

Practical Manual No. 7

# Ndjanssang

*Ricinodendron heudelotii*

Field Manual for  
Extension Workers and Farmers

**DFID** Department for  
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World Agroforestry Centre  
TRANSFORMING LIVES AND LANDSCAPES



2006

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A series of underutilised fruits are being produced and this is Practical Manual No. 7 dealing specifically with Ndjanssang.

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# 1 INTRODUCTION

*Ricinodendron heudelotii* (Baill.) Pierre ex Pax, belonging to the Euphorbiaceae family, is traditionally called the ndjanssang tree. Various names are, however, used to designate it throughout its naturally occurring range.

## 1.1 Description

Ndjanssang is a broad crowned, deciduous, fast-growing tree averaging 20–50 m. It has a straight trunk, short buttress and big running roots. It can measure up to 2.7 m in diameter. Its smooth bark is bright grey in colour but red inside when slashed. Its alternating leaves are divided into elliptical leaflets 20 cm long and 12 cm wide with petioles measuring between 5 and 15 cm long. Toothed, leafy and persistent stipules clasp the stems of the plant.

## 1.2 Flowering

Ndjanssang has male and female trees with small yellowish white flowers of 5 mm long forming a long terminal panicle measuring between 15 and 40 cm. These flowers appear between April and May in Southern Cameroon. The tree's indehiscent green spherical fruits enclose seeds, which have 1 to 3 lobes containing the corresponding number of kernels. Mature fruits weigh 19–47g and smell like over-ripe apples. They appear between August and September.

## 1.3 Distribution

The ndjanssang tree is found in central, western and southern African countries from Senegal to Kenya and Tanzania, Angola and Madagascar.

## 1.4 Habitat

- Ndjanssang grow mainly in rain forests.
- They can also be found in deciduous forests, forest edges, secondary scrub and thickets in semi-dry savannahs, in food crop fields, cocoa farms and fallows.
- The tree can be deliberately planted in the same habitats and in home gardens.

## 2 WHY GROW NDJANSSANG?

Ndjanssang is a high-value multi-purpose tree, which provides food, medicine, and firewood to rural populations. The uses of ndjanssang are listed in Appendix 1.

### 2.1 Food value

- The highly nutritive kernels contained in the seeds are the edible part of the plant.
- The kernels are dried, ground and used as a flavouring agent in some dishes in West and Central Africa.
- The paste derived from the ground kernel is also used to thicken soups and stews.
- Oil freshly obtained from the kernel is used in cooking.
- Caterpillars of the moth *Imbrasia ertli*, found in the leaves, are considered a delicacy in some areas of Central Africa.

Table 1.2 Food value of ndjanssang kernel

Constituent	Quantity (%)
Water	3.1 $\pm$ 0.8
Fatty acid	47.4–55.30
Crude protein	24.3–65.2
Total carbohydrates	5.6–9.3
Digestible carbohydrates	5.6–9.3
Crude fibres	8.9–9.3
Ash	10.5–17.8
Nitrogen	8.6 $\pm$ 0.9
Dry extracts	97.8
pH	7.84
Energy value	495 kcal/100 g

Source: Tchiegang *et al.*, 1998, 2000; Tiki-Manga *et al.*, 2000; Kapseu, 1998; Dandjouma *et al.*, 2000; Ekam, 2003; Tane, 1997.

## 2.2 Medicinal value

Extracts from the tree bark are said to contain *lupeol*, an active agent in the treatment of coughs. Traditional doctors have tested and tried it as an antidote against poison, and use the following parts:

### 2.2.1 Bark

- To cure elephantiasis, gonorrhoea, dysentery, diarrhoea, cough, hernia, rheumatism, abscesses, rickets, smallpox, yellow fever, anaemia, skin diseases, malaria, stomach pain, headache, toothache, and worms.
- As an aphrodisiac.
- As an anti-inflammatory.

### 2.2.2 Seed husks and latex

- To cure gonorrhoea and diarrhoea.

### 2.2.3 Leaf decoctions

- To cure dysentery, oedema and female sterility, and as a febrifuge.

### 2.2.4 Sap

- To cure eye infections.

## 2.3 Ecological importance

Ndjanssang is used as a soil-improving tree because:

- It forms arbuscular mycorrhizae.
- It is a natural leaf litter.
- Ash from burnt kernel shells is rich in potassium.
- Cake remaining after oil extraction from the seed is a good nitrogenous fertilizer, as is the waste from fermented leaf pulp.
- It provides shade in cocoa plantations owing to its large crown.
- It is a source of high-quality fodder for sheep and goats during the dry season.

## 2.4 Industrial uses

- Thick, pale yellow oil obtained from dried kernels as well as ashes from its burnt wood can be used in the manufacturing of soap and varnish.
- The tree fibres are equally suitable for paper pulp manufacturing.

## 2.5 Socio-cultural importance

- Dried seeds of ndjanssang are used for popular games (“songho” in Cameroon and “okwe” in Nigeria) and rattles for “bundu” dances in Sierra Leone.
- The wood of the tree is also used to make drums, which accompany traditional dances in most African countries.



## 3 WHAT TO GROW

### 3.1 Varieties

Ndjanssang has only been actively under domestication since 1995. Consequently, there is limited information on patterns of genetic diversity and the identification of potential genetic resources that could be used to improve the plant.

### 3.2 Propagule types

The ndjanssang seed does not germinate easily because of its hard shell. This has encouraged the development of various methods to facilitate its propagation. The tree can be propagated using seeds or vegetative material.

## 4 WHERE TO GROW

### 4.1 Climatic and soil conditions for cultivation

Table 4.1 Climatic conditions under which ndjanssang does best

Climatic condition	Minimum	Maximum
Altitude (m)	100	1250
Rainfall (mm)	1000	<3000
Temperature (°C)	18 °C	32 °C

Ndjanssang planting materials (rooted cuttings, marcotts or grafts) germinate best on a mixture of river sand and forest soil mixed in the ratio of 1:3. Juvenile cuttings develop roots even faster in a non-mist propagator on a mixture of river sand and rotten sawdust.

### 4.2 Site requirements

Table 4.2 General physical soil requirements for the growing of ndjanssang

Characteristics	Suitable habitat
Soil type (texture)	Medium textured ultisols and oxisols
Topography	Lowlands
Rooting depth	Freely draining
Soil pH	Acidic, pH 5–6

### 4.3 Light requirements

Ndjanssang is a fast-growing light-demanding tree, and is a good coloniser of areas where farming has been abandoned. It regenerates sparsely from seeds under dense canopies.

