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NAMIBIAN AGRONOMIC BOARD

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Creating a marketing environment that is conducive to growing and processing crops in Namibia

AGRONOMY AND HORTICULTURE MARKET DEVELOPMENT DIVISION
RESEARCH AND POLICY DEVELOPMENT SUBDIVISION

A GUIDE TO COWPEA PRODUCTION IN NORTHERN NAMIBIA

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CONTENTS

CROP CLASSIFICATION

Scientific name: ***Vigna unguiculata***

Common names in Namibia

Oshiwambo: *Omakunde*

Otjiherero: *Omakunde*

Afrikaans: *akkerboon, swartbekboon, boontjie, koertjie, dopboontjie*

English: *Cowpea, black-eye bean or pea, southern pea*

Rukavango: *Makunde*

Lozi: *Manawa*

FORWARD BY THE CEO

Let me take this opportunity to thank the team of experts who developed this manual for their great idea and support to the Namibian Agronomic Board's (NAB) motto of creating a marketing environment that is conducive to the growing and processing of crops in Namibia. Cowpea is one of the most important protein crops in Namibia which is widely known and cultivated in the country. Most families in Namibia depend on cowpea for food, income generation, and soil improvement. The grains are favoured for taste and protein, especially for growing children. However, there has been limited information on how to grow cowpea, especially for the youths who might be interested in making cowpea as one of the commodities on the local market. Sustaining productivity and profitability is one of the major challenges to the agricultural sector for fulfilling the food demand of the growing population in the country.

This production manual was designed to provide farmers and all plant lovers with the relevant technical information and cultural practices for cowpea production using basic agricultural language. The manual can be used throughout the planting season by anyone in its simplest form. I do not doubt that the techniques explained in the manual can guide all our growers in producing quality crops for maximum yields. The provided guidelines are meant for encouraging and motivating all farmers to get involved in cowpea production as a way to contribute to food security while simultaneously generating wealth.

We at the NAB, in collaboration with the Ministry of Agriculture, Water and Land Reform (MAWLR), the University of Namibia (UNAM), and the GIZ-Namibia, are happy to bring this manual to our farmers with the hope to encourage, advise, guide, and motivate farmers in their work. Since crop production plays a key role in enhancing total production by improving productivity resulting in food and nutritional security, farmers and all growers should know in-depth about how to plant cowpea and all other cultural practices. Therefore, I am encouraging all farmers and growers to make use of this manual in order to contribute to food security in the region. Let me wish all our readers and users of this manual a pleasant reading and a bumper harvest of cowpea.

I thank you

Dr Fidelis N. Mwazi (PhD)
Chief Executive Officer
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1. Introduction

Cowpea [*Vigna unguiculata* (L.) Walp.] is one of the widely cultivated and consumed grain legumes globally, especially in the arid and semi-arid tropics (Noubissietchiagam *et al.,* 2010). Cowpea can grow in harsh environments under dry-land conditions, making it one of the most widely grown legume crops in sub-Saharan Africa (Baidoo & Mochiah, 2014). In Namibia, cowpea is the third most important staple crop after pearl millet [(*Pennisetum glaucum* (L.) R. Br.)] and sorghum (*Sorghum bicolor* [L.] Moench) (MacDonagh and Hillyer, 2003). It is grown by 95% of small-scale farmers in the north and central regions of the country including Kavango East and West, Oshikoto, Oshana, Ohangwena, and Omusati (Fleissner & Bagnall-Oakeley, 2001). Farmers' preferred traits of cowpea include a straight pod shape, a long pod size bearing at least 10 seeds, a white grain colour, and high above-ground biomass (Horn *et al*., 2015). Inter-cropping of cowpea with sorghum or pearl millet is the dominant cowpea farming system in northern Namibia. Furthermore, cowpea is grown by the majority of farmers for food, feed, cash income, and soil fertility improvement. The cowpea grain contains 23% protein and 57% carbohydrate, and the leaves contain 27 to 34% of proteins.

