



Market chain of Zambian agrarian products in Mongu,

Western Province:

**Case study of Bravo Mushaukwa – Bmuka Cassava
production & Marketing Enterprise**

**Within the project „Value chain development “financed
by the Czech Development Cooperation**



Mongu, Western Province, Zambia | 2019

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Summary

This report is the outcome of the project titled Value chain development in Western province of Zambia, financed by the Czech Development Cooperation. Report has a standard structure starting with introduction to cassava agroecological characteristics, global production overview and utilisation. The aim of the study is to provide the reader with the logic of data collection and evaluation. All data was collected and assessed via methods that are frequently used in the studies on value chains and indicators provide easy and relevant respond to current situation. Study further provides basic feedback to business proposal on corresponding with the chosen product, in this case it is meal produced from cassava. Conclusion section summarizes main ideas, recommendations, lessons learnt as well as suggestions for value chain development. The study is trying to stress the role of traditional knowledge and processing technologies that are economically viable and accessible, there is slow but continuous rise on demand side for local and traditional products, and potentially they might attract either tourists or consumers abroad.

Preface

Cassava (*Manihot esculenta* Crantz.), a woody shrub of the Euphorbiaceae family has been pantropically distributed and became the most important tropical tuber crop. Nowadays it is grown as an annual crop in the tropics for its edible starchy tuberous roots.

Based on FAO database, Africa's production of cassava has risen from around 40% of world cassava production in early 1960s to more than 50% in 1990s. At the end of the second decade of new millennia, 13 biggest producers out of first 20 are from Africa. A biggest world producer of cassava is Nigeria with >45 mil. tonnes, followed by Thailand, Brazil and Indonesia. African leading producers of cassava apart from Nigeria are Angola, Ghana, DR Congo, Malawi, Tanzania and Cameroon with a total annual production from 4.6 to 16 mil. tonnes.

Cassava production area in Zambia encompass Luapula province, Northern province, North Western province and Western province, with the total harvested area almost 180 thousand hectares with average annual yield 5.85 tonnes per ha. The total annual production is around ~1 mil. tonnes and has an increasing tendency.

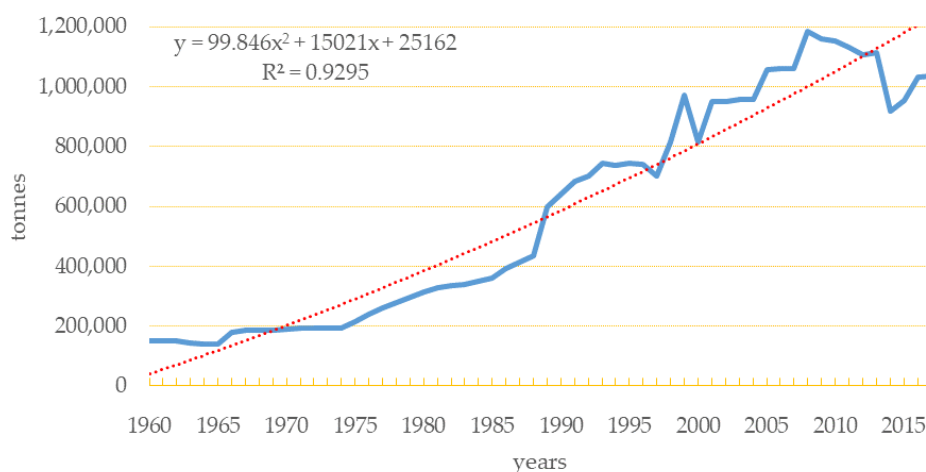


Figure 1 Annual production of cassava in Zambia 1960-2017 (Faostat, 2019)

Increase in production may be explained by the fact that cassava is being more and more promoted by the government in many development programmes, including the improvement

of supply chains of main inputs, e.g. genetic materials or fertilizer, and market/value chains. In addition, demand for cassava has expanded because of population growth and increased poverty thus, encouraging consumers to search for cheaper sources of calories.