### 4.4 Land use systems

- The tree is widespread in fallows, secondary forests and farmlands where it has been preserved. In Cameroon, during land clearing for crop establishment, farmers spare trees of the species.
- In home gardens, the species is associated with banana, maize, African plum (*Dacryodes edulis*), bush mango (*Irvingia gabonensis*), *Cola* spp., etc.
- In rainforests, ndjanssang tends to grow in association with forest trees such as *Alstonia boonei*, *Pycnanthus angolensis*, *Triplochiton scleroxylon* (Ayous, samba), *Milicia excelsia*, *Ceiba pentandra*, *Terminalia superba*, *Cordia platythyrsa* and *Ficus exasperate*, *Holarrhena floribunda*, *Bombax buonopozence*, *Antiaris africana*, *Tectona grandis* and *Sterculia tragantha*.

### 4.5 Wind

Ndjanssang tree branches are not resistant to strong winds.

## 5 HOW TO GROW

### 5.1 Propagation by seeds

- Trees from seeds have the advantage of developing a strong taproot, which stabilises the tree in the soil, and allows wide exploration of the soil for nutrients.
- The inconvenience of propagating ndjanssang through seeds lies in the difficulty in distinguishing between male and female trees before the reproductive phase when female trees flower, while the male plants do not.
- Offspring produced from seeds may not necessarily present the same characteristics as the parent plant.

#### 5.1.1 Seed collection and handling

Seeds should be extracted only from fruits harvested from selected quality trees with identified characteristics to be reproduced. When well managed, trees start fruiting five years after planting. The production is regular in most countries of West and Central Africa.

- Collect mature and healthy fruits that fall freely at maturity from the trees. In southern Cameroon this is during September and October.
- Fruits usually contain 1 or 2 seed lobes, and rarely 3.
- Keep fruits under ambient temperature for 2 weeks to allow decomposition of the fruit pulp and facilitate extraction of the seeds.
- When the fruit pulp is soft, squeeze the seeds out of the pulp and wash in cold water.
- If seeds are to be conserved and not directly used, dry seeds in open air for 1 week and store them at room temperature in airtight polythene bags.
- Seeds collected from different trees should be stored separately to facilitate the choice of planting material.

#### 5.1.2 Seed treatment for germination

- Ndjanssang seeds germinate at a rate of less than 40% untreated.
- Germination rate is 70% when the seeds are treated before planting.
- Scrape the seed apex on sandpaper to open the micropyle, through which water can enter and accelerate germination.

#### 5.1.3 Sowing

- Sow seeds in seedbeds or pots at a depth of 2–3 cm.
- In the dry season, water plants preferably in the morning, once every two days for the first month after planting.
- Place seedbeds or seed pots under shade for the first 2 months.

## 5.2 Vegetative propagation

☞ See Technical Note 2b on vegetative propagation.

This is the method used to reproduce trees with exact desired characteristics or female trees. Leafy stem cuttings, marcotts and grafted plants are the most used propagule types. Experiments to better integrate these different propagules, especially those obtained from vegetative propagation, are in progress at ICRAF – AHT station in Yaounde, Cameroon.

### 5.2.1 Rooting of leafy stem cuttings in a non-mist propagator

#### 5.2.1.1 Setting up the propagator

- Non-mist propagators are constructed at 3 m x 1 m x 1 m. They are made up of a wooden frame enclosed in transparent polythene sheets with a watertight base.
- A thin layer of fine river sand to prevent the stones from bursting the polythene sheets covers the base of the propagator.
- Successive layers of small stones and gravel are then overlaid with the rooting medium to a depth of 10 cm on top of the gravel.
- Treat the rooting medium with fungicide (Ridomil or Caocobre) and insecticide (Cyperdim 220 EC) 3 days before using it.
- Protect eyes, nose and mouth when using chemical products.

#### 5.2.1.2 Preparation of cuttings

- After setting the propagator, select pest- and disease-free coppiced shoots (sprouts) from stumps of recently cut trees. When propagating from cuttings, juvenile plant material is the best, as the capacity to form adventitious roots decreases with maturity.
- Spray coppiced shoots with water, cut and store in polythene bags, moistened inside, for a maximum of 18 hours before reaching the nursery.
- Using a sharp blade, trim shoots into cuttings of 3–4 cm of length. Each cutting should have a node and full internodes under it. The number of cuttings to be obtained per shoot depends on the number of nodes present on the shoot.
- After obtaining the cutting, reduce the leaf to half its size.
- Insert cuttings in a 1:1 mixture of sand and sawdust medium contained in the non-mist propagator.
- After 5 weeks, lift each cutting to assess rooting; remove rooted cuttings from the propagator and put in polythene bags of 1 litre each containing a 2:1 mixture of sand and sawdust.
- A cutting is considered to be rooted when it has successfully developed one or more roots exceeding 1 cm.
- Remove rooted cuttings from the propagator and pot them in black polythene bags containing a 2:1 mixture of forest soil and sand.

### 5.2.2 Air-layering or marcotting

- The best trees on which to set marcotts are those 7–12 years old, having borne fruits once.
- To increase the chances of survival and long-term production of the marcott, it is important to select vertical branches of 5–8 cm diameter in the middle of the crown.
- Remove the bark from a 3–4 cm girdle at about 10–15 cm into the main tree stem.
- Mix the rooting medium with a powdered insecticide, apply the mixture around the branch and wrap with transparent polythene plastic.

*See observations concerning the use of chemical products.*

- After 2 months, detach rooted marcotts from the mother tree. Take care not to injure the new-formed roots when trimming lateral branches.
- Water the marcotts abundantly and pot up into black polythene bags of 10 l containing a 2:1 mixture of forest soil and river sand. Rooted marcotts are weaned in humidity chambers (with humidity levels of between 80 and 90%) to allow acclimatization and development of new leaves.
- After 6 months in the nursery, rooted marcotts are ready for planting.

### 5.2.3 Grafting

Grafting is the uniting of a shoot or bud (the scion) with a plant (the rootstock) that is already established, either by insertion or by placing them in close contact.

The following materials and equipment are needed to graft the ndjanssang tree:

#### 5.2.3.1 Grafting materials

- A clean sharp budding knife.
- Polyethylene tape (budding tape) measuring 1.5–2.0 cm wide and 30–40 cm long, or strips cut from black or transparent polyethylene bags.
- Clear plastic bags large enough to cover the top of the shoot or scion.
- Shoot.
- Rootstock.

#### 5.2.3.2 Rootstock preparation

A rootstock is raised from seeds or young plants collected under mother trees and potted in polythene bags containing a 2:1 mixture of forest soil and river.