Cowpea grain, dried succulent and tender leaves are marketed informally and consumed in Namibia. However, cowpea production and productivity and market supply has declined in recent years due to several challenges such as low yields, the unavailability of improved seeds, drought stress, post-harvest loss and damages by field pests including aphids [*Aphis craccivora* (Koch)], storage pests such as cowpea weevil (*Callosobruchus maculatus*), and parasitic weeds such as *Striga* [*Striga gesnerioides* (Willd.) Vatke] and yellow witchweed [*Alectra vogelii* (Benth)] (Matanyaire, 1996). Fleissner and Bagna-llOakeley (2001) reported that only 5,000 tonnes of cowpea were produced annually by the Namibian communal farming households. Furthermore, the reported cowpea yields vary from 250 to 350 kg ha^{-1} per household, which is relatively low compared to potential yields of 1500 to 3000 kg ha^{-1} (Stejskal *et al*., 2006).

In Namibia, three varieties of cowpea, namely, Nakare (IT81D-985), Shindimba (IT89KD-245-1), and Bira (IT87D-453-2) have been cultivated by smallholder farmers. Breeding cowpea for biotic and abiotic stress tolerance and improved yield through the use of modern technology (Induced mutation breeding) was introduced in 2009 (Horn & Shimelis, 2013). Hence some seeds of the three cowpea varieties were gamma-irradiated with varied doses for targeted selection. Thirty-four elite lines were selected through rigorous evaluations from the M2 through M6 generations. These elite lines were selected for their desirable agronomic characteristics including flowering ability, early maturity, high biomass production, desirable grain colour, and improved grain yields (Horn & Shimelis, 2013; Horn *et al*., 2017). Varieties developed through the project on induced mutations have been released and will be distributed to farmers and seed growers. Therefore, there is a need for a production guide to provide information to the growers. Therefore, this production guide was developed to help farmers improve production and

reduce loss. This guide was developed based on the lessons from the work and experience of the International Institutes of Tropical Agriculture (IITA) and partners in research for development on cowpea-based systems in the farmers' guide to cowpea production in West Africa (Dugje *et al*., 2009). The guide is intended to help farmers, extension personnel, and researchers in Namibia to grow cowpea profitably and sustainably.

2. Utilisation of cowpea

Cowpea is used as food, forage, and vegetable crop mainly in the tropics. The grains are an excellent source of food and feed; a vital nutrient for healthy growth both for humans and livestock. The leaves, green pods, and grains are consumed as a dietary source of protein (Ghaly & Alkoaik, 2010). Its grain contains 23% protein and 57% carbohydrate, and the leaves contain 27 to 34% of proteins (Horn *et al*., 2016).

3. Cowpea climatic and soil requirements

Cowpea can be grown under rain-fed conditions as well as by using irrigation. The minimum and maximum temperatures are between 28 and 30ºC (night and day) during the growing season. Cowpea performs well in agro-ecological zones where the rainfall range is between 500 and 1200 mm per annum but improved and early maturing cultivars can thrive even when the rain is below 400 mm/year. Best yields are obtained in well-drained sandy loam to clay loam soils with a pH between 6 and 7. Cowpea also plays an important role in providing soil nitrogen to cereal crops (such as maize, millet, and sorghum) when grown in rotation, especially in areas where poor soil fertility is a problem. It does not require a high rate of nitrogen fertilisation; its roots have nodules in which soil bacteria called Rhizobia help to fix nitrogen from the atmosphere.

4. Steps in growing cowpea

4.1. Site selection

Well-drained sandy loam soil is ideal for rainfed cowpea production. Cowpea does not tolerate excessively wet conditions or waterlogging and should not be grown on poorly drained soil.

4.2. Choice of varieties

The choice of variety is based on maturity period (varieties that have a maturity period that falls within 60–80 days are regarded as early maturing), yield potential, drought tolerance and responsiveness to day length, grain size, and colour, pest and disease resistance.

4.3. Before planting

Land can be prepared with an oxen-drawn plough or by a tractor with the help of extension services. Land can also be prepared manually with a hand-hoe. Ploughing and harrowing in the field should be properly done to provide sufficient tilth for good root growth. Sometimes ridges are encouraged where desired.

Where weed and shrubs are a problem, glyphosate (Round-up) can be applied at the rate of 4 L/ha to clear the land before ploughing. Where the soils are more fragile and prone to erosion, minimum or zero tillage is encouraged.

