under favorable conditions all healthy plants of susceptible varieties become infected within 5 months from planting. The virus remains in infected stems indefinitely and planting such stems disseminates the disease.

Cassava mosaic virus produces the effects of severe leaf chlorosis, leaf curl and tip dieback.



Cassava affected by mosaic

Leaf spot is common but not serious. Bacterial blight is serious in parts of northern and eastern Uganda. Use resistant cultivars and clean cuttings for control

Rot damages the roots, especially after 10 months of leafy growth. It often occurs under flooded conditions. The tubers turn soft and give off an unpleasant smell; they are no longer any good for human or animal food. This means a big loss to the farmer. To avoid rot, do not plant cassava in a place that is often flooded. If a cassava field is flooded after heavy rain when the tubers are already ripe, you must get the cassava out of the ground very quickly, before it starts to rot.

Control

Means of controlling mosaic disease are not yet known. To avoid it, do not take cuttings from plants attacked by the disease. Choose varieties

You can prepare leaf meals from many plants that are available around your farm. Some examples include cassava leaves, sweet potato leaves, young grass.

How to mix your own chicken rations

If you are interested in mixing chicken rations on your farm, the example that follows may be useful. The formulations are given for mixing of a 100kg ration.

Table 2. Chicken rations using cassava meal

Ingredient	Ration for		
	Chicks	Growing chickens	Laying chickens
		Parts per 100Kg	
Cassava meal	20	30	40
Maize	37	40	20
Soya meal	30	15	20
Fish meal	8	6	6
Cassava leaf meal	3	6	6
Bone meal	1	2	1
Oyster shell	0	0	6
Vitamin-mineral premix	0.5	0.5	0.5
Salt	0.3	0.3	0.3
Methionine	0.2	0.2	0.2
Total	100	100	100

These ingredients are given as useful examples. The feeds that are commonly available in your area may be different. You can modify the formulation according to what feeds are available to you.

Use of cassava roots in rabbit feeding

You can feed fresh cassava roots to rabbits. They like to nibble and eat them.

When you are giving fresh roots, remove the peel, cut the roots into sections and then feed the root pieces. You can also feed the cassava as dried chips or as meal. You can use up to 40% cassava meal in rabbit rations.

Using cassava

For young chickens and for broilers, you must not use more than 20% cassava meal in rations. For example, if you are mixing a 10kg ration, cassava meal must not make up more than 2kg.

In the rations of growing chickens, you can include up to 30% cassava meal. I.e. you can use up to 3kg of cassava meal in mixing a 10kg ration.

For chickens that are laying eggs, you can include up to 40% cassava meal. When you mix a 10- kg ration, up to 4 kg can be cassava meal.

Too much cassava meal must be avoided. If you use too much cassava meal, the ration will become powdery and dusty. Chicken can be irritated by dust and not eat enough.

Ways of overcoming dustiness include pelleting, or addition of molasses or fat or wet mash feeding. Using pellets is very effective in overcoming the dustiness and powdery texture. However, you cannot do this on your farm because you need a pelleting machine. But use what is available and cheap in your area.

Wet mash feeding can be used to avoid the dustiness problem. Wet mash feeding is also very useful during hot weather. Wet the feed only when feeding the to chickens. Otherwise it may get spoiled.

Low level of pigments in cassava

Cassava meal is white in colour. It does not have any pigments. When you feed rations with a lot of cassava, the egg yolks will be light-coloured and the chicken meat will have pale skin. These eggs and chicken meat will fetch low price.

You can avoid this problem by using feeds that have a lot of pigments. Leaves have a lot of pigments. You can use dried leaf meals in your ration to supply the pigments.

When you use high levels of cassava meal, make sure to include a leaf meal in the chicken ration. At least 300- 500g of leaf meal must be used when mixing a 10kg chicken ration.

of cassava that have been bred for resistance to the disease. To prevent mosaic spreading in a region, burn all the plants attacked by the disease. Avoid planting towards the end of the rain season; this is the time when transmission by the white fly is most rapid.

A package of integrated control is advocated for cassava. The first objective is to ensure healthy and resistant plants. This is insured through:

Good soil preparation and good drainage.

The use of robust stakes taken from well-lignified stems, free from disease and undamaged.

