



COLLECTION
PRO-AGRO

Cassava

production and processing

*Justin Kouakou, Samuel Nanga Nanga, Catherine Plagne-Ismail,
Aman Mazalo Pali & Kukom Edoh Ognakossan*

Contributors

COORDINATOR

E. Lionelle Ngo-Samnick

AUTHORS

Justin Kouakou, Samuel Nanga Nanga, Catherine Plagne-Ismail, Aman Mazalo Pali and Kukom Edoh Ognakossan

REVIEWERS

Mélanie Rousseau, Pascal Nondjock, Anne Downes and Bianca Beks

ILLUSTRATIONS

Éric Mengaptche

TRANSLATION

BLS

LAYOUT

Stéphanie Leroy

The Pro-Agro Collection is a joint publication by Engineers Without Borders, Cameroon (ISF Cameroun) and The Technical Centre for Agricultural and Rural Cooperation (CTA).

CTA – P.O. Box 380 – 6700 AJ Wageningen – The Netherlands – www.cta.int

ISF Cameroun – P.O. Box 12888 – Yaoundé – www.isf-cameroun.org

© CTA and ISF 2016

Cover photo: © Silvia Muña Moirón

ISBN (CTA): 978-92-9081-597-6

Contents



1	Description of the plant	05
2	Cassava production	07
2.1	Site selection	07
2.2	Site preparation	08
2.3	Selection of cuttings	08
2.4	Crop rotation, density and planting	09
2.5	Maintenance of the crop	12
2.6	Fertilisation	12
2.7	Crop protection	13
3	Cassava harvesting	16
4	Storing cassava	17
5	Some food products based on cassava leaves	19
6	Cassava processing	21
6.1	Traditional production of cassava paste	21
6.2	Production of cassava sticks	23
6.3	Production of dried cassava chips	24
6.4	Traditional production of cassava flour	25
6.5	Traditional production of cassava starch	26
6.6	Production of fermented and baked semolina	26
6.7	Production of gari	28
6.8	Production of cassava pasta	29
6.9	Traditional production of cassava beer	30
6.10	Traditional production of cassava spirits	30
7	Socio-economic indicators	32
7.1	Production and sale of cassava tubers	32
7.2	Production, processing and sale of gari	33
7.3	Production, processing and sale of attiéké	34
8	Additional information	35
8.1	Bibliography	35
8.2	Useful contacts	37



General information

With the scientific name, *Manihot esculenta*, cassava is one of the most cultivated and consumed food crops in many parts of the world.

This shrub, growing to around 1 to 4 metres in height, is cultivated for its tubers and leaves. The tubers are rich in starch. The stems are used as planting material. Eaten both by humans and animals, cassava is widely used in the food industry (pastries, tapioca, food pasta, chips). With over twenty derivative products, cassava is also used in the textile industry and in the production of paper, glues, alcohol or starch.

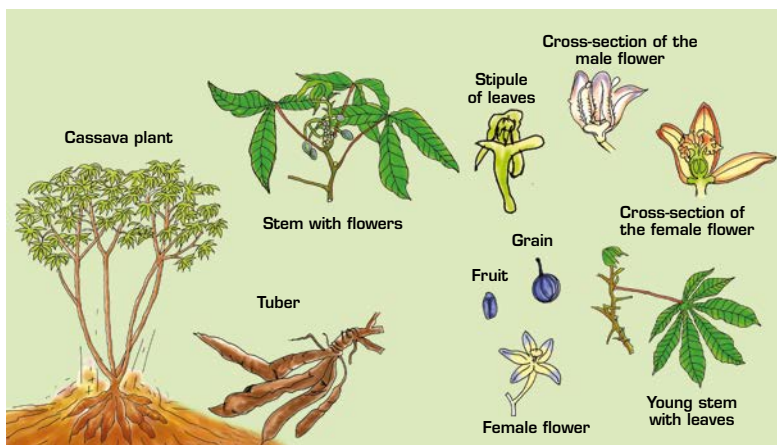
Its cultivation provides significant income to small producers around the world. Cassava tubers as well as its by-products are sold everywhere without difficulty. The stems of improved varieties are also sold as a planting material.

This guide is intended to allow the communicator to make simple techniques available to cassava producers and to improve production, storage and processing.

1

DESCRIPTION OF THE PLANT

Cassava is a woody perennial and branched shrub that can grow up to 5 metres in height. It has large, spirally arranged, lobed leaves of very variable forms. During growth, the shrubs produce several tuberous roots as reserves made of up to 35% starch which may reach up to 1 m in length and together may weigh up to 40 kg. Cassava produces small, regular female and male flowers in small clusters. The shrub produces a form of non-fleshy fruit capsule.



↑ *Parts of the cassava plant*

Cassava grows better in all regions near the equator, at elevations below 1,500 m, rainfall between 1,000 to 1,500 mm/year and a temperature of between 23 and 25°C. With the exception of heavy or saturated soils, it can grow in all soil types; it prefers light, well-drained, deep soils that are rich in organic matter. It favours sunny locations and grows in high temperatures in tropical and subtropical regions. It tolerates long dry seasons (6 to 7 months) as well as reduced precipitation.

Cassava may be planted alone or in combination with other crops such as maize, plantain, vegetables or legumes. The cultivation of cassava does not require much labour, typically 75 to 125 man-days per hectare, from the preparation of the land to harvesting. Sweet cassava tubers may be harvested 8 to 10 months after planting, whereas for the bitter varieties, the harvest starts from the 12th month.



Because of its resistance to high temperatures, drought, and increased concentrations of atmospheric carbon dioxide, cassava is very much adapted to climate change.

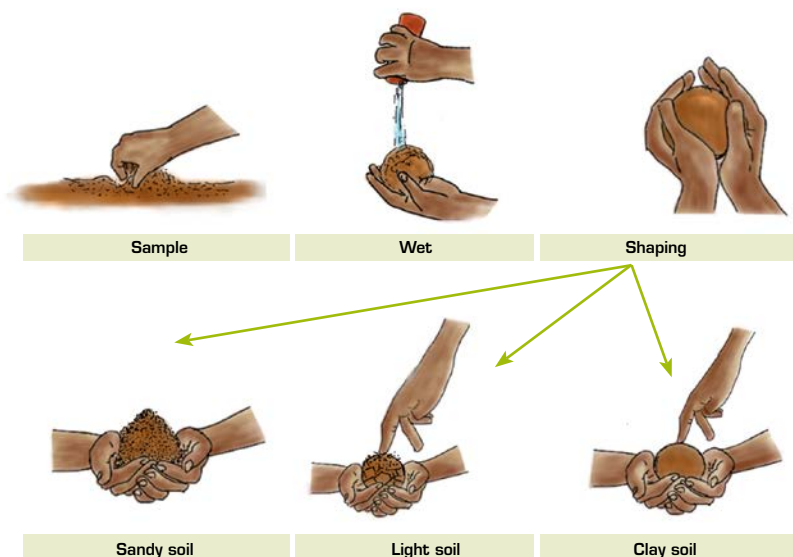
2

CASSAVA PRODUCTION

2.1 Site selection

Cassava is an undemanding plant that is happy in a wide range of soils. Sites favourable to growing cassava have the following characteristics:

- Dense vegetation with lots of dead leaves which increase soil fertility as they decompose.
- A light, deep soil of good texture. Sandy and clay soils are less suitable for growing cassava. Take a small sample of the soil, wet it and shape it into a ball. If the wet earth cannot be shaped into a ball, the soil is characterised as sandy. If the ball crumbles under pressure from the fingers, this is a light soil. If the ball does not crumble under pressure from the fingers, it is a clay soil.