4.4. Seed requirement

The seeding rate for cowpea is about 12 - 25 kg/ha of cowpea seeds. Choose seeds that are uniform and not mixed. Select good seeds (**Error! Reference source not found.**) without damage, holes, or wrinkles for planting. Obtain seeds from an approved supplier such as the Agra, Agrigro, Aqualand and other reliable suppliers in Namibia or from neighbouring countries.

Figure 1: Cowpea plants growing at Omahenene Research Station during the 2014/15 season

Figure 2: Uniform seeds from the M8 generation of cowpea breeding programme in Namibia

4.5. Treatment of seeds pre-planting

In Namibia, cowpea seeds treatment before planting is not a common practice. Also, some farmers treat their seeds when planting, however, some farmers store their seeds in ash to protect them from insect damage. In other African countries, seeds are treated with Benomyl (50%) or Carbendazine, Captan, or Thiram at the rate of 3 g/kg of seeds, or with Apron Plus at the rate of 10 g/4 - 5 kg of seeds or Apron

Star 42 WS at the rate of 10 g/8 kg of seeds. This will enhance good germination and protect the seedlings from insect and fungal infection at emergence.

4.6. Planting

Planting should not be done too early or too late in the rain season. The crop needs enough moisture for growth, as well as pod and seed formation. It is important to estimate the onset and duration of the rains for planting. The planting season in Namibia is from late November to mid-February depending on the rain. Planting can be done towards the end of July during the off-season under irrigation. Most of the semi-erect and prostrate varieties are photosensitive. Planting too early will lead to vegetative growth with delayed flowering and yield may be reduced.

4.7. Sowing and spacing for sole cowpea

Erect cowpea varieties should be planted at a spacing of 50 cm between rows and 20 cm between plants, especially for extra-early maturing varieties. In terms of semi-erect varieties, spacing should be 75 cm between rows and 25 - 30 cm within rows. For prostrate varieties, plant at a spacing of 75 cm between rows and 50 cm within rows. For all recommended plant spacing, sow 2 seeds per hill to have two plants per stand. If you have more than two plants per stand, thin to two plants at two weeks after planting. Cowpea can be planted either on ridges or flatbeds, depending upon the field preparation. Planting is done by hand or by mechanical planters.

4.8. Sowing and spacing for cowpea with cereal intercropping

When cowpea is intercropped or relayed with other crops such as pearl millet and sorghum, the ideal spacing is 75 cm × 50 cm. Cowpea should be planted at about 4 - 6 weeks after planting the main crop (maize, sorghum, or millet) to allow the cereals to grow and to reduce competition with cowpea. For strip intercropping, 2 rows of cereal to 4 rows of cowpea is a better option to improve the productivity of erect and shade-sensitive cowpea varieties. The cereal and cowpea are planted at the recommended spacing rates. The recommended sowing depth is 2.5 to 5 cm.

4.9. Fertilizer rates and application

Cowpea fixes nitrogen from the atmosphere using the nodules in their roots. Therefore, nitrogen fertilizer application in cowpea is not crucial. A minimum of N 15kg/ha (NPK, 15:15:15) can be applied to assist initial crop establishment in areas where soils are very poor. Excessive N application promotes vegetative growth and leads to poor grain yield. Application of Super Phosphate at 30 kg of P/ha (2 bags of single super phosphate) will help the crop to initiate flowers, seed, and fruit development, nodulate well and fix its nitrogen from the air.

4.10. Weed control

The practice of herbicide application in Namibia is not popular. Farmers usually control weeds by weeding with hoes or pulling by hand. The problematic weeds of cowpea in Namibia are *Striga* (*Striga gesnerioides* Willd.) and yellow witchweed [*Alectra vogelii* (Benth)]. Weeds are a serious problem in cowpea production and, if not well managed, can harbour pests and reduce both the yield and the quality of the grain. The problem becomes worse when soil moisture is limited. The seeds of these parasites can survive in the soil for many years (more than 20 years) until a susceptible variety is planted. Weed control in cowpea could be done pre-planting and through manual or chemical methods.