One of the critical variables/challenges in the expansion of the cassava area/production is the availability of improved processing equipment to dehydrate the roots (the roots are 70% water) and thereby reduce the cost of transportation. Improved processing and food preparation methods reduce bulk and make it possible for cassava products being transported at reduced costs over poor roads to distant urban market centres.

1. Introduction

1.1. Definition of markets and market chains

The term market has received a variety of definitions. Nevertheless, in general, we can speak about the place where those who want to sell are meeting with those who are willing to buy. In one moment, if both parties make a deal, the market can be quantified in terms of price for a product and the quantity sold. Besides of this, market is a place that can provide unique information on local needs, preferences, culture, habits etc. This is important particularly for agricultural markets that deals directly to local food chains and diet. Thus, any new product must either meet local needs and preferences or to change them. Both strategies are risky and need good planning and resources to succeed in the market. In the case of new product, a seller should consider local food/taste preferences and traditional post-harvest handling, which could cause further changes in human diet and consequently in farming system. Globally, these strategies are usually linked to loss of biodiversity and cultural values as well as dietary failures leading to obesity, deficiencies in vitamins and other basic dietary elements, and other food-related health disorders. In this case, the role of government is to regulate import of such products or their production at the local level or to support local economy.

1.2. Theoretical background on value chains

Kaplinsky and Morris (2000) describe the value chain as the full range of activities, which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use.

Generally, to be successful at the market, sellers use various strategies on how to attract potential buyer. These strategies are called marketing. Even though marketing is always defined as a process of satisfying human needs by delivering the certain product (or service) in proper form, time and place, it also has a productive value for the seller. All sellers are following one goal – maximizing their profit.

One of the functions of marketing is to upgrade existing production systems and to bring/offer the consumer with something specific, in economic words we can call it added value. This

strategy is usually linked to technological processes, such as proper storage, processing, transport, packaging etc. However, marketing must contain a significant creative component in all above-mentioned processes to get an advantage at the market. This requires additional resources and certain level of experience and/or education. Important point is not to maximize the profit by leaving behind quality standards. Marketing must be considered as a social and cultural aspect creating links between producers (farmers) and consumers, and other nodes along the market chain. These linkages are expected to be of a long-term character and are based on mutual understanding and commitment of all being involved.

The market chain could be thus described as numerous links that connect all actors and transactions involved in the movement of agricultural products from the production place (farm) to the consumer (household, restaurant, hotel, school, administrative office etc.). In other words, all paths of product flow from its origin to the ultimate destination of final use. Very often the raw product is also being changed or transformed, which put into the market chain value-added component. In this case, we can speak about the value chain.

Every market/value chain tend to be more and more specialized in order to deliver a high-quality product at a good price to reach maximum profit. Specialization could occur also at different nodes along the chain as well. This specialization leads or may lead to product differentiation as the consumers have various preferences related to their socioeconomic and demographic characteristics. Any producer or seller should be aware of who are the consumers and how the product should be specified, and what price to ask. Final price also influences a marketing margin, measure of performance of a marketing system, or in other words, how consumers' expenses are divided along the market chain at different levels. Such margin is simply the outcome of the demand and supply at the market, quantified as a difference between the price the consumer pays and the price that is obtained by producers.

1.3. Production opportunities and challenges for cassava

Geographic aspects

The cassava wide geographical distribution in the past resulted in a huge number of regionally developed cultivars. Soon after cassava introduction to Africa it became valuable famine reserve crop. Nowadays, Africa has largest area under cassava cropping, especially thanks to

cassava resistance to herbivorous animals causing significant damages to other crops, as well as thanks to its vegetative propagation through stem cuttings and its tolerance to poor soil fertility. The herbivory resistance is based on presence of latex and bitter compound Linamarin, cyanogenic glucoside, being present in all plant parts including edible tubers, which poses a potential risk of consumption in humans.

There are basically 3 agroecological production zones distinguished within Zambia with the principal zone for cassava cultivation being the northern and North-western part of the country including regions of the agroecological zone III with hot and humid climate. In this zone, cassava serves as the primary staple food being cultivated by over 75% of farm households.