Correct planting practices, including wide spacing between plants, weed control and fertilizing. Weed control is important not only to avoid all competition with the crop, but also to avoid the appearance of plants that may be hosts to cassava pests.

Use of disease and pest-resistant varieties.

Regular inspections should be made so that appropriate pest control may be applied at an early stage when necessary.

Natural biological control is important and chemicals should be used only when absolutely necessary.

After harvest all plant residues should be removed. Continuous planting of adjacent areas should be avoided as this gives the opportunity for pests to have uninterrupted access to plants at their most susceptible age.

Growth period

Generally cassava reaches maturity in 9-24 months or up to 36 months depending on variety, climate and soil conditions. Some quick-growing cultivars can be harvested in 6-7 months, but good yields are normally

only obtained after 9-12 months. When used fresh the tubers are normally harvested within 12 months, otherwise they become very fibrous. Yields also vary depending on the varieties and soil types besides other natural factors.

Ratooning

After 6 months cassava stems are old enough to be cut and planted elsewhere. The stem is cut without uprooting the cassava. The healthy stems can be planted to other fields or sold to other farmers. Fresh vegetative parts will grow within weeks.

How to harvest and store cassava

Depending on the variety, harvesting of cassava for food may begin from the seventh month after planting for early maturing varieties, or after the tenth month for late varieties. Before this, the tubers are too small. In addition, they still contain too much prussic acid.

In smallholder farm families you can harvest the tubers as you need them. Without cutting the stems, begin by taking the biggest tubers from each plant, leaving the smaller ones time to fill up.



Caption: Well harvested Cassava

If you are selling to a factory, you must harvest all the cassava at the same time. The production of roots and starch is highest 18 to 20 months after planting.

Once cassava is ready, it should be harvested, if left in the ground over longer periods of time the tubers lose quality due to hydrolysis of

If you want to mix your own pig ration in your farm using cassava meal as the energy feed and if you need help ask your extension agent. The agent can help you to formulate a properly balanced ration using feedstuffs available in your area.

When you use high levels of cassava meal in ration, the ration becomes powdery. If you find a pig ration powdery, you can overcome the problem by mixing with water and practicing wet feeding. When you wet the ration, use one bucket of water to wet one bucket of ration. Pigs like wet feed and will eat enough of the ration.

Feeding of cassava root silage

Cassava root silage is a good pig feed. It has low levels of cyanide. When you make silage, the cyanide level is reduced.

When you first introduce the silage, pigs may not like it. They may not eat much. After a few days, they will get used to the silage.

You may see watery faeces when you feed root silage. You need not worry about it because all silages have a slightly laxative effect.

Cassava root silage can be used just like fresh roots to feed pigs. Give the pigs as much as they want to eat. Make sure that you feed the silage with a protein concentrate. You can use the silage to feed pigs of all age groups, except for very young pigs.

Use of cassava roots in chicken feeding

Feeding chickens is different from feeding pigs. For chickens, you need to give all their feed in mash form only.

Cassava meal must be mixed with other feeds in compounded rations and fed in mash form. The energy value of cassava meal for chickens is similar to those of cereal grains. The maximum amount of cassava meal that can be used varies for different types of chickens.

can mix this type of ration on your farm as well.

In compounded rations, cereal grains are used as energy feeds. You can use cassava meal instead of cereal grains. Cassava meal gives the pigs the same amount of energy as cereal grains.

How much cassava meal can you use?

The amount of cassava meal that you can put into compounded rations will vary according to the size of the pigs. As the pigs grow bigger, you can use more cassava meal.

Growing pigs

For growing pigs, 2-4 months of age, you can use up to 60% of cassava meal in the ration. For example, if you are mixing a 10kg ration, up to 6kg of it can be cassava meal.

Finishing pigs

At 4-6 months of age and older pigs, you can increase the use of cassava meal up to 70% i.e. in a 10kg ration; up to 7kg can be cassava meal.

When you are using cassava meal in your rations, you must use good protein feeds such as fishmeal, meat meal or soybean meal.

For you to understand the principle of compounded rations, an example of pig rations using cassava meal follows.