☞ See Technical Note 3a on rootstock preparation.

- The young tree is ready for grafting at 4–6 months, when it is 40 to 50 cm tall, with a diameter of 0.8 to 1 cm (pencil size).

- Select pest- and disease-free plants; clear the stem of the rootstock of any soil and debris.
- Cut off the top at a height of 30–40 cm retaining two or more leaves below the cut.
- Make a cut obliquely into the rootstock.

#### **5.2.3.3 Scion collection and preparation**

Scions should be collected from trees that are mature, having borne fruits at least once. Scion material should additionally:

- Measure 5–15 cm long.
- Measure 1 cm in diameter (pencil size).
- Be collected at the tree's vegetative growing stage.
- Have one or more buds.
- Select and cut scion material from the tree and then remove the leaves with a sharp knife.
- If scions are not to be used immediately, wrap them in a moist newspaper and place them in a plastic bag to keep them fresh.
- Make two cuts 3–4 cm long at the base of the scion to match the cut of the rootstock. Place a sharp knife almost parallel to the twig and cut in one stroke providing a completely level surface. The scion should fit exactly and tightly into the notch of the rootstock.
- Cut away the top of the scion afterwards to encourage the union, leaving at least one bud.

#### **5.2.3.4 The graft union**

- After preparing the rootstock and scion, join them to establish firm contact at the growing surfaces.
- Firmly tie the union with plastic tape to prevent drying out of the growing surfaces, which may result in union failure. Make sure that the wound is entirely covered.
- Cover the top of the grafted plant with a transparent polythene bag to prevent water from touching the newly created wound; water the plant regularly, to prevent loss of moisture by transpiration.
- When the wound heals and fresh leaves grow on the newly attached portion, the graft is said to be successful. The polythene bag can be removed to enable the buds to produce new leaves and enhance further growth of the grafted plant.
- This can take approximately 1–3 months.

## 5.3 Field establishment

### 5.3.1 Site preparation

Humid lowlands (0–800 m above sea level) with clay or very sandy soils are the best for the planting of ndjanssang trees. The land should be prepared long before the installation of the young trees.

- All shrubs and eventually other trees must be cleared from the site if you decide to plant the trees in association with food crops.
- Young plants should be installed in planting holes of about 30 cm x 30 cm (for seedlings, cuttings and grafted plants) or 50 x 50 cm (for marcotts).
- To prevent tree crowns from touching each another and to guarantee higher yields, it is advisable to plant the trees at a distance of 10 m.

### 5.3.2 Transplanting

- The plants you want to transplant should have spent at least 6 months under shade, be at least 20–30 cm tall, and have a robust stem.
- When planting you should first put the topsoil in the planting hole, followed by the plant, and finally cover with the remaining soil.
- Create shade around the plant by making a 1 m high fence of palm fronds, covered at the top for the first 2 weeks.

## 5.4 Plant management/husbandry

### 5.4.1 Watering

- Water trees abundantly after planting, especially if it did not rain the day before planting.
- Water plants once every 2 days, early in the morning, for the first month after planting, in order to help the plant adapt to its new environment.

### 5.4.2 Fertilising

As a fast-growing species, the young potted ndjanssang plants can benefit from the application of chemical fertilizer to provide additional nutrients for their growth and development.

- Nursery: 25 g of fertilizers can be applied as NPK 20:10:10, as top dressing every 4 months.
- In the field: 50 g of inorganic fertilizer can be applied as NPK 20:10:10, as top dressing every 4 months.

### 5.4.3 Husbandry

- No pruning is recommended in the management of ndjanssang.

- Weeding is very important to allow quick growth and development of the young plants.
- It is recommended to weed 1 metre around the trees once every 2 months for the first year after planting.
- During the first year, mulch with dry herbs during the dry season to avoid water loss and protect the young plants from drought.

#### 5.4.4 Pest/disease control

Insects and fungi usually attack young ndjanssang plants. This can slow down their growing process. To overcome these attacks, insecticide can be applied on young plants every 15 days for the first 2 years.

- Using a knapsack sprayer, spray insecticide on the plants on dry days (one dose of Cyperdim in 15 litres of water).
- Apply fungicide as a spray of Ridomil or Caocobre once every month (one dose in 15 litres of water).

### 5.5 Harvesting

☞ See Technical Note 5b on harvesting.

- Naturally growing ndjanssang trees begin bearing fruit at 6 to 7 years of age, but trees derived from cuttings or managed planted seedlings start fruiting at 3 to 4 years.
- The ground under and around the tree crown should be thoroughly cleared to facilitate the picking of all fruits that drop from the tree at maturity.
- Once the fruits have been gathered, pile them in heaps for 2 to 3 weeks to speed up the rotting of the pulp.

### 5.6 Yields

- Most trees bear fruits once every 2 to 3 years, but some fruit every year.
- A ndjanssang tree can produce 900–2018 fruits a year.
- From this number of fruits about 72 kg of kernels can be obtained.
- The kernel, the economically important part of the fruit, represents only about 4.05% of its total weight.

To obtain good ndjanssang kernels, collect mature and healthy fruits that fall freely from the trees between the months of September and October. It is not advisable to pluck fruit from the trees, because it is not easy to distinguish mature fruits from immature ones.



## 6 POST-HARVEST AND PROCESSING

Extraction of kernels from the seed is time-consuming and tedious because of the seed's extremely hard shell. It takes approximately 2 days to extract a 10 l bucket of kernels.

- Once the fruit is rotten, squeeze it to remove the fleshy part and reveal the yellow seeds.
- Wash them abundantly.
- Boil for at least 8 hours.
- Put in cold water for 24 hours.
- Rinse and put in lukewarm water for about an hour until the seed shells crack.
- Extract the kernels using a small knife or nail. Be careful to avoid cutting hands.
- Sort the kernels to remove damaged ones. The damaged kernels are of lower quality, and are usually kept for home consumption.
- Dry the kernels by exposing them to sunlight daily for 2 to 3 weeks, or by putting them on a rack above the fireplace. Customers prefer kernels dried in the sun because of their shiny yellow colour.

### 6.1 Storage and preservation

Most ndjanssang is stored as kernels, but some households prefer to store the seeds, which have been previously washed and boiled. Well-dried kernels can be kept for up to two years provided they are not exposed to water. If not well dried, they can develop mould and eventually rot.