In commercial setups and where zero or minimum tillage is practiced, Glyphosate (Glycel, Force Up, Round-Up, Delsate, Uproot, Sarosate, Touchdown, Clearweed, Killoff, etc.) herbicides are used. Herbicides such as Paraquat and Pendimethalin are effective in controlling grass and broad-leaved weeds. Paraquat controls emerged grass and broadleaf weeds, while Pendimethalin prevents weed seeds from germinating. All chemical containers come with instructions on how to use them. Cultural practices such as early planting, crop rotation, and manual removal through cultivation are also effective in weed control.

Figure 3: The parasitic yellow witchweed Alectra vogelii (Benth) at Bagani Research station

4.11. Diseases and their control in cowpea

Cowpea diseases are not well documented in Namibia. However, in general, fungal, bacterial, and viral diseases affect cowpea production. Diseases affect different parts of the crop at various stages of growth. The major and common diseases are *anthracnose*, *Sclerotium* stem-rot, root and crown rot, damping-off, *Cercospora* leaf spot, *Septoria* leaf spot, *Fusarium* wilt, and scab. Diseases are not easy to control but cultural practices can be employed.

The use of crop rotation, clean seeds, seedbed treatment before planting (e.g. using Apron Star), resistant varieties, uprooting and burying infected plants, and ploughing contaminated topsoil will reduce

the incidence of pathogens. For fungal pathogens, apply fungicides (e.g., Benomyl or Mancozeb) to the leaves at the rate of 35 - 70 mL in a 15-L sprayer or 50 - 80 mL in a 20-L sprayer.

4.12. Insect pests and their control

Pests cause significant yield and quality losses in cowpea in Namibia. However, no systematic studies were conducted to provide information on the magnitude of damage caused by cowpea insect pests in the country. Cowpea pests can be classified into three major groups: pre-flowering, flowering and post-flowering, and storage insects. Damage by insect pests on cowpea can be as high as 80 - 100% if not effectively controlled.

4.13. Pre-flowering pests

The main pre-flowering pest of cowpea is an aphid (*Aphis craccivora* (Koch)) (Figure 4). Aphids cause direct damage to the cowpea plant and also act as vectors in the transmission of the cowpea aphid-borne mosaic virus. The aphid damages young cowpea seedlings by sucking sap from under the surface of young leaves and stem tissues, and on the pods of mature plants. If only a few plants are seriously affected, it is better for them to be uprooted and burnt.

Figure 4: Aphid and blister beetle infestation on cowpea at Omahenene research station

4.14. Post-flowering pests

The following are major post-flowering pests of cowpea:

Flower Thrips (*Megalurothrips sjostedti* [*Taeniothrips sjostedti*]): These are usually tiny black insects which feed on flower buds and flowers. Severely infected plants do not produce any flowers. Symptoms are premature falling of flower buds and flowers without forming any pod.

Blister beetles: These feed on flowers, causing significant damage. Adult insects are attracted to maize pollen. Cowpea intercropped with maize often suffers serious damage.

Maruca pod borer (*Maruca testulalis*): The adult is a nocturnal moth, which is light brown with whitish markings on its forewings. The larvae feed on tender parts of the stem, peduncles, flower buds, flowers, and pods.

Pod-sucking bugs (*Anoplocnemis curvipes*): This pest causes yield losses varying from 30 to 70%. They suck the sap from green pods, causing them to shrivel and dry prematurely, resulting in seed loss. Cultural practices such as cleaning up the haulms from previous crops and using resistant cowpea cultivars and spraying with recommended insecticides are the major control methods. Birds are not easy to control and they can cause huge economic loss, however, chickens can be enclosed in cages to prevent them from going to the crop fields.

Birds

Birds, especially guinea fowls, are a problem mostly in commercial areas, while chicken can destroy cowpea in communal areas. They can pull up emerging seedlings, and feed on developing green and mature pods.