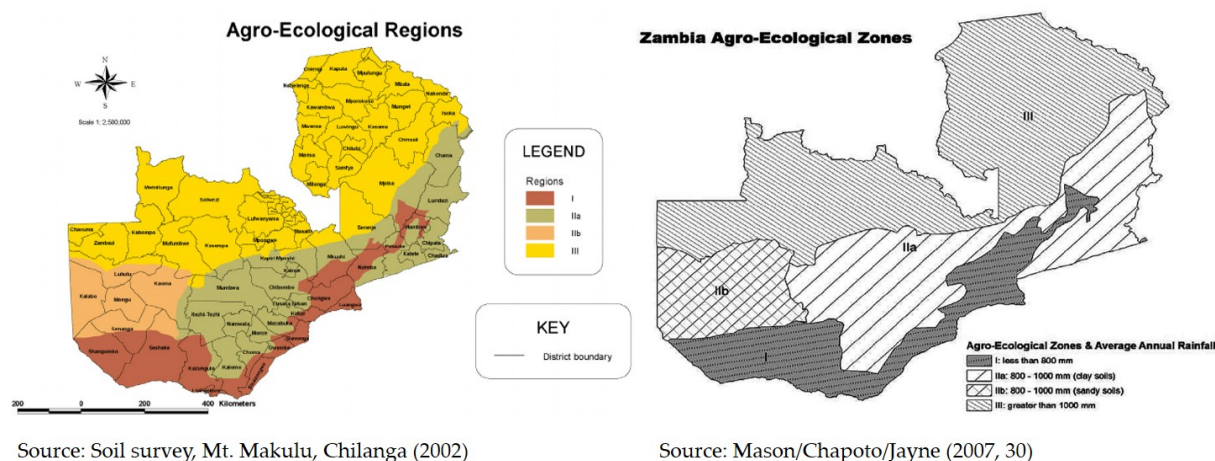


Figure 2: Zambia's Agro-Ecological zones

The target region of this study belongs to the agro-ecological zone II. More specifically to the zone IIb. This an intermediate, dual staple zone forming a buffer between Zambia's cassava and maize belts, where sandy soils favour cassava production. According to cassava production statistics, this zone could hardly compete to northern and north western provinces in terms of yields and production quantity, which is more than double that in the agro-ecological zone II. However, in the dual staple zone, there seems to be potential to orient cassava production on value-added quality cassava products using more sophisticated methods of processing and diversification of an assortment of cassava products.

Status of cassava production in Zambia

In Zambia, cassava production is characterized by small scale farmers cultivating at subsistence. Cassava is the second important cash crop after maize as a staple food and one of the major roots and tuber crops widely cultivated besides the sweet potatoes. Cassava is planted in the rainy season during the period November-March. The harvesting season varies from 6 months for early maturing cultivars to 24 months or later for late maturing varieties. The cassava tubers and derived products provide food and income for many local agricultural dependent populations.

Agroecological aspects

Optimal agroecological conditions for cassava growing include annual precipitations between 1,000-1,500 mm without distinct dry periods. However, once established, cassava withstands severe drought period during which the plants shed their leaves. Accordingly, it is a suitable crop in areas with uncertain rainfall distribution. Principally, the good yields can be expected on well-drained soils and with exposure to full sunlight. The best yields are obtained on fertile sandy loam soils; however, cassava provides acceptable yields also on depleted or even eroded soils. Unsuitable soils include gravelly or stony soil types as well as saline and alkaline soils. Agroecological conditions and mineral supply influence the glucoside content causing cassava toxicity. Particularly, the high content of nitrogen and low content of potassium in the soil, increase the glucoside content, which increases with the plant age and after attains a peak then declines.

Harvesting aspects

For direct consumption, cassava is best harvested before the roots are too hard and fibrous, but it is harvested later for starch production. The starch content is increasing significantly in the dry season. Cassava because of its perennial nature has no distinct period of harvesting. For human consumption, it is usually harvested 9-12 months after planting. It is sometimes harvested earlier if needed for food. When grown for starch production, it may be harvested after 18 months or even later. In Mongu, even for consumption, varieties are harvested commonly after 2-3 years of growing. Optimum harvest period depends on root quality, yield and climatic conditions. Tubers become too woody when harvested late, so the

determination of optimal harvesting time should be carefully considered with respect to final product quality. It is, therefore, best to harvest cassava when the starch content reached its peak. For most cultivars, it occurs at 12-18 months after planting although some early-maturing cultivars are ready for harvest at 8-9 months (Onwueme 1978).