Here are a few guidelines for the storage of ndjanssang kernels:

- First, reduce moisture content of kernels by drying them:
  - In the sun.
  - Above a fireplace.
- Then, store the kernels in a dry place:
  - On a bamboo rack hung over the fireplace.
  - Directly hung from the ceiling.
- Use appropriate containers, such as:
  - Dry cloth or plastic bags.
  - Airtight cooking pots.
  - Airtight steel tins.
  - Dry bamboo baskets or calabashes, which are readily available and cheap.
- Keep dry kernels away from rodents.

## **6.2 Processing**

### **6.2.1 Kernel**

- Kernels are mainly used as a spice or thickening agent in cooking. They are ground using a stone or a food mill, separately or mixed with other spices.

### **6.2.2 Paste**

- The kernels can be roasted, ground into a paste, and used to make a sauce similar to peanut sauce.

### **6.2.3 Powder**

- The kernels can be ground in a blender or traditional grinding stone to produce powder that can be stored for easy usage later.

### **6.2.4 Oil**

- A very limited amount of local seed oil extraction is carried out. Total oil content in kernels varies between 49 and 63%. The oil is light yellow, with a pleasant taste similar to that of groundnut oil. It is suitable for the commercial production of cooking oil and margarine, as well as soaps and pharmaceutical preparations.

## 7 MARKETING

### 7.1 Marketing potential

☞ See Technical Note 6b on marketing.

- Ndjanssang is mostly sold in its kernel form. However, the kernels are now ground, packaged in small plastic bags of 20 g, and sold in powder form in supermarkets in Cameroon. These bags can be preserved in a fridge or freezer together with other ground spices such as ginger, parsley, celery, pepper, basil, etc.
- Ndjanssang kernels, and to a lesser extent the bark and roots, are widely traded within and between the countries of West and Central Africa.
- Estimated exports from markets studied (Perez *et al.*, 1999) in Cameroon to neighbouring countries in 1996 amounted to at least 1,188,000 €. Ndjanssang is exported to other countries of the central African region such as Gabon and to European countries, amongst which are Belgium and France. In Paris, a survey (Tabuna, 1999) listed ndjanssang among the non-timber forest products most imported into France.
- In Cameroon, market openings for ndjanssang are concentrated in the vicinity of large urban centres. Wholesalers buy from local markets and villages and either sell to larger urban centres or export. The marketing chain can be presented as follows.

#### 7.1.1 Pricing

In Cameroon, kernels are mainly sold in piles or in cups of different sizes.

Prices vary according to availability and marketed size.

- Piles (20–25 g): 50–100 francs CFA (0.0762–0.152 €),  
Cups (216 g): 200–250 francs CFA (0.23–0.46 €), rising to 300–400 francs in periods of scarcity.  
Price per kilogram: 1000–2500 francs CFA in Yaoundé since 1993 (Manirakiza, 2002).
- Ndjanssang kernels are available in the market throughout the year, due to the ease of storage. The peak supply period in the forest zone of Cameroon is between July and December, when prices are about 25% lower than in periods of scarcity (January–June).
- Shiny bright kernels (dried under the sun) usually sell at higher prices than matt dark kernels (dried in traditional barns).

## 8 SOCIO-ECONOMICS

- Estimated annual production per household is 47.77 kg in central and southern Cameroon.
- Annual production is valued at about 11,250 francs CFA (1999 middle season prices), but may be as high as 75,000 francs CFA (in 2005) in high production areas, such as Akonolinga in the Centre Province of Cameroon.
- On average, households generate about 12% of their annual income from ndjanssang.
- The market potential of kernels is high, as illustrated by consumption patterns, e.g. total ndjanssang consumption in Yaoundé alone was estimated at 380 tonnes in 2002.
- The survey (Manirakiza, 2002) carried out in the forest areas of Cameroon indicated that 84% of households consumed ndjanssang kernels. Annually, these households spent about 708 francs CFA per person on ndjanssang, which is the equivalent of 350 g of kernels.

## APPENDIX 1: USES OF NDJANSSANG TREE

Seeds	Husks are cure for gonorrhoea, diarrhoea.
Kernels	Flavouring and thickening agent in cooking, dried ones used as seeds in popular cultural games.
Oil from kernels	Used in the manufacture of soap and varnish.
Leaves	Decoction used against dysentery and as a febrifuge.
Sap	Against eye infections.
Bark	Cure for elephantiasis, gonorrhoea, dysentery, diarrhoea, coughs, hernia, rheumatism, abscesses, rickets, smallpox, yellow fever, anaemia, skin diseases, malaria, stomach pain, headache, toothache, and worms; as an aphrodisiac and as an anti-inflammatory.
Fibres	Used in the manufacture of paper pulp.
Trunk and branches	Handicrafts such as kitchen utensils, firewood, drums for dancing.

## GLOSSARY

Air layering	Technique of plant propagation by the development of adventitious roots on a stem while the latter is still attached to the parent plant.
Ambient temperature	Temperature in a given environment.
Antidote	Any substance used against poison.
Buds	Dormant and unelongated stem composed of a short axis of meristem cells from which embryonic leaves, lateral buds, flower parts or all three arise.
Coppiced shoot	Any shoot arising from an adventitious or dormant bud near the base of a woody plant that has been cut.
Crown	A tree canopy, the upper part of a tree or other woody plant carrying the main branch system and foliage. It is also defined as the branches and foliage of a tree.
Cutting	A detached part of a plant (stem, root or leaf) that is placed in suitable conditions to promote rooting and subsequent production of a new leafy shoot.
Deciduous tree	Tree that loses leaves at a certain period of the year.
Dioecious tree	Tree species with male and female plants.
Dormancy	A period of quiescence when no apparent growth or development is taking place; form of growth regulation.
Fallow	Crop land that lies idle, either tilled or untilled, during the whole or greater portion of a growing season; it is also defined as land rested from deliberate cropping, not necessarily without cultivation or grazing, but without sowing; it can also be the state of land left without crop or weed growth for an extended period, often to accumulate moisture.
Febrifuge	A substance that treats fever.
Fodder	Plants or plant parts eaten by browsing or grazing animals.
Foliage	The entire leaf mass of a tree or trees (or of plants generally).
Fungicide	Chemical used against fungi.
Genetic diversity	Variability among living organisms and the ecological contexts of which they are a part.
Genetic resources	Genetic material of plant, animal, microbial or other origin containing actual or potential functional heredity units.
Juvenile material	Cuttings from young shoots.