4.15. Insect control in cowpea

To control leaf, fruit, and soil-dwelling insects and migratory insect pests, the use of Lamda-cyhalothrin 25 EC (Karate 2.5 EC and Karto 2.5 EC) at a rate of 0.4 - 0.8 L/ha is recommended. This dose rate is the same as 35 - 70 mL per 15-L water or 50 - 80 mL per 20-L water. Plant sucking insects can be controlled with an insecticide such as Perfekthion 2.5 EC (Dimethoate) at a rate of 0.5 - 0.8 L/ha prepared by dissolving 40 - 70 mL in 15-L water or 50 - 80 mL in 20-L water. Cypermethrin plus Dimethoate at a rate of 75 mL in 15-L water or 100 mL in 20-L water is effective to control sucking insect pests. This pesticide can be applied at a rate of 1L ha^{-1} for controlling sucking insects.

To control foliar and soil-born insect pests including nematodes, the use of Diafuran 3G (Carbofuran) 25 -100 kg/ha is recommended at a rate of 3 g/plant or 7 - 10 g/m2 of soil during seedbed preparation. Note that the application of any of the recommended insecticides should be done early in the morning or late in the evening.

4.16. Harvesting of cowpea

Cowpea is harvested when the pods are fully matured and dry (Figure 5). Dried pods can be picked two or three times sequentially. After harvest, thresh the cowpea pods, clean the seeds, and separate them from the chaff or haulms through winnowing.

Figure 5: Dry matured cowpea pods ready for picking. Note that some of the pods are still maturing for sequential harvesting

4.17. Post-harvest handling

Grain storage facilities should be cleaned before storing the newly harvested grain. Residues from the old harvest should be destroyed. Only well-dried and properly cleaned seeds with a moisture content of less than 10% should be stored. The biomass is dried to store for the dry season as animal feed. Some farmers in northern Namibia collect fresh leaves and boil them and mix them with Kalahari melons to be dried and used as a snack.

4.18. Storage pests and their control

Weevils or bruchids (*Callosobruchus maculatus*) are the most destructive storage pest of cowpea (Figure 6). A grain loss of up to 100% can be reported as caused by bruchids. Seeds are infested while in the field, followed by the formation of eggs which are later brought to stores where they will hatch. After hatching, the larvae develop within the seeds and they eat up the cotyledon, thereby causing extensive damage. Adults emerge from the seeds through characteristic holes made by the larvae (Figure 6). In Namibia, farmers store their seeds in a mixture of ash and black pepper powder to prevent bruchids. However commercial pesticides such as Actellic dust were reported to have significantly lower percentages of seeds damages in cowpea.

Figure 6: Cowpea grain damaged by weevils/bruchids in store

To minimize losses incurred because of weevils, grains should be stored in airtight containers such as sealed oil drums, locally constructed tanks, high-density plastic sacks, and bottles that should be placed under dry conditions in the sun. If seeds are to be stored for long, then Fumigation with Dichlorvos (DDVP) combined with Primophos methyl or Phosphine gas at the rate of 1 - 2 tablets/100 kg of seeds is recommended. The Phostoxin tablet should be wrapped in a piece of cloth or tissue paper or a perforated envelope before it is placed inside the container. Aluminium phosphide is also marketed as Phostoxin, Cyclotoxin, Forcetoxin, Protex, Gastoxin, etc.

Treated seeds should be stored by packing them into jute or polypropylene bags with polythene inner liner or triple bagging. Seeds can be sprayed with a mixture of 100 - 200 mL of Actellic 25 EC in 5 L of water. This solution can cover 100 m2 of the store or 10 bags of grains. Alternatively, a mixture of 16 - 40 mL of Actellic 25 EC with 1 - 2 L of water is sufficient to treat 10 bags of grains. Chemically treated grains should not be used or sold for consumption until after 6 months of storage. Seeds should only be used after exposure in the open air for 1–2 hours before use.

4.19. Sorting

Seeds quality is very important for a consumer to make buying decisions. It is therefore important that care must be taken when harvesting and during post-harvest handling to avoid cracked or split seeds. Sorting facilitates the separation of the broken and damaged seeds from the good seeds. Most often, seed retailers prefer to buy the cleaned and bagged seeds, while some will prefer to buy grain in bulk and clean it themselves.

4.20. Grading

According to the FAO report, cowpea seeds are graded at 10 percent moisture content using a 4.8 mm diameter round perforated sieve and 4.0 mm diameter for small-seeded varieties.