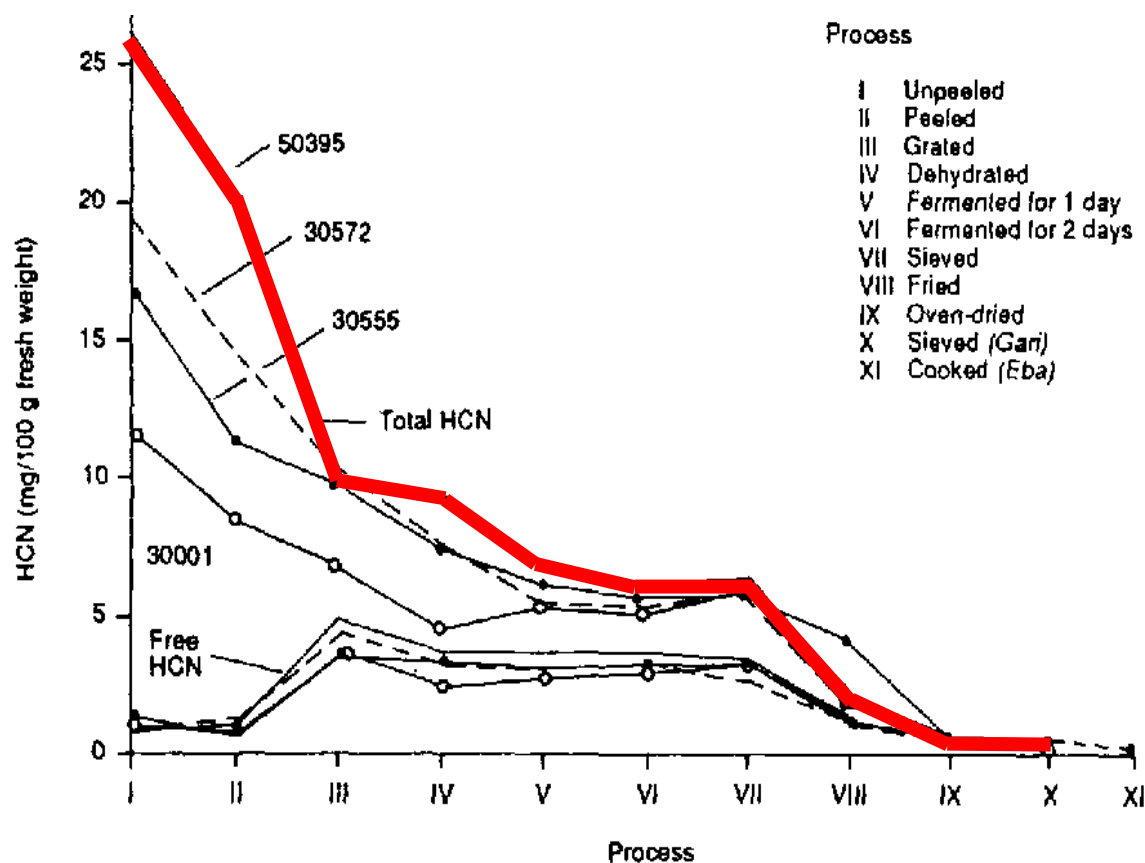
Cassava properties

The overall energy value of cassava tuberous roots reaches 600 kJ/100 g. Average nutritional composition per 100 g of cassava tubers' edible portion includes water (62%, the dry matter content of the tubers vary between 30-40%), carbohydrates (mainly starch, 35%), protein (1%), fat (0.3%), minerals (mostly phosphorus and iron 1%). In terms of vitamins, only the vitamin C content is of importance (35 mg/100 g of fresh weight) (Onwueme 1978).