Land use systems	Areas with a recurring pattern of land facets.
Leaf litter	Layer made of leaves fallen on land in any farm system (forest, cocoa farm, etc.)
Marcotts	Sections of plant branches that have developed adventitious roots after treatment.
Multi-purpose tree	Tree providing many uses.
Mycorrhizae	Symbiotic relationships between fungi and plants.
pH	Scale for measuring acidity.
Propagules	Parts of a plant that can grow into a new plant (seedlings, grafts or cuttings).
Rootstock	Root system and lower portion of a woody plant to which a graft of a more desirable plant is attached.
Seed dormancy	The inability of seed to germinate under normal conditions.
Shoot	First part of the plant to appear above the soil as it grows from the seed.
Transpiration	The process through which plants lose water through their surfaces.

## REFERENCES

- Dandjouma, A. K., Tchiegang, C., Ndjouenkeu R., Kapseu, C. and Mbofing, C. M. F. (2000) "Caracteristiques morphologiques des amandes et physico-chimiques des huiles de *Ricinodendron heudelotii* (Bail.) du Cameroun." In: *Third International Workshop on the Improvement of Safou and other Non-Conventional Oil Crops*. Edited by Kengue, J., Kapseu, C. and Kayem, G. J. Presses Universitaires d'Afrique, Yaoundé. pp. 288-299.
- Ekam, V. S. (2003) "Evaluation and characterization of the seed oils of *Trichosanthes cucumerina* (snake gourd) and *Ricinodendron heudelotii* (honey plum)." *Global Journal of Pure and Applied Sciences*, **9** (2) : 217-220.
- Kapseu, C. (1998) "Composition en acides gras et en triglycérides des huiles des oléagineux non-conventionnels." In: *Second International Workshop on African Pear Improvement and other New Sources of Vegetable Oils*. Edited by Kapseu, C. and Kayem, G. J. Presses Universitaires du Yaoundé, Yaoundé. pp. 165-174.
- Tane, R. (1997) *Etude de la valeur nutritionnelle du ndjansang* (*Ricinodendron heudelotii*). Faculté des Sciences Agronomiques et Biologiques Appliquées, Université de Gent, Belgium.
- Tchiegang, C., Kapseu, C. and Mapongmetsem, P. M. (1998) "Interet nutritionnel de la domestication d'une euphorbiacee, le *Ricinodendron heudelotii* (Bail.)." In: *Regional Symposium on Agroforestry Research and Development in Humid Lowlands of West and Central Africa*. Edited by Duguma, B. and Mallett, B. CIRAD, Yaoundé. pp. 105-112.
- Tiki Manga, T., Fondoun, J. M., Kengue, J. and Tchiegang, C. (2000) "Chemical composition of *Ricinodendron heudelotii*: an indigenous fruit tree in southern Cameroon." *African Crop Science Journal*, **8** : 195-201.



# Why Grow the Ndjanssang Tree?

Ndjanssang is a high-value multi-purpose tree indigenous to Africa. It is a source of food, medicinal extracts, oil, organic manure, and substantial income to rural people.

## B E N E F I T S

### 1. For appetising dishes

- ☞ The kernels are rich in proteins, minerals, carbohydrates, vitamin B2, fibres and unsaturated fatty acids, which lower cholesterol levels.
- ☞ Use its kernel powder and paste to flavour or thicken stews and sauces.
- ☞ Extract fresh cooking oil from its kernels.

The pulp is not yet used for human consumption.

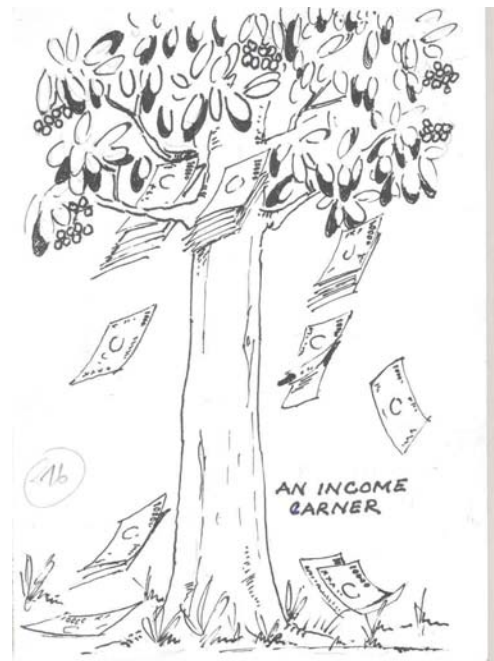
### 2. For income

- ☞ 1 kg of ndjanssang kernels sells at US\$ 2.5 on average.

### 3. For medicinal uses

Several parts of the tree can be used as medication.

- ☞ **Boiled tree bark:** used against leprosy, elephantiasis, gonorrhoea, dysentery, diarrhoea, coughs, hernia, rheumatism, abscesses, rickets, smallpox, yellow fever, anemia, skin diseases, malaria, stomach pain, headache, toothache, worms, as an aphrodisiac and an anti-inflammatory.
- ☞ **Seed husks and latex:** used against gonorrhea and diarrhea.
- ☞ **Leaf decoctions:** used against dysentery, oedema, female sterility and as a febrifuge.
- ☞ **Sap:** used as eye drops against infections.



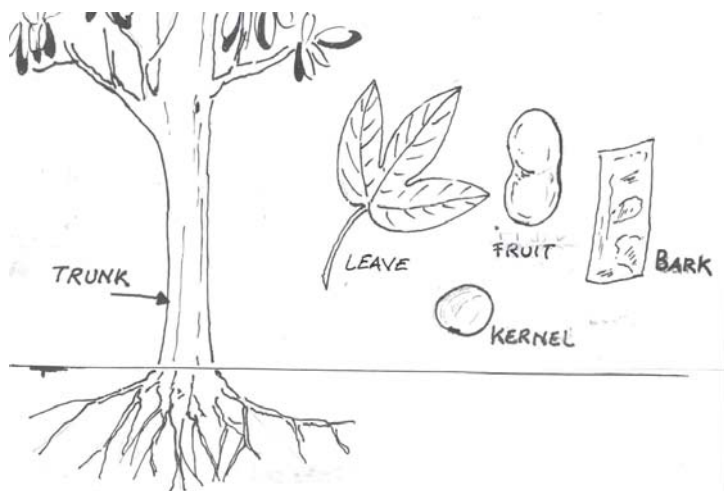
Ndjanssang fruits

Ndjanssang kernels



#### 4. For fuel and timber

- ☞ Use as firewood.
- ☞ Use for durable building.
- ☞ Use to make small wood handicrafts such as stirring sticks and tool handles.



#### 5. For industrial use

- ☞ Oil used for soap and vanish making.
- ☞ Wood ashes used in soap making.
- ☞ Fibres suitable for the manufacture of paper pulp.