4.21. Packing

Some buyers prefer the seed to be cleaned and bagged, while others will take the grain in bulk form and clean it themselves. Dried grains are packaged in sacks and staked under the shade inside a room or stored in drums and silos to be used or sold later in the season.

4.22. Storage

The major problem post-harvest in cowpea is insect pests that can be devastating to cowpea during storage. There are some storage insects that cause damage to the seed; it is, therefore, important to store seed in a protected place. A serious insect pest during storage is the cowpea weevil, Callosobruchus maculatus (Coleoptera: Bruchidae). In Namibia, ten insect pest species were found to be affiliated to the orders of Coleoptera (Attagenus fasciatus, Callosobruchus subinnotatus, Cryptolestes ferrugineus, Oryzaephilus surinamensis, Rhyzopertha dominica, and Tribolium

castaneum), Lepidoptera (Corcyra cephalonica, Sitotroga cerealella), Psocoptera (Liposcelis paeta), and Blattodea (Blattella germanica) (Stejskal *et al*., 2006). Farmers also make use of ashes mixed with seeds to preserve it.

The storage life of cowpea depends on its moisture content at storage. Lower moisture content is recommended for a better quality of seeds in storage. In some African countries and where farmers can afford it, cold storage is the best alternative to keep insect pests out of seeds. Seeds can be exposed to -18ºC for 6 to 24 hours to reduce pest infestation by more than 99%. In the case of short-term storage, seed can be stored at 12% or less moisture content, while for long-term storage, 8 to 9% moisture content is recommended. On the other hand, cowpea biomass is dried to be used as animal feed during the dry season. Sun-dried cooked leaves mixed with Kalahari melon are stored for up to a year and consumed as a vegetable.

4.23. Transport

In Namibia, cowpea grain is transported by the farmers themselves. After packaging in bags, the bags are loaded on a truck to deliver to the nearest market. The promotion of the formal market is currently underway through the NAB. For some markets, especially in South Africa, the cowpea is harvested at higher moisture, such as 18 %, and trucked directly from the field to the processor and this does not require specialised transportation for the seed. In a country where the leaves market is popular, it could be necessary to organise a cooling truck to avoid wilting.

4.24. Marketing

In Namibia, farmers sell green pods of cowpea during February and March depending on the rainfall. Dried grain is sold during the dry season (August-January). The formal marketing of cowpea in Namibia constitutes less than 10% and the rest is predominantly occupied by the informal market. Cowpea is yet to be a controlled commodity whereby the NAB is responsible for market facilitation in that regard.

For the cowpea seed market, seed quality is vital, so care in harvest and post-harvest handling may be important to avoid cracked or split seed. Cowpea leaves are sold in Namibia, South Africa, Ghana, Mali, Benin, Cameroon, Ethiopia, Uganda, Kenya, Tanzania, and Malawi.

Table 1: Cowpea production schedule in Namibia

Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Soil Sampling							x	x	x	x	x	
Soil Preparation							x	x	x	x	x	x
Planting	x							x	x	x	x	x
Topdressing	x									X	x	x
Monitoring of pests & diseases	x	x	x	x							x	x
Weeding	x	x		x	x				x	x	x	x
Harvesting & processing				x	x						x	x
Marketing				x	x	x	x	x	x	x		