As mentioned above all cassava plant parts including tuberous roots can contain dangerous amounts of the bitter-tasting glucoside, from which hydrocyanic acid (HCN) is released by the enzymatic hydrolysis. If the cells of tuberous roots are crushed, glucoside linamarin and the enzyme linamarase make contact and the HCN is produced. This is the key to methods of getting rid of HCN. The glucoside content (as HCN) in the central part of fresh tuberous roots varies from 10-490 mg/kg. Small amounts of glucoside content are tolerable in consumption, but the maximum intake of HCN should not exceed 1 mg of HCN per kg of body weight per person a day. The tubers, rich in starch, are usually detoxified before consumption by cooking, roasting, soaking in water, drying or fermentation. The content of glucoside is a varietal characteristic. Some cultivars are characterized by low glucoside content (called "sweet" cultivars) while others have high glucoside content (called "bitter" cultivars). (Onwueme 1978). The bark of cassava tuberous roots is usually peeled off, and only the pith of the roots is utilized. With bitter varieties, the glucoside is removed by crushing or by soaking. The volatile HCN should be allowed to escape. Boiling is not always a guarantee that the product is safe, as the HCN can be trapped in the starchy paste. Grating and slow drying the resulting product is effective. Though consumers in villages usually know how to prepare a safe product, accidents still occur, especially with children.

Importance of assessing and exploring local or regional intraspecific diversity (cultivars and varieties) of crops is evident also in cassava where the sweet cultivar Manyokola from Malawi

cultivated by Zambian farmers significantly grew up the market of fresh cassava tubers in Lusaka. The availability of other specific varieties about for example low-glucoside content or yellow-fleshed cultivars of cassava improves prospects for developing the marketing potential further. Given that Zambia's Root and Tuber Improvement Programme (RTIP) released their latest three sweet varieties of cassava only in 2003, these new varieties are not yet widely available among farmers, either in the cassava belt or outside. In Mongu, the cassava varieties on the market are categorized in sweet and bitter varieties. The variety characteristics are key as they determine the purpose and cassava product generated. Some of the varieties include Nalumino (bitter), Nakamoya (sweet), Kapumba (sweet), Mutembo (sweet).



Source: Hahn, 1983

Figure 3 HCN levels for different processing methods

Postharvest handling and storage aspects

Once harvested, cassava must be consumed or processed within a couple of days to prevent the decay of the tubers. Primarily, cassava needs to be processed into various forms to increase the shelf life of the products and improve palatability (Hahn and Keyser 1985). For human consumption, and to produce starch or dried chips, the further processing should be done as soon as possible, and it should certainly follow within 2 or 3 days because the roots decay quickly after harvesting.

Physiological changes cause blue or brown vascular streaking in the tubers, just below the peel, already 2 days after harvest. In addition, a microbial deterioration normally starts after the onset of physiological deterioration but often within a week after harvest. First symptoms are blue or brown streaks throughout the tuber. Spoilage is fastest in damaged tubers, so the harvesting practices and postharvest handling should avoid as much as possible the physical damages to the harvested tubers.

Some progress has been made with the storage of fresh roots. One method is to pack fresh, undamaged tubers in moist sawdust in boxes, which can be used for marketing roots in urban areas. This practice allows to store cassava tuberous roots for up to two months, however, microbiological deterioration still occurs. Another method of storing cassava is to dry pieces of roots (chips). These chips should be dried quickly to avoid deterioration. Sun-drying is quite common in many cassava production areas. The shape of the chips is important for quick drying, usually the smaller the pieces the better and pieces of regular cube shape are recommended. For commercial production, the chips are dried on concrete floors and subsequently, they are converted into pellets, which are denser than chips and easier to transport.

Cassava can also be stored as flour/meal. For this purpose, freshly harvested tubers are peeled, grated, squeezed, and then slowly roasted and dried. This product is called *farinha de mandioca* in Brazil, *fariña de yuca* in Peru and *gari* in West Africa. *Gari* is a grainy meal obtained after the fermentation process.