- A flat or slightly sloped site to prevent erosion that may destroy the humus-rich top soil.
- Favourable cropping history: learn lessons from any diseases experienced, the presence of termites or other pests and difficult-to-manage weeds. This information may guide the choice of site and help implement a suitable protection programme for cassava.

2.2 Site preparation

This varies depending on the climate, soil type, vegetation and terrain. The soil surface should be loosened, enriched in organic matter and the growth of weeds should be reduced.

- For manual cultivation, clear the land and dig the soil. For heavy soils, carry out any mounding or ridging.
- For heavy soils, carry out mechanised cultivation, gyro-mulching, ploughing and ridging.

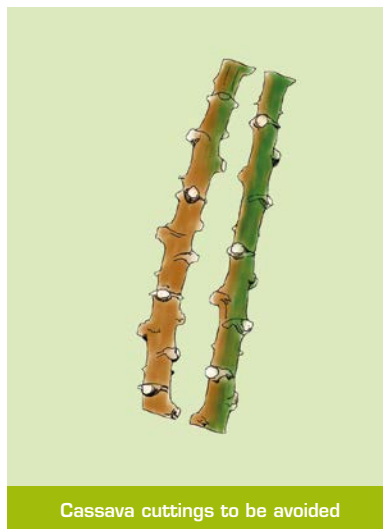
2.3 Selection of cuttings

The best varieties of cassava to plant are those that are rich in dry matter, which can be stored in the ground and are well adapted to the production area. These are the varieties with early tuberisation and which are easy to process.

Cassava cuttings are usually collected in the field during harvesting. Improved varieties may also be obtained from research or appropriate development organisations.

Collect the cuttings of 20 to 30 cm long from the central portions of the brown healthy stems at around 12 months old. Avoid any significantly hardened or tender stems. Healthy crops can be identified by their strong stems and branches, lush foliage, stems and leaves showing little damage from diseases or pests.

To ensure uniform growth, harvest the stems about a week before setting and store them in the shade, in a well ventilated area. The cuttings should be taken at the time of planting or on the day before. Each cutting should have 5–7 dormant buds.














Recommended form of cassava cuttings

2.4 Crop rotation, density and planting

In intensive cultivation, it is advisable to alternate the cassava crop with a rest period using a legume cover crop.

With intercropping, it is best to plant the cassava at the end of the rotation, just before the fallow period, as it depletes the soil.

Types of crop rotation	Farming seasons			
	Season 1	Season 2	Season 3	Season 4
Crop rotation in forest region	 Peanut + Maize	 Squash + Cassava	Fallow	
	 Peanut	 Maize	 Banana + Cassava	Fallow
	 Rice + Cassava + Banana	Fallow		
Crop rotation in savannah region with two rainy seasons	 Peanut + Maize	 Sesame + Cassava	Fallow	
Crop rotation in tropical region	 Cotton	 Peanut	 Sorghum + Cassava	Fallow

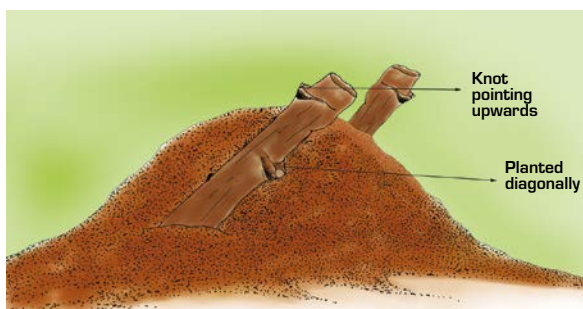
⬆ **Some examples of crop rotation with cassava**

Three factors are important for planting: the planting period, the planting density and the position of the cuttings.

The planting period varies depending on the region. Ideally the farmer should plant immediately after the first rain.

Planting should be at a density of between 6,000 and 10,000 plants per hectare or with spacing of between 1.5 x 1 m to 1 x 1 m for single cultivation and 2 x 2 m with intercropping, or 2,500 plants per hectare. Cassava should be combined with other crops to improve agricultural profitability and soil quality. Because of the nutrients they release into the soil, legume species such as cowpea, beans and peanuts are particularly suitable. Cassava can also be combined with maize, plantain, arrowleaf elephant ear and legumes such as black nightshade.

The cuttings are planted horizontally, diagonally or vertically, with one or two cuttings per placement. The best method is to push them in sideways up to $\frac{3}{4}$ of their length, with the knots pointing upwards. Positioning the knots upside down reduces the yield. Planting sideways favours the consolidation of the roots into one area and results in a grouping of tubers, which makes harvesting easier.



Method for planting cassava cuttings

2.5 Maintenance of the crop

Maintenance comprises:

- Replacing missing plants as required and removing the fragile shoots at the end of the third month and only keeping the most vigorous shoots.
- Combatting weeds by hoeing two or three times:
 - first hoeing: 3 to 4 weeks after planting
 - second hoeing: 1 to 2 months after first hoeing
 - third hoeing: at the start of the second year.
- Make a 10 cm ridge 5 to 6 weeks after planting (for flat seeding).



2.6 Fertilisation


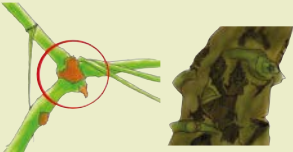

With new or long-term fallow land, fertilisation is not necessary. Under intensive or continuous cultivation, fertilisation compensates for the plant's absorption of mineral elements.

For the production of cuttings, mineral fertiliser is preferred. When preparing the soil, add dolomite lime at a ratio of 100 kg per hectare. Two months after planting, add NPK fertiliser (10, 18, 18) at a rate of 300 kg per hectare, to produce at least 25 tonnes per hectare of urea (150 kg per hectare), tricalcium phosphate (100 kg per hectare) and KCl (250 kg per hectare), with a production target of at least 30 tonnes per hectare.