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7. Annexure

1. Production cost

COWPEA PRODUCTION COSTS OF 2018 Determining the floor price for the 2018 marketing season										
VARIABLES			Commercial		Communal		GRN Subsidized Rate		NAB Production Cost Estimate 2018	
SEEDS	UNIT	UNITS/ha	PRICE/ UNIT (N$)	COST/ha (N$)	PRICE/UNIT (N$)	COST/ha (N$)	PRICE/UNI T (N$)	COST/ha (N$)	PRICE/UNIT (N$)	COST/ha (N$)
Nakare {Black Eyed Beans}	Kg	24	NAD 50,00	NAD 1 200,00	NAD 12,00	NAD 288,00	NAD 12,00	NAD 288,00	NAD 12,00	NAD 288,00
Seeds treatment {Inoculation}	Kg	1	NAD 50,00	NAD 50,00	NAD 0,00	NAD 0,00	NAD 0,00	NAD 0,00	NAD 0,00	NAD 0,00
Sub - Total:				**NAD 1 250,00**		**NAD 288,00**		**NAD 288,00**		**NAD 288,00**
SOIL PREPARATION & PLANTING										
Ploughing & Sowing {Own Tractor}	Litre	30	NAD 13,00	NAD 390,00						
Ploughing & Sowing {Hired Tractor}	Hour	2	NAD 0,00	NAD 0,00	NAD 450,00	NAD 900,00	NAD 125,00	NAD 250,00	NAD 450,00	NAD 900,00
Sub - Total:				**NAD 390,00**		**NAD 900,00**		**NAD 250,00**		**NAD 900,00**
FERTILIZER										
MAP	Kg	50	NAD 10,00	NAD 500,00	NAD 10,00	NAD 500,00	NAD 4,70	NAD 235,00	NAD 10,00	NAD 500,00
Sub - Total:				**NAD 500,00**		**NAD 500,00**		**NAD 235,00**		**NAD 500,00**
WEEDING										
Mechanical {Own Tractor}	Litre	15	NAD 13,00	NAD 195,00						
Manual {Labour-Day}	Person/ Day	13	NAD 60,00	NAD 780,00	NAD 60,00	NAD 780,00		NAD 250,00	NAD 60,00	NAD 780,00
Sub - Total:						**NAD 780,00**		**NAD 250,00**		**NAD 780,00**
Pest Control										
Chemical Pest Control	Litre	2	NAD 100,00	NAD 200,00	NAD 100,00	NAD 200,00	NAD 100,00	NAD 200,00	NAD 100,00	NAD 200,00
HARVESTING										
Mechanical {Harvester}	Litre	15	NAD 13,00	NAD 195,00						
Manual {Labour-Day}	Person/ Day	15	NAD 60,00	NAD 900,00	NAD 60,00	NAD 900,00	NAD 60,00	NAD 900,00	NAD 60,00	NAD 900,00
Sub - Total:						**NAD 900,00**		**NAD 900,00**		**NAD 900,00**
THRESHING										
Mechanical {Thresher/Pre-Cleaner}	Litre	5	NAD 13,00	NAD 65,00						
Manual {Labour-Day}	Person/ Day	5	NAD 60,00	NAD 300,00	NAD 60,00	NAD 300,00	NAD 60,00	NAD 300,00	NAD 60,00	NAD 300,00
Sub - Total:						**NAD 300,00**		**NAD 300,00**		**NAD 300,00**
TRANSPORT										
Transport cost to the nearest market	Bag	20	NAD 20,00	NAD 400,00	NAD 20,00	NAD 400,00	NAD 20,00	NAD 400,00	NAD 20,00	**NAD 400,00**
Sub - Total:				**NAD 400,00**		**NAD 400,00**		**NAD 400,00**		**NAD 400,00**
PACKAGING MATERIAL										
Empty Polyethylene Bags	Bag	20	NAD 8,00	NAD 160,00	NAD 8,00	NAD 160,00	NAD 8,00	NAD 160,00	NAD 10,00	NAD 200,00
Sub - Total:				**NAD 160,00**		**NAD 160,00**		**NAD 160,00**		**NAD 200,00**
COWPEA PRODUCTION COST/ha under rainfed				**NAD 3 355,00**		**NAD 4 428,00**		**NAD 2 983,00**		**NAD 4 468,00**
Inflation rate	**%**	**3,6**		**NAD 120,78**		**NAD 159,41**		**NAD 107,39**		**NAD 160,85**
TOTAL COWPEA PRODUCTION COST/ha under rainfed				**NAD 3 475,78**		**NAD 4 587,41**		**NAD 3 090,39**		**NAD 4 628,85**
Producer Price (Determination based on Production cost)										
COWPEA AVERAGE PRODUCTION COST/ha						**NAD 3945,61**				
STANDARD/INTERNATIONAL COWPEA PRODUCTION COST/ha				**N$3 810,66 - N$4 076,52 {272,19 - 291,18 USD}**						