Cassava starch is usually prepared in special factories, where the roots are washed, crushed and further processed. The pure starch is usually separated by centrifuging.

Methods of processing and respective products

Cassava is principally cultivated for its tubers used for direct human consumption (65% of the global cassava production), as an animal feed (20%) and for starch and industrial uses (15%). The cassava tubers have a high content of carbohydrates (starch) and are a valuable source of food. The young leaves, rich in protein (up to 7%) and vitamins (carotenoids and vitamin C), are used as a vegetable. Mature leaves are fed to domestic animals. According to a recent study of Alamu et al. (2019) on cassava processing and use at the household level in Zambia shows, that cassava is still cultivated as a food security crop with only the surplus sold to generate income.

In Zambia, cassava processing is still conducted at lower level using traditional methods. Processing reduces food losses and stabilizes seasonal fluctuations in the supply of the crop. The method of processing consists of manual operations (peeling, pressing, sun drying) which is both time consuming and labour demanding. These processing methods possess a challenge to control the perishability and reduce the levels of glucoside in fresh cassava tubers. The lack of improved processing technologies limits the number of cassava-derived products and compromises the quality and quantity of the cassava products. Therefore, in some cases, marketing of the cassava products is restricted to low income consumers. Sun drying is the common practice for cassava among the small-scale farmers since no advanced drying technologies are implemented. The utilization of improved processing technologies can enhance opportunities and motivation for more farmers and other actors to be involved in the production, marketing and selling of more cassava products.

The data for Kaoma (one of our target districts) shows that households process cassava predominantly for consumption only or both consumption and income. However, there is no evidence of purposive processing exclusively for income. The most common methods of processing cassava in Zambia include *bwabi* (81%) followed by *kapesula* (42%) and *kasabe* (36%). *Bwabi* involves peeling fresh cassava and soaking it in water for a period of between 2 and 6 days and sun-drying it. However, *kapesula* processing involves peeling, sun drying for at least two days and soaking in water for 1–2 days before sun drying for the second time. The key attribute of *kapesula* is its long shelf life and good storability. On the other hand, *kasabe* involves chipping freshly peeled cassava tubers, which are then mixed with a starter culture

(fermented cassava) to begin the fermentation process. The product is usually dark in colour and has a strong fermented odour (Alamu et al., 2019).

According to Alamu et al. (2019), Zambian farmers, traders and processors prepare dried cassava, then mill it to produce cassava flour for use in a variety of human foods, including toasted snacks, composite flour biscuits, blended *nshima* and as convenience foods. To promote cassava and its commercialization, there is a need to promote a wide range of cassava-based products to improve consumption and utilization in its various forms. In the medium run, if Zambia were to reach cassava consumption patterns similar to those achieved in West Africa, then *gari* and other cassava-based convenience foods could ultimately account for as much as 50% of total cassava consumption, or roughly 500,000 tons of fresh cassava per year. However, the assessment results of cassava secondary products either produced or consumed by the households showed that there were extremely low levels of production of secondary products.

According to Onwueme (1978), the following methods are utilized for reducing the HCN level of cassava before consumption:

- a) *Crushing, maceration or pulverization*: to bring enzyme linamarase in contact with linamarin to release HCN followed by the removal of resulting HCN by squeezing out the juice and heating. The same process is applicable even more effectively in cassava leaves (e.g. in making *pondu* in west Africa).
- b) *Decomposing the linamarin by heating*: heat treatment of the tubers or leaves using the temperature above 150°C.
- c) *Sun/oven drying*: removes about 80% of the free and 80-90% of the bound cyanide.
- d) *Retting – prolonged soaking of the tuber in water*: it allows the fermentation process elicited by the microorganisms. It makes tuber more permeable thus the water-soluble linamarin leaches out from the tuber into the water. Retting followed by sun-drying can remove up to 99% of cyanide.

No matter how carefully cassava has been processed, traces of HCN invariably remain in the consumed product. For persons heavily dependent on cassava diet the total quantity of HCN

ingested can be appreciable. Ingested HCN in the human body is metabolized and resulted compounds decrease levels of methionine and cystine amino acids; inhibit the accumulation of iodine in the thyroid gland, resulting eventually in iodine deficiency, endemic goitre, endemic cretinism, and mental retardation. Therefore, the careful cassava processing should be a priority and the appropriate processing methods should be used to reduce the HCN content to the minimum.