Organic fertiliser is recommended for the production of tubers. When preparing the soil for planting, add chicken litter or any other animal manure at a rate of 10 tonnes per hectare, or 15 or 20 tonnes per hectare if the soil is depleted.

2.7 Crop protection





Cassava is predominately planted as a subsistence crop; therefore chemical treatment should be limited. Crop control is usually recommended.

Symptoms	Diseases and causes	Crop management	Chemical treatment
<ul style="list-style-type: none"> Deformed leaves showing yellow or pale green spots. Reduced vegetative growth. 	<p>Virus or African cassava mosaic disease, caused by a virus transmitted by the whitefly (<i>Bemisia tabaci</i>), which is abundant at the start of the rainy season and disappears in the dry season. Mosaic disease is caused by using infected cuttings.</p>	<ul style="list-style-type: none"> Use resistant varieties. Plant healthy cuttings. 	<p>Use <i>thiamethoxam</i> (<i>Actara®</i>) or <i>pymetrozine</i> (<i>Chess®</i>)-based insecticides.</p>
<ul style="list-style-type: none"> Cankers on young stems and drying at ends. Brown necrosis on the leaves. 	<p>Anthracnose caused by a fungus (<i>Colletotrichum gloeosporioides</i>) transmitted by a bacterium (<i>Pseudothera raptus devastans</i>). The disease is also transmitted by contaminated cuttings.</p>	<ul style="list-style-type: none"> Use healthy cuttings. Eliminate crop debris. 	
<ul style="list-style-type: none"> Angular spots on the limb. Foliage burns from production of a toxin. Leaf wilt. Lesions on stems with production of exudates. Defoliation of branches. Drying of the leaves. 	<p>Bacterial blight is caused by a bacterium (<i>Xanthomonas axonopodis pv manihotis</i>) and transmitted by infected cuttings but also by crop operations (work tools, soil), rain, wind and insect vectors including the <i>Zonocerus variegatus</i> (orthoptera), often involved in the transmission of cassava bacterial blight.</p>	<ul style="list-style-type: none"> Use resistant varieties. Plant healthy cuttings. 	<p>Dip cassava cuttings in a fungicide solution (<i>Maneb</i>) before planting. Disinfect the soil before planting using an insecticide-nematicide based on carbofuran such as Sesame 10G or terbufos such as Counter 10G.</p>

↑ Main cassava diseases

Symptoms	Diseases and causes	Crop management	Chemical treatment
<ul style="list-style-type: none"> • Small yellow chlorotic spots form pits on the upper side of the leaf. • Dieback of the leaves. • Death and shedding of terminal shoots leading to 'candle stick' appearance. 	<p>The green mite (<i>Mononychellus tanajoa</i>) are tiny wingless creatures which look like spots to the naked eye but may be seen clearly using a pocket magnifier. The pupae (immature mites) are green initially, then have a yellowish colour. The cassava green mite sucks sap from the leaves and ends of the cassava stems.</p>	<ul style="list-style-type: none"> • Plant healthy cuttings. • Carry out crop rotations. • Plant early in the rainy season. • Keep the plot clean. 	
<ul style="list-style-type: none"> • Shorter distance between knots. • Distortion of leaves giving a bushy appearance. • Distortion of the stem (torsion). • Wilting of leaves. • Defoliation of cassava plant. 	<p>The cassava mealybug (<i>Phenacoccus manihoti</i>) appears on the ends of cassava stems, the underside of the leaves and the stems. These mealybugs are covered with abundant secretions of white wax and are characterised by the absence of wings, a pink colour, oval shape and very short body filaments.</p> <p>The cassava mealybugs prick and suck the sap from cassava leaves and buds. While feeding, they infect the plant with a toxin that causes severe disruption to the plant development.</p>	<ul style="list-style-type: none"> • Plant healthy cuttings. • Carry out crop rotations. • Plant early in the rainy season. • Keep the plot clean. 	
<ul style="list-style-type: none"> • Development of sooty mould on the plant. • Blackening of the leaves that dry and fall off. 	<p>By feeding on the sap of cassava leaves, whitefly (<i>Aleurodicus dispersus</i>) secrete large amounts of honeydew which promotes the development of sooty mould on the plant. The adults are a clear white and the insect's pupae appear in a mass on the underside of the cassava leaf, which is covered with an abundant waxy secretion.</p>		<ul style="list-style-type: none"> • Use of insecticides based on thiamethoxam (Actara®) or pymetrozine (Chess®).
<ul style="list-style-type: none"> • Defoliated cassava plants. 	<p>The variegated cricket (<i>Zonocerus variegatus</i>) chews the cassava leaves, petioles and green stems. It defoliates the cassava plants and removes the bark from the stems.</p>	<ul style="list-style-type: none"> • Collect by hand or destroy bands of larvae before their dispersion. • Identify spawning areas close to the crop and destroy the egg pods. • Trap larvae and juveniles using poles sunk obliquely on which they will gather. Collect and destroy the crickets gathered on the poles. 	<ul style="list-style-type: none"> • Use bait poisoned with insecticide. • Use neem tree extracts.

Main cassava pests

Symptoms	Diseases and causes	Crop management	Chemical treatment
<ul style="list-style-type: none"> • Cassava cuttings eaten. The latter suffer from poor growth, dieback and rot. • Chewed and fragile stems. 	<p>Found in several types, termites damage the stems and tubers. They live in the soil or in nests built in the ground. They can also be found in burrows in the cassava stem. They are small insects with a white or brown body and a brown head, with or without wings. The workers, responsible for all the damage to crops, feed the other members of the termite mound.</p>	<ul style="list-style-type: none"> • Always keep the field clean. • Pile debris and harvest waste in one place or bury it. Burn the debris before it is destroyed. • Do not leave crop residue and debris all over the field. 	
<p>The tuberous roots become smaller and deformed.</p> 	<p>The cassava root mealybug (<i>Stictococcus vayssierei</i>) lives underground on tuberous roots, feeder roots and the underground parts of the cassava stem. The insects are purple, red or brown and oval. Firmly glued to the cassava, they are wingless and resemble ticks.</p>	<ul style="list-style-type: none"> • Bury grass during ridging. • Include chicken droppings before planting cuttings. 	<ul style="list-style-type: none"> • Treat the field 4 to 5 months prior to planting with a tephrosia solution.
<p>Drying of the stem.</p> 	<p>The white cassava mealybug (<i>Aonidomytilus albus</i>) sucks the sap from the cassava stem, which loses a lot of water and dies. It is mainly found on the surface of the cassava stem. The females are wingless, cling tightly to the stem and are covered in a white substance.</p>	<ul style="list-style-type: none"> • Use healthy cuttings. • Choose fields isolated from any source of contamination. Do not plant downwind of infested crops; the juvenile larvae are transported in this way. • Use resistant varieties. • Plant as early in the rainy season as possible. 	
<p>Appearance of pale yellow oval spots on the underside of young leaves.</p> 	<p>The whitefly (<i>Bemisia tabaci</i>) absorbs the sap from the leaves without creating physical damage to the plant and infects the plant with a virus causing cassava mosaic. The loss of root yield ranges from 20 to 90%. Adults have bright white wings similar to those of greenhouse whitefly. However, the flies are smaller than the greenhouse whitefly and are not covered with a white substance. They can be found on the underside of young leaves.</p>	<ul style="list-style-type: none"> • Use resistant varieties. • Plant healthy cuttings. 	<ul style="list-style-type: none"> • Use resistant varieties. • Plant healthy cuttings.