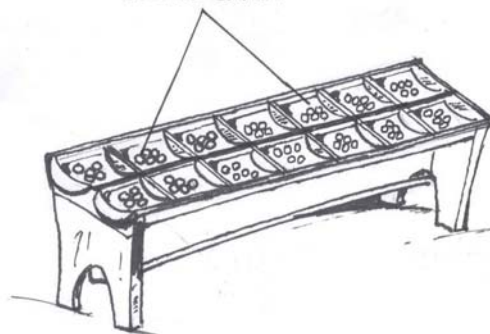
① A DRUM TO ANIMATE TRADITIONAL DANCES



#### 6. Socio-cultural value

- ☞ Wood used for drum manufacturing.
- ☞ Dried seeds used for popular games ("songo") and rattles for dances.

NOJANSSANG KERNELS IN POPULAR SONGO GAME



#### 7. Ecological and environmental value

- ☞ Positively improves soils through mycorrhizae, leaf litter, ash from burnt nut-shell, waste from fermented leaf pulp.
- ☞ Provides shade for other plants.
- ☞ Source of fodder for sheep and goats.

# How to Grow the Ndjanssang Tree

## - Propagation by Seed -

### 1. Collecting planting material

- ☞ Collect seeds from 'elite' trees.
- ☞ Trees free from pests and diseases.
- ☞ Trees that have produced fruits at least twice.

### 2. Propagating

Ndjanssang can be propagated:

- ☞ By planting the seeds.
- ☞ By vegetative multiplication.

### 3. Seed collection and handling

- ☞ Plant seeds immediately after extraction from fruits.
- ☞ Dry for one week and store to plant later.
- ☞ Scarify the seed coat manually by scraping the seed on sandpaper, to hasten germination.

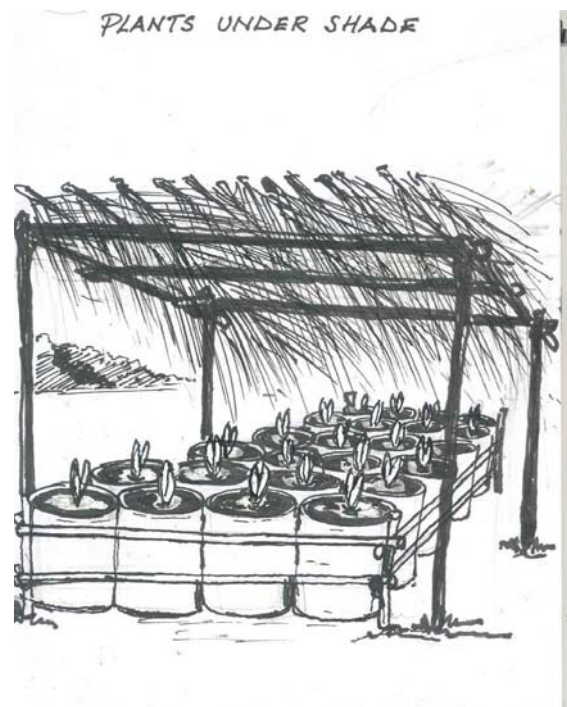


### 4. Collecting potting soil

- ☞ Collect forest soil.
- ☞ Mix 3 parts soil with 1 part sand.
- ☞ Use potting medium to fill pots.
- ☞ Seeds can also grow in clay or very sandy soil on farmland.

### 5. Sowing

- ☞ Sow seeds at a depth of 2–3 cm in seedbeds or pots.
- ☞ In dry season, water plants once every two days in the morning.
- ☞ Keep seedbeds or seed pots under shade for the first 2 months.





# How to Grow the Ndjanssang Tree

## - Vegetative Propagation -

### 1. Vegetative propagation

- ☞ There are 3 methods of vegetative propagation:
  - Cuttings
  - Marcotting
  - Grafting
- ☞ Rooting of leafy stem cuttings using a non-mist propagator is the most appropriate technique for the vegetative propagation of ndjanssang.

### 2. Rooting of leafy stem cuttings

- ☞ Cut shoots from coppiced trees.
- ☞ Mist shoots with water and store in moist polythene bags for not more than 18 hours.
- ☞ Cut the shoots into sections 3–4 cm long, each having one single node and a full internode below.
- ☞ Reduce the leaf size by half.
- ☞ Insert cuttings into 1:1 mixture of river sand and decomposed sawdust in a propagator.
- ☞ After 5 weeks, lift each cutting very carefully to assess rooting.
- ☞ If cuttings are rooted, remove them from the propagator and put in 1 litre polythene bags filled with a 2:1 mixture of sand and decomposed sawdust.



Leafy cuttings in a propagator

# How to Grow the Ndjanssang Tree

## - Grafting -

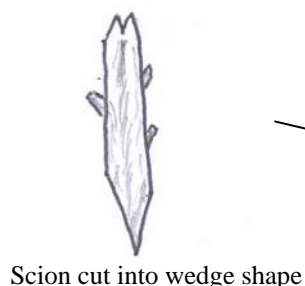
### 1. Grafting

In order to graft this plant, you will need

- ☞ A sharp budding knife.
- ☞ Polyethylene tape (budding tape) (1.5–2.0 cm wide x 30–40 cm long), or strips cut from black or transparent polyethylene bags.
- ☞ Transparent plastic bags large enough to cover the top of the scion.

### 2. Scion preparation

- ☞ Collect shoots (scions) from mature trees, having borne fruit at least once, pest- and disease-free. Collect scion only at the vegetative growing stage of the tree.
- ☞ Cut scion material 5–15 cm long, 1 cm in diameter (pencil size), with 1 or more buds.
- ☞ Place the knife almost parallel to the twig to cut a level surface of 3–4 cm long at the base in one stroke.
- ☞ Make a second cut on the other side.
- ☞ The scion should fit exactly and tightly into the notch of the rootstock.



### 3. Rootstock preparation

- ☞ Choose rootstock:  
Raised from a seed for 4–6 months, measuring 40–50 cm long, and with a diameter of about 1 cm (pencil size),  
OR young plant collected under mother tree.
- ☞ Clear the stem of soil and debris.
- ☞ Cut off the top at a height of 30–40 cm, leaving 2 or more leaves below the cut.
- ☞ Make a slit cut of about 3–4 cm long in the rootstock.