Table 1. Pig rations using cassava meal

Ingredient	Ration for	
	Growing pigs	Finisher pigs
	Parts per 100Kg	
Cassava meal	60	70
Maize	10	6
Soya bean meal	22	16
Fish meal	6	6
Bone meal	1	1
Vitamin, mineral pre-mix	0.5	0.5
Common salt	0.3	0.3
Methionine	0.2	0.2
Total	100	100

starch to sugars. The plants can be topped, i.e. the above ground parts removed by hand, using a machete. The roots may then be dug by hand. The hoe is used to expose the roots and leave them to be pulled by hand when the soils are loose or dug out under dry conditions. Damage to tubers is still a problem and this should be avoided.

When you lift the cassava, take good care not to break it.

Tubers damaged in lifting go bad even more quickly.

Pre-pruning of aerial portions of the plant 2-3 weeks before harvesting has been shown to minimize physiological deterioration in the tubers.

Once lifted, cassava cannot be kept for long. The roots begin to spoil as soon as they are out of the ground. That is why on a family plantation, you should not harvest more roots than you can eat while they are fresh, or sell immediately. Cassava keeps longer when it is left in the ground, but the soil must not be too wet. Once harvested, the tubers should be immediately stored wholly under moistened and cold conditions.

When you lift the cassava, take good care not to break it. Tubers damaged in lifting go bad even more quickly.

Pre-pruning of aerial portions of the plant 2-3 weeks before harvesting has been shown to minimize physiological deterioration in the tubers.

There are two types of deterioration that occur during storage, one physiological and the other due to microorganisms. Physiological deterioration, which begins to appear within three days, is essentially a humidity-sensitive wound response that increases enzyme activity leading to discoloration in later stages.

Physical damage to the roots also permits the entry of microorganisms, causing rapid rotting. Storage under conditions that favour wound healing, such as packing in moisture-absorbent material such as saw dust, has been reported to minimize physiological deterioration and invasion by pathogens to give a storage life of 4 or more weeks.

Tubers - these are dark coloured, fleshy and cylindrical, varying a great deal in size and form, with a starch content of 20-40 per cent.

Storing

Primary products

Each plant normally yields 5-10 tubers.

Yield

Yields vary greatly according to cultivars, soil, climate, age at harvesting, etc. Overall average yields for new varieties may vary between 10 to 35ton/ha. On smallholdings normally range from 5 to 15 ton/ha under normal conditions but can drop to 3ton/ha on poor soils.

4-5kg of oilcakes
3-5kg of fishmeal, meat meal or soybean meal
80-100g of bone meal
20g of salt
20g of mineral and vitamin premix
20g of methionine (if available).

To get good results, you must give 200-400g of protein concentrate for every kilogram of cassava roots that you are feeding.

You must mix the protein concentrate well with the fresh roots and then feed the pigs. Do not feed the roots and the protein concentrate separately.

Sometimes you may find that feeding protein concentrate is not economical, especially when you are getting low prices for your pigs. At times like this, you can feed cassava along with various wastes available in your area, such as fish wastes, slaughterhouse wastes, vegetable wastes, food peelings, leaves and grasses. Pigs will not grow fast on this type of feeding, but this method is cheaper.

Feeding of dried cassava to pigs

You can use dried cassava chips to feed pigs, just as you would feed the fresh roots. You must mix the chips with a protein concentrate and feed. Pigs will eat the dried chips without any problem. However, they will like them more if they are moistened before use. A convenient way of using the dried chips is to grind them into a meal and use for feeding.

Use of cassava meal

Cassava meal can be included into compounded rations and can be fed to pigs. Compounded rations are complete feeds and are balanced to supply all necessary nutrients. Compounded rations are prepared by mixing together energy feeds, protein feeds and mineral and vitamin supplements in correct amounts. The mash type feeds that you buy from the dealer are prepared like this. You

Chips

Need for supplements

Remember cassava root is an energy feed. It cannot be used as the sole feed to pigs. Cassava is low in protein, minerals and vitamins. These nutrients must be given in the form of supplements when you feed cassava tubers.

There are many feeds that can supply protein to pigs. These include: oilcakes, grain legumes (or pulses), meat meal, fishmeal and dried leaf meals.