Main cassava pests

3

CASSAVA HARVESTING



The harvest involves cutting stems at a height of 25 to 34 cm from the ground using a machete and removing the tubers, making sure not to damage them. This can be done by hand if the soil is light or using a hoe, a stick or a daba. A maximum of 500 kg of tubers are harvested daily

in compacted soil and up to 1,000 kg tubers are harvested each day in wet and light soil.

The dry season is the best time to harvest cassava because the tubers are rich in starch at that time, drying is easy and the products can be easily processed and preserved.

The early varieties may mature at between 6 and 8 months on average after planting, whereas the late varieties require 12 and 19 months under optimal conditions (such as a humid forest region). In the humid savannah, the late varieties should be harvested 20 to 24 months after planting. Cassava grows faster in humid lowlands than in high altitude areas.

The yield varies from 20 to 30 tonnes per hectare for local varieties and from 25 to 70 tonnes per hectare for improved varieties. In hostile environments where other crops fail, cassava can provide good yields. In typical conditions, the yield may vary between 8 to 15 tonnes of tubers per hectare.

4

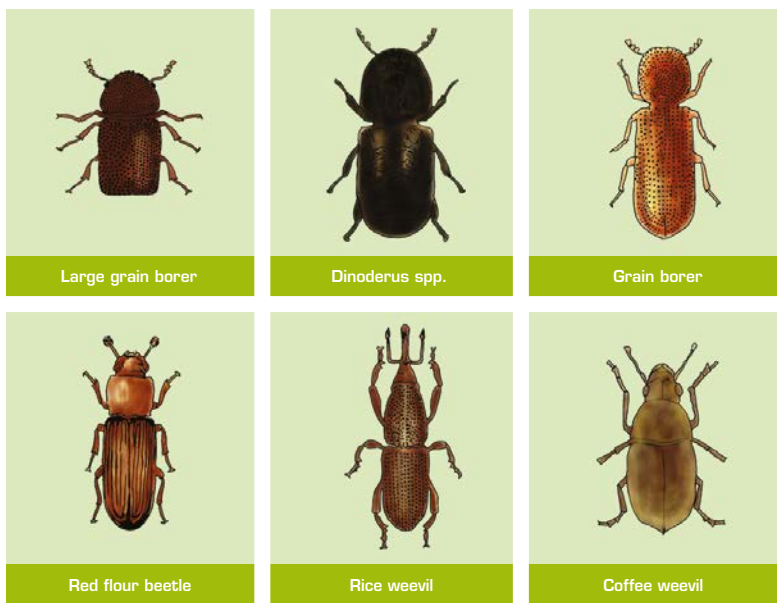
STORING CASSAVA

Two to three days after harvesting, there is a rapid rotting of the tubers. The harvest usually takes place according to use, including a short storage time in the open air. Several methods make it possible to prolong storage by a few days. These are:

- Storage in silo pits covered with a thatched roof.
- Storage in moist sawdust.
- Immersion in a thiabendazole-based fungicide (e.g.: Mertect SC) and placing in polyethylene bags.
- Cold storage and freezing.
- Storage in plastic sheeting with the roots soaked in water.

The field storage method is the most commonly used at family farms but it reduces the productivity of the land, which cannot be used for new crops. The tubers, which can easily be attacked by rodents, insects and nematodes become more fibrous and liquefied, resulting in lower nutritional value.

Cassava is stored as chips (i.e. pieces of cut cassava, shredded or unshredded). The stored chips present a favourable environment for the development of numerous insects such as beetles. The pests include the larger grain borer (*Prostephanus truncatus*), some species of *Dinoderus*, the grain borer (*Rhyzopertha dominica*), the red flour beetle (*Tribolium castaneum*), the maize weevil (*Sitophilus zeamais*), the coffee weevil (*Araecerus fasciculatus*), etc. The larger grain borer is the most destructive and could cause losses of up to 70% after 4 months of storage. It can be controlled through integrated pest management, particularly biological, using the predator *Teretrius nigrescens*.



Insect pests of cassava storage

To do this, you must quickly dry out the chips under hygienic conditions. They must then be stored in facilities that provide sufficient protection against harmful insects and rehumidification. Granaries built from clay as well as bags and plastic barrels are the best storage facilities.

Then stores of cassava must be checked regularly during the storage period for signs of pests. If the crop has been attacked, it must be spread out in the sun to allow the escape or death of most of the pests. They must then immediately be milled and consumed to avoid subsequent losses.

5

SOME FOOD PRODUCTS BASED ON CASSAVA LEAVES

To make the leaves edible, previously chopped or ground leaves must be cooked to remove the large amount of cyanogens that it contains.

KISANVU (TANZANIA)

Ingredients

- 1 kg of fresh and tender cassava leaves
- 30 g of refined oil
- 20 g of onion
- 1 cup of coconut milk or peanut butter
- A pinch of salt

Preparation

Crush the leaves using a pestle and mortar to a very fine pulp.

Boil the water, add the salt and the crushed leaves. Stir continuously until the leaves are cooked (at least 15 minutes). Put aside.

Fry the onions and add the coconut milk or peanut butter. When the mixture starts to boil, add the cooked cassava leaves. Stir for a few more minutes and remove from the heat. Serve with rice or another main cereal-based dish.