Rootstock sliced to fit in scion



Scion tightly fitting into rootstock

# How to Grow the Ndjanssang Tree

## 4. The graft union

- ➡ Match the surfaces so that both growing zones have firm contact.
- ➡ Firmly bind the rootstock and scion with plastic tape to form a union, making sure that the wound is entirely covered.
- ➡ Cover the top of the grafted plant with a transparent polythene bag.
- ➡ Water the plant regularly.
- ➡ Remove polythene bag when fresh leaves start growing on the scion, in 1–3 months.



Wrapping the graft union.



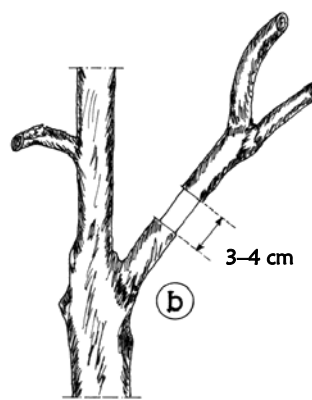
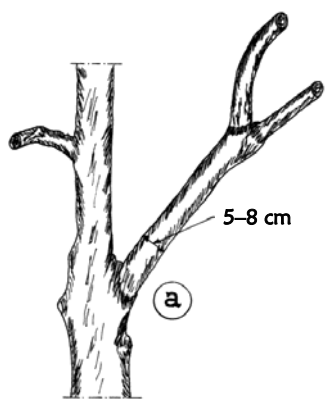
Growing grafted ndjanssang plant

# How to Grow the Ndjanssang Tree

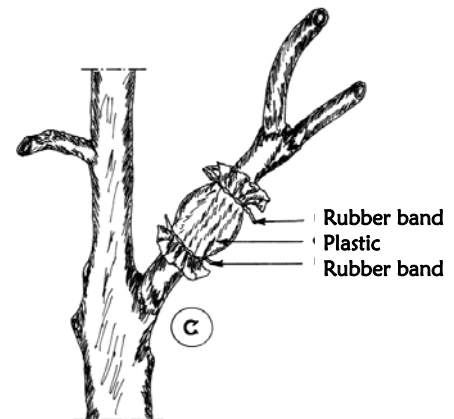
## - Air-layering -

### Air-layering or marcotting

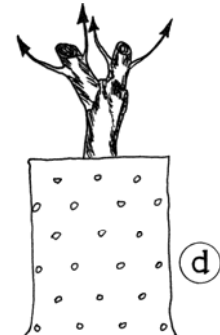
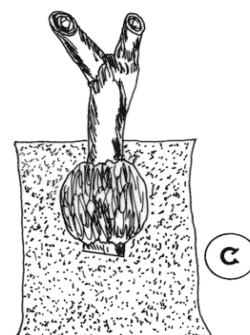
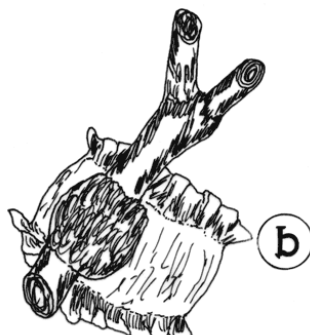
- ☞ Select trees of 7–12 years old that have produced fruits at least once.
- ☞ Choose a tree's vertical branches of 5–8 cm in diameter.
- ☞ Remove the bark from a 3–4 cm girdle at about 10–15 cm from the main tree stem.



- ☞ Place the plastic sheet below the cut and secure it tightly with a rubber band.
- ☞ Fold the plastic over the cut so that a pocket is formed.
- ☞ Mix rooting medium of moist rotten sawdust with powder insecticide.
- ☞ Put rooting medium in plastic pocket.
- ☞ Wrap the plastic and its contents around scraped section of the branch and close the top end with a rubber band.



- ☞ After 2 months, detach rooted marcotts from the mother tree (a).
- ☞ Remove the plastic and take care not to injure the newly formed roots (b).
- ☞ Pot the detached rooted marcotts in a 10 litre polythene bag containing a 2:1 mixture of river sand and decomposed sawdust. Water the plant after potting. (c&d)





# Where to Grow the Ndjanssang Tree

## - Field Establishment -

### FIELD ESTABLISHMENT

#### 1. Site characteristics

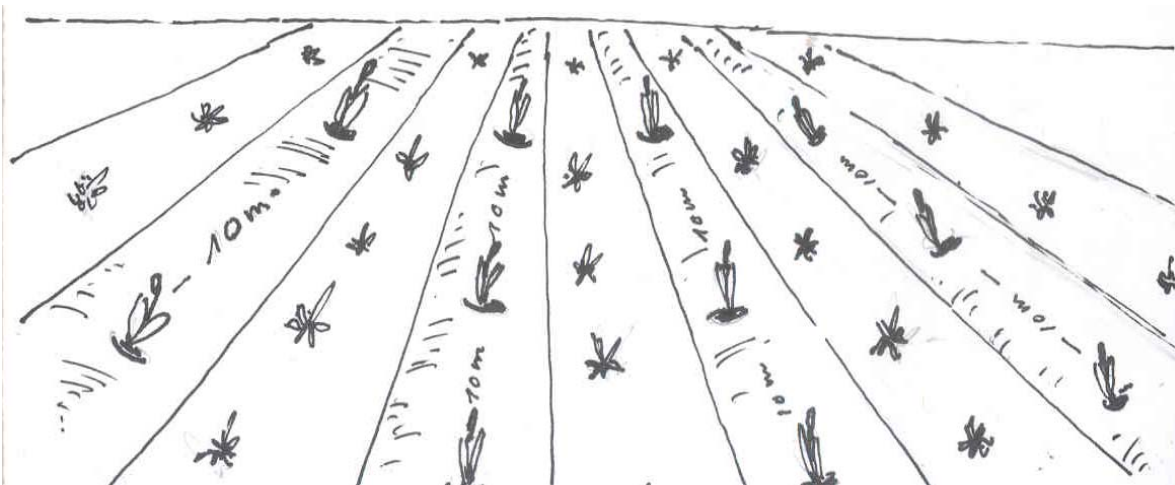
- ☞ Plant in humid lowlands (0–800 m above sea level).
- ☞ Do not plant on soils with too much clay or sand.
- ☞ In areas between 1000 mm and 3000 mm of annual rainfall.
- ☞ Plant in a good light with a little shade.
- ☞ Avoid windy areas since branches break easily.



Ndjanssang trees growing on a demonstration plot

#### 2. Site preparation

- ☞ Clear all shrubs from the site before rainy season.
- ☞ Dig planting holes of 30 x 30 cm for seedlings, cuttings and grafted plants.
- ☞ Dig holes of 50 x 50 cm for marcotts.
- ☞ Space out planting holes by 10 m.