Cassava Products

Use of the fresh (unprocessed) tubers

Constraints of fresh tuber utilization are based on glucoside content and perishability of fresh tubers, which are storable just for a few days after harvesting. The primary deterioration (vascular streaking) caused by enzymatic processes described above fails to occur when tubers have been dipped in warm water (53°C for 45 minutes), stored in anaerobic conditions, submerged in water, or kept under refrigeration. Secondary deterioration involves microbial rotting causing deterioration of the starch quality. However, the storage in the sawdust boxes mentioned above allows storing cassava tubers for as long as eight weeks. This storage should be preceded by treatment of the tubers at 30-35°C and 80-85% relative humidity.

Only tubers of cultivars with very low glucoside content ("sweet" cultivars) can be safely consumed with little or no processing. Such tubers can be eaten raw as a salad or snack or maybe boiled or roasted. Alternatively, they can be boiled and pounded into a paste and eaten with a sauce as for example *fufu* in Ghana.

The fresh or alternatively cooked cassava tubers are also utilized as animal fodder for sheep, goats, cattle and particularly pigs. However, cassava should not exceed 40% of the ration.

The major processed forms of cassava tuber are meal, flour, chips and starch. Cassava chips and starch are mainly industrial products little used for direct human consumption. However, in Zambia the most common forms of cassava tubers are meal and chips.

Fermented and roasted cassava tubers

In Zambia, the fermented and roasted cassava tubers are prepared for sale on the markets. The fresh tubers are soaked in a bucket of water for 3 days in the hot season and 7 days in the cold season to ferment. Once the tubers are soft, the fresh fermented tubers are then roasted on charcoal. The roasted tubers are peeled and then roasted again to obtain a brown colour and sold as a snack.



Fig. 1. First phase – soaked and fermented cassava tubers



Fig. 2. Second phase – fermented cassava tubers after 1st roasting



Fig. 3. Third phase – 2nd roasting of the peeled tubers



Fig. 4. Final product

Figure 4 Preparation of fermented-roasted cassava in Mongu

Toasted cassava meal

Gari is the most popular form of processed cassava consumed in West Africa. Its preparation includes the following steps: peeling, grating, pressing, sieving, toasting, and sieving again to sort different particle sizes. To prepare *gari*, cassava tubers are peeled, washed and grated. The juice is extracted from the grated meal by pressing it for 2-4 days. During this period, it becomes slightly fermented. Subsequently, the meal is removed from the bags and sieved. Sieved material is placed in wide, shallow metal pans over a fire and toasted. Constant stirring is necessary during toasting. When sufficiently dry, the meal is removed from the pan and let cool down. At this stage, the product is ready for consumption. The final product has a higher protein content than the meal itself. Partial dextrinization of the starch during toasting allows the swelling of the product when put into hot or cold water.

As a snack, it is eaten directly in the dried form or cold water can be added to form a suspension. The most popular method is to pour *gari* into boiling water to make a paste (*eba*). The paste is eaten in a similar way as *nshima* in Zambia. *Gari* is very popular among the urban dwellers due to convenient price, ease of storage, and ease of preparation for consumption. In Zambian context, for *gari* and other cassava-based convenience foods, past efforts by private entrepreneurs suggest that market development will require time as well as resources sufficient to finance investments in marketing, packaging and processing technology.

Farinha is very much like *gari* in its mode of preparation. The only difference is that pressing and fermentation (if any) times for *farinha* are much shorter. It is the most popular cassava product consumed in Brazil and some other South American countries. The consumption of *farinha* is also very similar to that of *gari*; can be eaten dry or mixed with hot or cold water to form a paste. *Farinha* production in Brazil is commonly mechanized using power graters, power pressers and rotating ovens. Using such equipment, it is possible to process over 30 t of fresh tubers at each processing plant per day (1 t of fresh roots yields 0.35-0.4 t of *farinha*).