KWEM (CAMEROON)

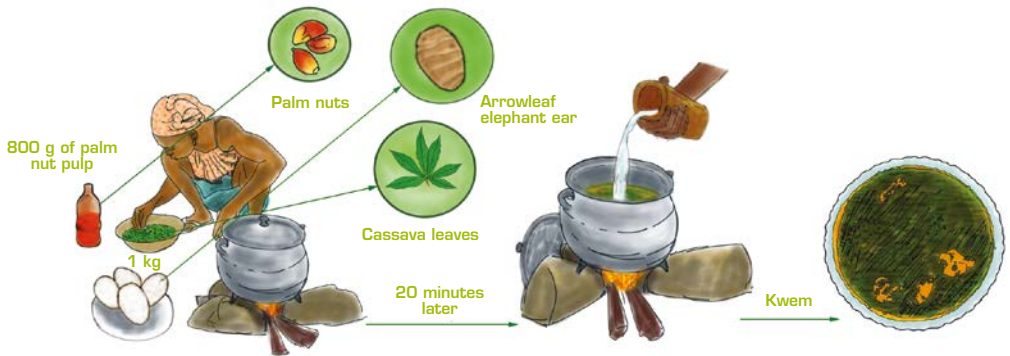
Ingredients

- 1 kg of fresh and tender cassava leaves
- 1 box of palm nut pulp (800 g palm nut soup)
- Cassava or arrowleaf elephant ear tubers (optional)

Preparation

In a large, heavy pot, combine the palm nut pulp with the mashed cassava leaves. Pieces of peeled, cut and cleaned cassava tubers or arrowleaf elephant ear may be added (optional).

Cook them on high heat and stir from time to time. After 20 minutes, check the cooking process and adjust the amount of water. For a quarter of an hour, half cover the casserole to allow the water to evaporate. This vegetable soup is ready once the crushed leaves turn a yellowish colour and the liquid has reduced by half.



The cassava waste or by-products can be used for animal feed, especially pork and poultry.

6

CASSAVA PROCESSING

Cassava may be processed in different forms. A dozen by-products are listed below. Before any processing, select healthy, ripe, firm, freshly harvested cassava roots in order to obtain a quality product.

Cassava processing is based on two semi-finished products: cassava paste (fermented or unfermented) and cassava chips.

6.1 Traditional production of cassava paste

Ingredients

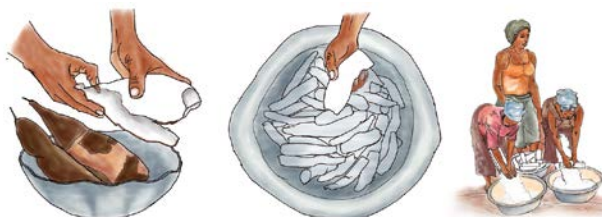
- *Fresh cassava roots*
- *Water*

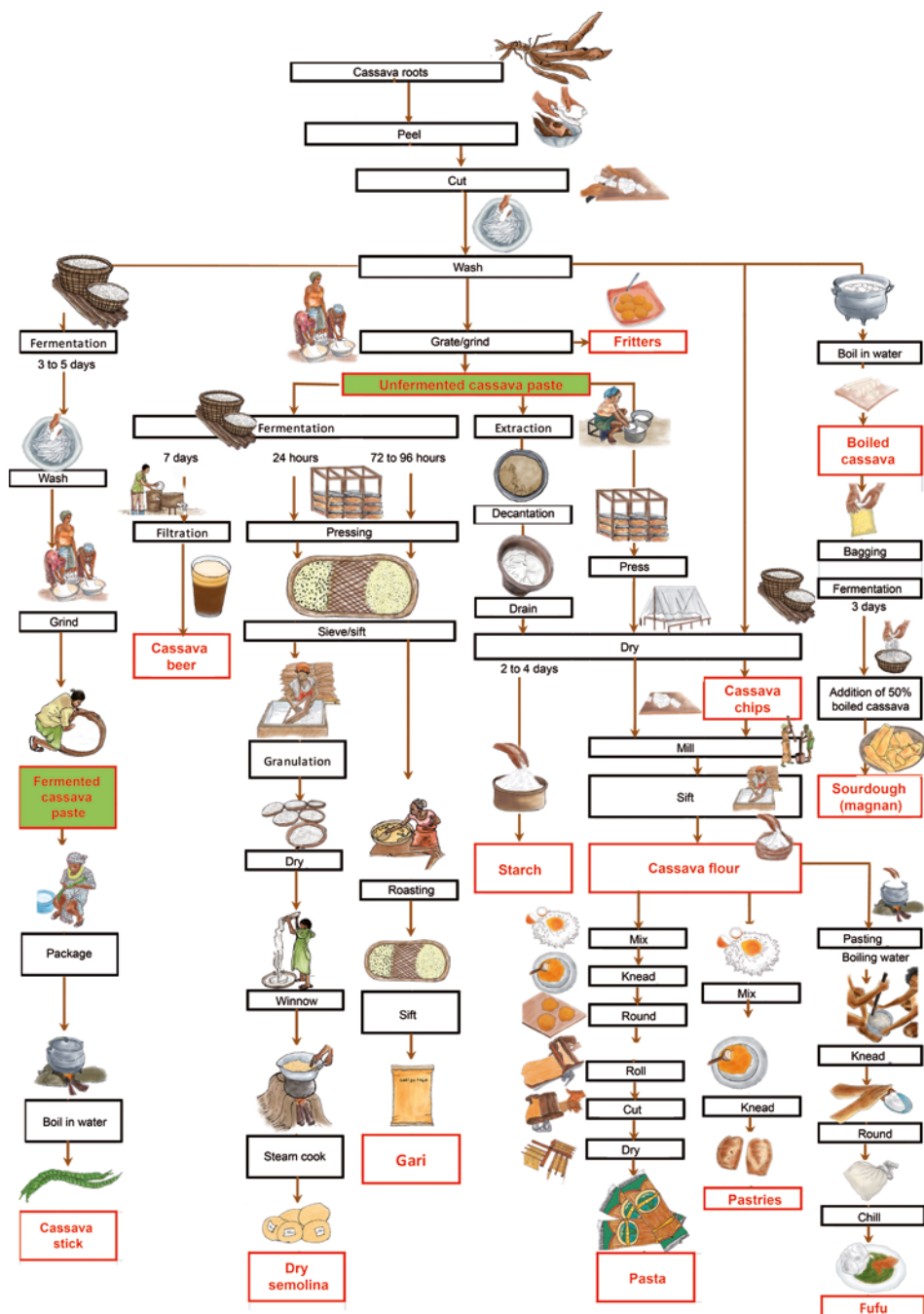
Fermented cassava paste

Peel and wash the cassava roots. Then soak them in water for 3 days to soften them. Once fermented, clean them by removing the central section, then take out the cassava. The resulting paste is pressed and crushed to make the fermented cassava paste used in the production of cassava sticks.

Unfermented cassava paste

Unfermented cassava paste is used in the production of several products such as: pastries, couscous, semolina, starch, etc. Peel the fresh roots. Wash them in clean water. Then grate the cassava. Grating is either done manually by rubbing the cassava against a grater or mechanically through a mill.





Processing procedures for cassava tubers

6.2 Production of cassava sticks

The stick produced depends on the type of packaging used.

Some types of cassava sticks (Cameroon)

>>> Miondo

Fermented cassava paste is made into a length of around 27 cm and put along the length of one or two pieces of reed or plantain leaves. About 1 to 2 cm is left at each end, then the leaf is rolled up and the ends are folded over. The whole piece is tied up.