Oilseed cakes are the commonly used protein feeds in animal feeding. You can find many types of oil seed cakes in your area. Examples include Soybean meal, cottonseed meal. Soybean meal is a very good protein feed, but is expensive. Grain legumes such as cowpeas, beans are important protein foods for humans. Usually these are too costly to use as animal feeds; but if the price is low, you can use them as well.

Animal protein feeds are better sources of protein than plant protein feeds. Fishmeal and meat meal are examples of animal protein feeds.

Minerals and vitamins are needed only in small amounts. Calcium and phosphorus can be given as bone meal. Other minerals and vitamins can be given as premix. Premix can be purchased from feed dealers.

You can also supply the vitamins and minerals by giving leaves, grass and other fresh materials to pigs.

The vitamins and mineral supplements must be mixed with the protein feeds and the mixture must be fed along with cassava roots. This mixture is called protein concentrate.

Protein concentrate

A 10kg mixture of protein concentrate could be prepared using the following ingredients:

Chapter 2

Cassava processing

Cassava is staple food for many people in Uganda. It is used in many forms.

Locally cassava is classified as bitter or sweet type. The bitter type contains higher hydro cyanic acid content than the sweet type. The bitter type must therefore undergo detoxification before it is consumed.

Cassava tubers can be eaten whole, but they are also turned into flour or paste. The reasons for this are to:

- ✓ get rid of the poison
- ✓ keep the cassava for a long time
- ✓ get foods with a more pleasant taste

For eating fresh, the sweet varieties are preferred. The poison in cassava is mainly in the peel. Wash the cassava carefully, cut the roots into pieces and boil or steam them. To make cassava paste, pound pieces of cooked tuber in a mortar or mash them. These are often consumed with soups and stews.

As the fresh tubers deteriorate rapidly they are often preserved in the form of sun-dried chips and consumed after being ground into flour. Sweet types are processed by peeling, slicing into thin strips using hand knives, and sun dried. The slices can keep for a long time. To make flour, the dried chips are milled.

Another principal form in which bitter cassava can be eaten is as a fermented and roasted meal known as 'gari', most common in West Africa.

Processing of bitter cassava types requires a lot of care to ensure that the poisonous substance is removed. There are three efficient techniques of processing bitter cassava types, these are:

The traditional dry fermentation method.

Fresh cassava
and paste

Dried
and flour

Gari

The traditional wet fermentation method, and
The rapid fermentation method (which is also called 'gari' making).

In this manual the focus is gari making.

In making gari from bitter cassava the following steps must be followed:

1. Washing with clean water
2. Peeling and washing the peeled tubers
3. Grating to form pulp - different methods can be used
4. Squeezing harmful juice out of the pulp - different methods can be used
5. Sieving
6. Fermenting
7. Roasting
8. Cooling
9. Sieving gari crumbs
10. Packaging

Gari can be eaten in the dry form, but more commonly is soaked in hot water or milk. Gari is good because it is pre-cooked food that needs very little time to prepare. The final product can store for long and therefore should be kept in clean, dry and airtight sealed containers i.e. plastic containers, bottles, tins or polyethylene bags.

Cassava leaves

In some parts of Uganda, cassava leaves are eaten as vegetable especially at a time of food scarcity. They are in fact rich in vitamin C and mineral salts, and contain some protein.

Collect the young leaves from the growing tips of mature cassava, wash them and pound in a mortar and cook, when ready you can mix with groundnut butter or fry like any other vegetable.

Mature leaves, which have a protein content of 5-7 per cent, can be used for animal feeding and are sometimes dried and ground into a meal. They have high lysine content

Chapter 4

Cassava in livestock feeding

Cassava in pig feeding

Cassava roots are good energy sources for animal feeding. Cassava tops after harvesting the roots are also valuable feeds. Cassava roots can be fed to animals in many forms including as:

- fresh roots
- dried chips
- meal
- silage

You can use cassava to feed your pigs, chickens, rabbits and cattle.

Use of cassava roots in pig feeding

The easiest way to feed cassava is in the fresh form. Whole roots can be peeled, chopped and given free choice to pigs. You can let the animals eat as much as they like. But you must be careful since cyanide can cause problems. They will not grow well. They may even get sick.