#### 3. Transplanting

- ☞ Transplant only 6-month-old seedlings, marcotts or rooted cuttings, measuring least 20–30 cm.
- ☞ Plant at least 24 hours after sufficient rainfall.
- ☞ First put topsoil in the hole, then the plant, and cover with the remaining soil.





# How to Grow the Ndjanssang Tree

## - Field Management -

### 1. Watering

- ☞ Water plants abundantly before planting.
- ☞ Water 10 cm round the plant in the morning every 2 days.

### 2. Weeding

- ☞ Weed 1 metre around the trees once every two months for the first year after planting.

### 3. Use of fertilizer

- ☞ In nursery, apply inorganic fertilizer, at a rate of 25 g (e.g. NPK 20:10:10), as top dressing every 4 months.
- ☞ In field, apply 50 g of inorganic fertilizer (e.g. NPK 20:10:10), as top dressing every 4 months.
- ☞ Follow the instructions on the labels of all chemical products you use.
- ☞ During the first year, mulch with dry herbs during the dry season to avoid water loss.
- ☞ Application of organic manure is optional.



Apply fertilizer around, not on the plant

### 4. Land use systems

- ☞ Ndjanssang trees can be associated with food crops species that grow under shade e.g. - cassava
  - cacao
  - yams
  - maize
  - bananas
  - plantains
- ☞ Plant at 10 m spacing when growing with food crops.
- ☞ Grow alongside other trees in the forest.
- ☞ Plant in home gardens.

# Harvesting

## 1. Harvesting time

- ☞ In managed systems, the tree produces fruits 4–5 years after planting. The fruits should ideally be harvested in the month of August. After this period, they lose some of their germination potential.

## 2. Fruit maturity

When mature, the fruit is:

- ☞ Indehiscent green in colour.
- ☞ Oval in shape.
- ☞ Formed of 2 or 3 lobes.
- ☞ Between 20 and 45 g in weight.



## 3. Fruit collection

- ☞ Clear the surroundings of the tree to easily find the fallen fruits.
- ☞ Collect mature fruits that drop under the tree.
- ☞ Gather them in small heaps under the tree or any secure place.
- ☞ Keep them under ambient temperature for 2 to 4 weeks for the pulp to rot.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			Flowering	Flowering		Fruits still developing seeds	Fruits ready for collection	Fruits ready for collection	Fruits containing seeds with low germination potential		

## 4. Yields

- ☞ Healthy trees will produce a harvest of 900–2180 fruits.

# Post-harvest Handling

## 1. Extracting seed from fruits

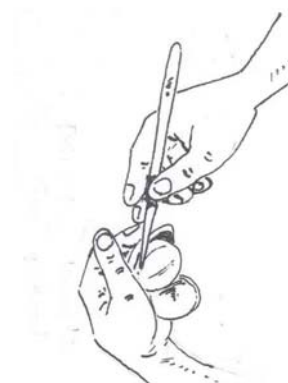
- ☞ Squeeze the rotten pulp from the fruit.
- ☞ Wash the seeds abundantly in cold water.
- ☞ Boil them in water for at least 8 hours.
- ☞ Leave in cold water for 24 hours.
- ☞ Rinse and place in lukewarm water for about an hour until the seed shells crack.



Boiling seeds in a pot

## 2. Extracting kernels from the seeds

- ☞ Take out the kernel using a small knife or nail.
- ☞ Watch out not to wound yourself.
- ☞ Sort the kernels in order to remove low quality and cracked ones.



Remember to protect your fingers when extracting kernels from seeds.



## 3. Conditioning

You can improve the kernels:

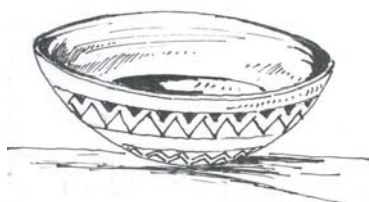
- ☞ By exposing them sheets on mats or sheets to sunlight for 2–3 weeks.
- ☞ By putting them on a rack above the fire-place.

## 4. Storage

- ☞ Store well-dried kernels in bamboo baskets, calabashes, airtight steel containers or pots.
- ☞ Keep kernels for up to 2 years.
- ☞ Watch out for rodents, which might feast on the dried kernels.



A basket



A calabash



An airtight container

# Marketing and Economics

## MARKETING and ECONOMICS

### 1. Marketing potential

In Yaoundé alone, capital city of Cameroon, there is a market for 380 tons (7600 50 kg bags) of ndjanssang kernels annually. The kernels are sold:

- ➡ Directly to people who live around you.
- ➡ To retailers in urban and rural markets.
- ➡ To wholesalers from urban and regional markets.
- ➡ To exporters to international markets.
- ➡ In some areas where ndjanssang is exploited intensively, households generate about 12% of their annual income from the sale of its kernels.



Measuring kernels

### 2. Pricing

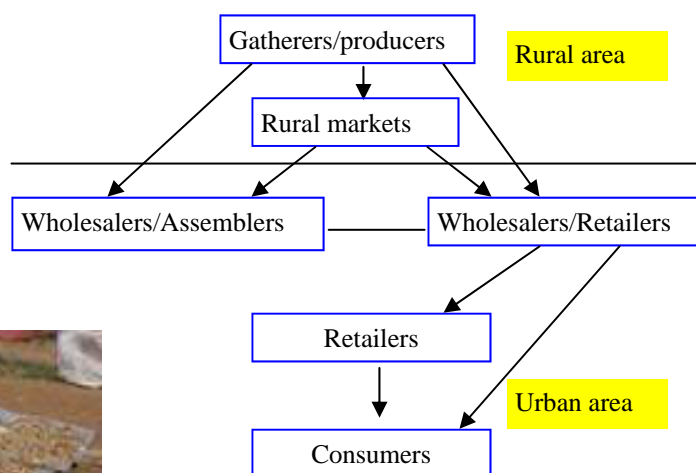
- ➡ Because the kernels can easily be stored, ndjanssang is sold throughout the year. Prices are lowest between July and December (150–200 CFA Frs per milk cup) and highest between January and June (250–300 CFA Frs per milk cup).

### 3. Economics

- ➡ Store and sell in periods of scarcity.
- ➡ Sell in markets where there is high demand and low supply to benefit from high price margins.
- ➡ Shiny bright kernels (dried in the sun) will fetch higher prices than matt dark kernels (dried above the fireplace).



Conditioning kernels



The ndjanssang market chain

Estimated half-year sales (1995) in Cameroon: 229 million CFA (432,000 USD)