>>> Bobolo

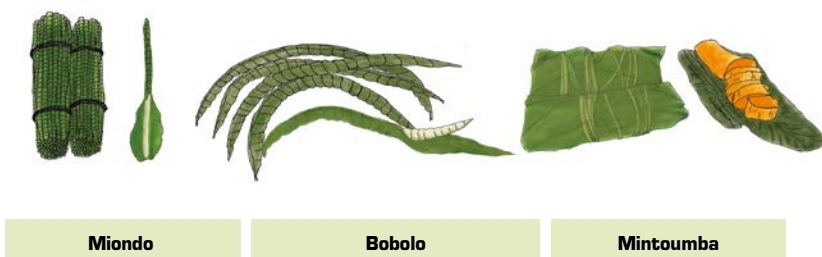
Fermented cassava paste is moulded into one or two leaves of *Halopigia azurea* at a length of 40 cm, with 1 to 2 cm at the folded ends.



>>> Mintoumba

Fermented cassava paste is seasoned with palm oil, salt, local spices and chilli, if required. The yellow paste is then packaged in the form of bread about 20 cm long and 5 cm thick and moulded in one or two pieces of large maranthacea leaves.

After packaging, the packaged pastes are cooked for 45 minutes.



6.3 Production of dried cassava chips

A total of 1 tonne of fresh cassava tubers are needed to produce 250 kg of chips that are made by peeling and cutting cassava into small pieces. The roots are then soaked for 3 to 6 days, depending on the season. This takes less time in the dry season.

Then the fibres are removed and the chips are dried in the sun before they are stored in clean bags.



6.4 Traditional production of cassava flour

Cassava flour production is made either from dried chips or from unfermented cassava paste. In both cases, the product is dried, ground finely and sifted before being packaged.

From dried chips

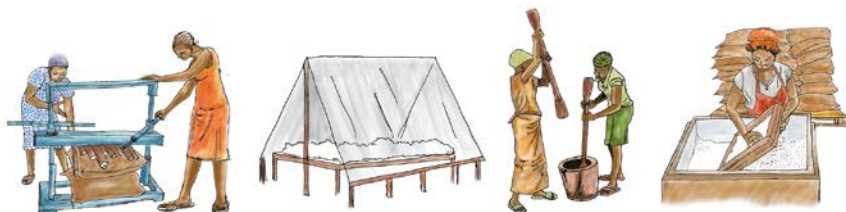
- Grind or crush the chips to produce the flour.
- Sift the flour and put it in suitable packaging (i.e. cup, bag, packet).



From cassava paste

- Press the paste obtained after grating the peeled and carefully cleaned roots.
- Dry in the sun on a clean cloth, positioned on a gentle incline.
- Dry the paste until it is floury. Then grind the dried paste in a mortar or in a mill to produce the flour.
- Sift the flour and transfer it to suitable packaging (i.e. cup, bag, packet).

The cloth must be put on a raised support and not directly on the ground.



6.5 Traditional production of cassava starch

Cassava starch is produced from unfermented cassava paste.

- Mix the cassava paste in a vat of water, at a ratio of 5 litres of water to 1 kg of paste.
- Sift the mixture and collect the starch milk in a basin. Allow the starch to settle for 1 hour.
- Collect the paste that has been deposited at the bottom and leave it to dry in the sun. This extracts the starch.
- Grind the starch and sift the powder, then package it into bags.



6.6 Production of fermented and baked semolina

The fermented and baked meal, commonly known as attiéké, is made from the fermentation of peeled and crushed cassava. Fermentation is carried out by enzymes known as magnan. The semolina is obtained after spinning the paste. It is dried, sifted, sized and steamed to give a sticky and slightly tangy product called fresh attiéké. To make 100 kg of fresh attiéké, you need 200 kg of fresh cassava tubers.

Ingredients

- 70 kg of unfermented cassava paste
- 15 kg of cassava tubers
- 150 ml of refined palm oil

Preparation of leaven

- Peel the cassava tubers. Wash them, cook them and allow them to cool.
- Then wrap them in a polypropylene bag. Allow them to stand for 2 to 3 days.
- Remove the fibres and wash the roots covered with mycelium (yeast).

Preparation of attiéké

- Prepare 70 kg of cassava paste and 7 kg of leaven. Mix the paste and the leaven and add about 150 ml of palm oil, then mix everything together.
- Put the mixture into woven vegetable fibre bowls for fermentation and drain for 2 to 3 days.
- Press the paste in the bags using stone blocks.
- Drain using a large, square, sieve mesh of 1 to 2 mm while removing some of the fibres.



- Break up the lumps by making grains by hand in a large bowl and give the particles a smooth, more or less spherical shape.
- Place the semolina in the sun for partial drying out.
- Shake to remove the fibres. Then bake it in a steamer.
- Place the fresh attiéké in bowls, packets or baskets.



6.7 Production of gari

Gari is a dry meal that can be kept for a very long time. A tonne of cassava tubers can produce 200 to 300 kg of gari.

Preparation

- Prepare the cassava paste, pack into bags and leave it to ferment for 2 to 3 days.
- Press the paste using blocks of stone or a press, until the water stops dripping. Note that the surface of the bag should remain moist.

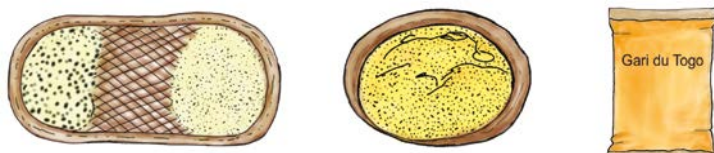
A lot of the water has to be removed to prevent the gari from becoming lumpy during roasting. If the paste is pressed too much, the gari will not cook properly and will be floury.



- Drain the dry paste using a sieve while removing some of the fibres.
- Grill or roast the semolina in a pan or on a hot plate.



- After roasting, sieve the gari to remove the large pieces that remain and size using a bamboo sieve with different mesh sizes, which will give different qualities of gari.
- Keep them in a clean container (bag or packet) for trading.



6.8 Production of cassava pasta

Ingredients

- 500 g cassava flour
- 5 eggs

Preparation

- Pour the flour onto the work surface. Make a well in the middle, add the eggs and mix using a fork.
- Once the flour is completely mixed with the eggs, work the pasta by hand for 15 minutes until it is compact, smooth and elastic.
- Form it into a ball and leave it to rest for 1 hour at room temperature.
- Then, divide the ball into three equal sized pieces. Roll each piece of pasta through the rollers at the maximum thickness setting, then a second time on the tightest setting. Roll it through five or six times until a fine band of pasta is produced. If necessary, pour flour on the pasta to stop it sticking. Fold it in half before rolling it through the machine again.
- Use the pasta dryer or rest the pasta on a cloth for at least 10 minutes, then put it into bags.