If you want to use bitter cassava types, you must boil it. However, boiling will require wood or fuel and it is costly. The safe way is to introduce the fresh roots slowly and watch the pigs carefully while observing any bad signs. If you do not see any bad signs that means there is no cyanide problem. Then slowly increase the amount given. However when you notice anything wrong with the animals and you do not understand why, stop feeding the fresh roots.

The bigger the pigs are, the more cassava roots they can be given. For 2-4 month old pigs, you can feed 1-1.5kg of fresh roots every day. For older pigs, you can feed 3-6kg of roots daily.

Features of commercial value

The approximate composition of commercial samples is: moisture 9-18%, protein 0.31-1%, fat 0.1-0.4%, starch (and a little fibre, etc.) 81-89%, and ash 0.1-0.8%. Good quality starch should be absolutely free from specks and have a pure white colour, a pH of 4.7-5.3, and a moisture content of 10-13.5% ash content of less than 0.2%.

Food safety

The above processes are efficient methods for removing the harmful substance from bitter cassava roots. Failure to process bitter cassava will lead to unsafe food that can cause problems even death. Always ensure that the most critical steps in processing bitter cassava that involve:

- breaking up and softening the roots as much as possible, and drying the product completely, are followed.

Remember this is important! never do the following separately as these methods singly do not remove poison:

- drying whole bitter cassava type roots
- cooking/boiling fresh bitter cassava type roots
- eating bitter cassava types in fresh or raw forms

Chapter 3

Other opportunities for utilising cassava

Starch production

A substantial industrial outlet for cassava is in the manufacture of starch for use in the foodstuff, textile and paper industries, the manufacture of plywood and veneer, adhesives, glucose and dextrin.

Steps

The mature roots are first washed to remove dirt and loose soil

In small-scale operations the roots are then peeled by hand to remove the skin and cortex; on a factory scale only the outer skin is removed, since when processing large quantities of roots it becomes economic to recover the starch from the cortex although it only contains about 50 per cent of that in the core of the root

The roots are next sliced and put through a rasping or grating machine to produce a slurry or pulp

The slurry is then sieved to separate the fibrous tissue from the starch milk; considerable quantities of clean water are used at this stage in order to ensure efficient separation of the starch granules from the slurry

The starch milk is collected and left in settling tanks for at least 6 hours, when the starch sinks to the bottom and the liquid is drained away

The surface layer of the starch mass is usually a yellowish-green colour and contains impurities and is therefore scraped off, leaving a creamy-white mass below, which is stirred vigorously with water and then left to settle. This washing and settling process is repeated once or twice more until the starch is judged to be sufficiently pure

The starch cake is dried, either by spreading it out in trays in the sun or in factories in hot-air driers

Finally, the hard lumps of starch are crushed into a powder and sieved.

It should be pointed out that, because the cells of cassava roots are relatively tough, the grinding process must be efficient in order to liberate all the starch granules and to obtain a commercial extraction rate of approximately 20-25 per cent of the raw material.

This is one of the basic forms in which many rural households derive their livelihoods. In Uganda alcohol is produced directly from cassava roots, through malt saccharification and immediate fermentation and distillation

Cassava flour

Cassava flour is used in the preparation of bread, biscuits and confectionery.

Glucose can also be produced from cassava.

Nutrition information

The typical range of composition for the edible portion of the tubers is:

Energy 607 kJ/100g, water 62-65%; protein 0.7-2.6%, fat 0.2-0.5%, total carbohydrate 32-35 per cent, fibre 0.8-1.3 per cent, ash 0.3-1.3 per cent, calcium 33 mg/100g; iron 0.7 mg/100g; thiamine 0.06 mg/100g; riboflavin 0.03 mg/100g, niacin 0.6 mg/100g, ascorbic acid 20-30 mg/100g, vitamin B 10 IU/100g.

The principal amino acids present in the protein are: arginine, histidine, isoleucine, leucine and lysine.

Owing to the low protein content the disease Kwashiorkor can be prevalent in areas where cassava is the main staple item of diet. A method of enriching the nutritional benefit of cassava is by eating it with other foods high in protein such as fish, meat, legumes and vitamin rich foods such as vegetables. It is important to always prepare and eat foods that have balanced nutritional components.

Alcohol

In confectionery