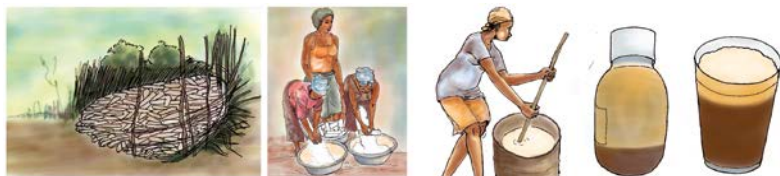
Add water if it is dry or flour if it is too sticky.



6.9 Traditional production of cassava beer

40 kg of cassava tubers are required to make 20 litres of beer.

- Soak the cassava tubers in water for 7 days.
- Peel the roots and grind them to a pulp.
- Add 20 litres of water to the pasta and mix. Leave it to stand for 3 days.
- Filter the fermented juice. Pack the beer into jars or other suitable containers.



6.10 Traditional production of cassava spirits

Ingredients for 4 litres at 45% alcohol

- 4 kg of cassava starch
- 1 kg of sorghum grains
- 20 to 30 g of brewer's yeast

Preparation of sorghum malt

- Sort and clean the sorghum grains.
- Soak in water for 4 days to allow the grains to germinate.
- Dry the germinated grains in the sun for 2 to 3 days.
- Remove the seedlings manually.
- Grind the whole grains (i.e. bark and albumen) to obtain malted sorghum flour.

Preparation and fermentation of the mash

- Heat 20 litres of water in a large kettle to 40°C. Once the water is ready, pour it into a sealed container.
- Pour in 4 kg of starch and 0.25 kg of sorghum flour, stirring with a spatula to prevent lumps forming. Stop once a more or less viscous liquid has been achieved.
- Heat the mixture to around 50°C for 1 hour. Then allow it to cool.
- Add 20 to 30 g of brewer's yeast to the mixture.
- Leave the mixture to ferment for 4 days.

Distillation of fermented wort

- Pour the fermented starch in the main barrel and pour water into the half drum, which will play the role of the refrigerant. Position the drum at the outlet pipe.
- Heat the starch wort to boiling point. Monitor the temperature and the amount of cooling water.
- About 10 minutes after boiling, the first drops of alcohol should come out of the pipe. Monitor the output and replace the container when full.



Despite its higher corrosive power and limited lubricant power, cassava ethanol is an alternative for some energy needs such as domestic fuel.

7

SOCIO-ECONOMIC INDICATORS

Cassava offers considerable advantages in terms of food security with stable and high yields, even on marginal soils and in conditions with uncertain rainfall. The labour and production costs required such as the purchasing of fertilisers, plant protection products and reproduction material are minimal.

As cassava leaves close in on themselves, the cassava plants can be left alone. This makes it possible to optimise the use of labour without endangering the cassava production.

7.1 Production and sale of cassava tubers

The production of cassava roots is a profitable business. The operating account of 1 hectare of cassava over 3 years is shown below:

Item	Amounts per hectare	Unit price (FCFA)	Year 1	Year 2	Year 3
Soil preparation (man/day)	50	1,500	75,000	75,000	75,000
Cutting preparation (man/day)	5	1,500	7,500	7,500	7,500
Planting (man/day)	15	1,500	22,500	22,500	22,500
Maintenance (man/day)	20	1,500	30,000	30,000	30,000
Harvest (man/day)	30	1,500	45,000	45,000	45,000
Purchase of selected cuttings	13,000	20	260,000		
Fertiliser (manure in kg)	10,000	15		150,000	150,000
Harvest transport	40	1,500	60,000	60,000	60,000
Total costs			500,000	390,000	390,000
Harvest (kg)	30,000	28	840,000	840,000	840,000
Net profit			340,000	450,000	450,000

For a plantation of around 10,000 plants in 1 hectare, with a potential yield of 30 tonnes, the net income would be FCFA 840,000 at FCFA 28 CFA per kg. In Côte d'Ivoire a 2.5 tonne truck trades between FCFA 100,000 and FCFA 200,000 (including transport).

Given the short shelf life, customers (i.e. processors, retailers) should be sought from the tenth month to secure firm orders before the harvest (which is expected at 12 months).

7.2 Production, processing and sale of gari

Gari is a popular food product in Benin; its production is a source of relatively stable income. The table below shows an account of operation for the production and trading of 825 kg of gari per week.

Item	Unit	Quantity	Unit price (FCFA)	Total (FCFA)
Raw materials				
Purchase of cassava truck	U/2,5t	1	125,000	125,000
Other materials (water & wood)	U/2,5t	2,5	5,000	12,500
Subtotal 1				137,500
Peeling	M/D	5	1,500	7,500
Washing	M/D	1	1,500	1,500
Rasping (at the mill)	M/D	6	1,500	9,000
Bagging & pressing	M/D	2	1,500	3,000
Sieving/cooking	M/D	4	1,500	6,000
Sizing	M/D	2	1,500	3,000
Subtotal 2				30,000
Total costs/cassava truck				167,500
Yield		0,3		
Production/sale (kg)	kg	825	300	247,500
Weekly net profit	FCFA			80,000
Annual profit (1 batch a week)	FCFA			3,840,000

This is a profitable activity that provides an income above the minimum wage for a group of 4 people.

7.3 Production, processing and sale of attiéké

Attiéké is a widely eaten product in Côte d'Ivoire and in its neighbouring countries.

Item	Unit	Quantity	Unit price (FCFA)	Total (FCFA)
Raw materials				
Purchase of cassava truck	U/2,5t	1	125,000	125,000
Oil	Litre	6	1,000	6,000
Other materials (water & wood)	U/2,5t	2,5	5,000	12,500
Subtotal 1				143,500
Peeling	M/D	5	1,500	7,500
Washing	M/D	1	1,500	1,500
Rasping (at the mill)	kg	2,500	10	25,000
Bagging & pressing	M/D	2	1,500	3,000
Sieving	M/D	6	1,500	9,000
Drying	M/D	1	1,500	1,500
Sizing	M/D	3	1,500	4,500
Cooking	M/D	4	1,500	6,000
Subtotal 2				58,000
Total costs/cassava batch				201,500
Yield		0,5		
Production/sale (kg)	kg	1,250	250	312,500
Net weekly profit	FCFA			111,000
Annual profit (1 truck per week)	FCFA			5,328,000

The production and marketing of attiéké can generate over FCFA 5,000,000 in annual profit.

8

ADDITIONAL INFORMATION

8.1 Bibliography

Amani, G., Nindjin, C., N'Zué, B., Tschannen, A., Aka, D. (editors), 2007. *Potentialités à la transformation du manioc (Manihot esculenta Crantz) en Afrique de l'Ouest*. Actes de l'atelier international UAA-CSRSC-NRA-I2T, 4-7 June 2007, Abidjan, Côte d'Ivoire, 341 p.

Ayissi Z. 2007. Essai d'élaboration et caractérisation d'un biocarburant à base de *manihot esculenta crantz*, Mémoire de Master DIPET II - Université de Douala, Cameroun. 120 p.

Bellotti AC. 2002. Arthropod pests. In: Hillocks RJ, Thresh JM, Bellotti AC, editors. *Cassava: Biology, Production and Utilization*. CABI Publishing, Wallingford, UK. pp. 209-235.

Bellotti, AC, Smith, L., and Lapointe, SL. 1999. *Recent advances in Cassava pest management*. Annu. Rev. Entomol. 44: 343-70.

Braima J., Yaninek J., Neuenschwander P., Cudjoe A., Modder W., Echendu N., Toko M. 2000. Lutte contre les ravageurs du manioc ; International Institute of Tropical Agriculture, Cotonou, Benin. 38 p.

Buhner S. H. 1998. *Sacred and Herbal Healing Beers: The Secrets of Ancient Fermentation*; Siris Books – pp 109-118.

CDDR/SAILD, 2008. Fiche technique – Comment lutter contre les termites ? Centre de Documentation pour le Développement Rural du SAILD, Yaoundé, Cameroon.

CDDR, 2006. Fabrication du baton de manioc. Centre de Documentation pour le Développement Rural, Yaoundé, Cameroon. 6 p.

CIRAD, GRET, MAE, 2002. *Mémento de l'agronome*. Montpellier : CIRAD, 1690 p.

James, B., Okechukwu, R., Abass, A., Fannah, S., Maziya-Dixon, B., Sanni, L., Osei-Sarfoh, A., Fomba, S. and Lukombo, S. 2013. Production du gari à partir du manioc : Guide illustré à l'intention des transformateurs de manioc à petite échelle. International Institute of Tropical Agriculture (IITA) : Ibadan, Nigeria, 24 p.

Janssens M. 2001. *Plantes à racines et plantes à tubercules*. In: Raemaekers R.H., Agriculture en Afrique Tropicale. Ministère des Affaires Étrangères, du Commerce Extérieur et de la Coopération Internationale, Bruxelles, Belgium, p. 171-282.

Mahungu, N. M., Tata Hangy, K. W., Bidiaka, S. M., Frangoie, A. 2014. Multiplication de matériel de plantation de manioc et gestion des maladies et ravageurs, Manuel de formation destiné aux agents de terrain, International Institute of Tropical Agriculture (IITA), Kinshassa, RDC. 44 p.

N'Zué B., Zohouri Goli P., Djédji C., Tahouo O. 2012. Bien cultiver le manioc en Côte d'Ivoire ; Centre National de Recherches Agronomiques, Abidjan, Côte d'Ivoire. 4 p.

PPAAO, FIRCA (2013). Répertoire de procédés et de technologies de conservation et de transformation du manioc : Abidjan, Côte d'Ivoire. 154 p.

Sotomey, M., Ategbo, E., Mitchikpe, E., Gutierrez, M. Nago, M. 2001. Innovations et diffusion de produits alimentaires en Afrique : l'attiéké au Bénin. CERNA, CNEARC, CIRAD, 97 p.

USAID/CORAF/SONGHAI. 2011. Manuel de formation - Transformation du manioc en gari et en farine panifiable de haute qualité en Afrique de l'Ouest, CORAF/WECARD, Dakar, Senegal. 40 p. (<http://usaid.coraf.org/documents/manioc.pdf>) (page seen on 20/02/2015).



8.2 Useful contacts

■ CENTRE NATIONAL DE RECHERCHE AGRONOMIQUE (CNRA) - CÔTE D'IVOIRE

Tel.: (+225) 22 48 96 24

Fax: (+225) 22 48 96 11

www.cnra.ci

■ INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE

IITA-Cameroon

1, Route principale IRAD Nkolbisson

P.O. Box 2008 Messa – Yaoundé

Cameroon

Tel: (+237) 2 223 7434

Fax: (+237) 2 223 7437

E-mail: r.hanna@cgiar.org

www.iita.org

■ FONDS INTERPROFESSIONNEL POUR LA RECHERCHE ET LE CONSEIL AGRICOLES (FIRCA)

Cocody, Deux-Plateaux, 7e Tranche

01 P.O. Box 3726 Abidjan 01

Côte d'Ivoire

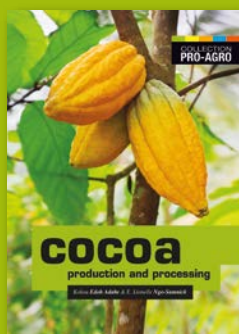
Tel: (+225) 22 52 81 81

Fax: (+225) 22 52 81 87

E-mail: firca@firca.ci

www.firca.ci

In the same collection...



Cocoa production and processing

Kokou Edoh Adabe & E. Lionelle Ngo-Samnick

Construction of solar cookers and driers

Christelle Souriau & David Amelin

How to make a hand pump

Thomas Simb Simb

Improved plantain production

E. Lionelle Ngo-Samnick

Improved technique for hand-crafted soaps and detergents production

Martial Gervais Oden Bella

Maize production and processing

Maybelline Escalante-Ten Hoopen & Abdou Maïga

Raising geese

Irénée Modeste Bidima

Rattan production and processing

E. Lionelle Ngo-Samnick

Rearing grasscutters

E. Lionelle Ngo-Samnick

Cassava

production and processing

PRO-AGRO is a collection of practical, illustrated guides that are jointly published by CTA and ISF Cameroun. They are an ideal source of information for farmers, rural communities and extension workers in tropical and subtropical regions.

This practical guide allows communicators to make simple techniques available to cassava producers and to improve its production, storage and processing. It stresses the socio-economic value of this plant and provides information on its production and processing.

- **The Technical Centre for Agricultural and Rural Cooperation (CTA)** is a joint international institution of the African, Caribbean and Pacific (ACP) Group of States and the European Union (EU). Its mission is to advance food and nutritional security, increase prosperity and encourage sound natural resource management in ACP countries. It provides access to information and knowledge, facilitates policy dialogue and strengthens the capacity of agricultural and rural development institutions and communities. CTA operates under the framework of the Cotonou Agreement and is funded by the EU.

- **Engineers without Borders (EWB)** is a network of professionals in more than 57 countries to promote human development through improved access to scientific and technical knowledge. In Cameroon, EWB works together with local people to improve their livelihoods and strengthen their technical capacity by sharing and diffusing information adapted to their needs.