Atieke is a common form of processed cassava in Ivory Coast. It is made of pulverized cassava, which is fermented and then steamed. The shelf life of the product is much shorter than in *gari* or *farinha*.

Meal of retted cassava

This is produced by soaking the fresh cassava tuber in water for several days until it has softened. The softened pulpy mass is then disintegrated in water and passed through the coarse sieve. After sieving, it can sediment and the semi-solid suspension is squeezed to expel the excess water. The final product is white and crumbly. During soaking it is important that whole tuber is completely submerged in water (exposed parts will fail to soften). Soaking in the water serves to reduce the glycoside content. The meal of retted cassava is usually cooked before eating. It is rolled into large balls, boiled in water, pounded, and then eaten in the same manner as above-mentioned *eba* or *nshima*. The negative characteristic of this product is that it tends to have a bad odour which decreased its popularity, especially among city dwellers (Onwueme 1978).

Chikwangu is a retted cassava product common in the Congo basin. The retted cassava tubers are pounded into a paste; fibre strands are removed; the paste is wrapped in leaves and steamed until well done. Such a product can be stored up to a week.

Cassava flour

For human consumption, cassava flour is made when using low-glucoside (“sweet”) cultivars by drying (usually sun-drying) cassava tuber pieces and milling them. The cassava tubers are peeled, washed and cut into large longitudinal pieces, which are subsequently sun-dried and stored. When flour is needed, the sun-dried pieces are milled to produce greyish-white flour. For consumption, the flour is added into a pot of boiling water over a fire and stirring it until it forms a brownish, viscose paste. The paste is allowed to cool and harden and is eaten with relishes or soups. Where high-glucoside cultivars are used the tubers are retted/fermented for 2-3 days before being sun-dried (e.g. product *lafun* in south-western Nigeria).

Attempts are made to produce a more refined cassava flour suitable for making bread, biscuit, glue etc. The ordinary cassava flour used for paste has large particles sizes. For the mentioned value-added products, the flour with finer particle sizes is needed. Such flour can be used for baking in a mixture with wheat flour or can partially substitute the wheat flour.

In Zambia, the production of cassava flour as an alternative and supplement to wheat flour is not developed, despite, other countries using the cassava to produce the flour for bakery sector. The cassava meal is one of the important products produced in Zambia and it is used to prepare *nshima*. It is sometimes mixed with the maize meal to prepare the staple food.

Cassava chips and pellets

They are produced mainly for feeding livestock. In Zambia, an array of innovative farmers and feed companies are experimenting with cassava-based feed rations as a means of lowering feed costs, the major cash expenditure in livestock production. The associated economic analysis indicated that cassava-based feeds would be profitable where cassava prices were 60% of the price of maize (Simbaya, 2007). For production of chips, the tubers are washed, peeled, and cut into slices of 3-6 cm long. The slices are subsequently dried and packed.

Pellets is a product made from chips. Dried chips are ground and hardened into cylindrical pellets, which are denser and easier to handle and transport. Production of chips and pellets is usually mechanized, and, in many cases, they are export-oriented products.

To prepare chips for human consumption, fresh tubers are peeled, boiled in water and longitudinally sliced. Chips are then soaked in water for 1-2 days during which the water is changed once or twice. Subsequently, chips are dried over fire or sun-dried for several days (e.g. *abacha* in Nigeria).

In Zambia, the raw cassava chips are fermented and dried. Firstly, the fresh tubers are soaked in a bucket for 3 days in the hot season or 7 days in the cold season to allow them ferment. After soaking and fermentation the cassava tubers are peeled immediately to prevent the colour of chips turning brown from white. The peeled cassava tubers are then sun dried for 4 days in hot season and 7 days in cold season to obtain the desired raw dried chips.

Cassava starch

For the processing in factories, only the outermost cork layer is removed, so that the starch in the skin layer is also utilized. The extraction of starch takes place in a wet process after the root tissue has been ground as finely as possible to produce a pulp. The pulp is suspended in water, the fibrous material is removed leaving the starch milk. Water during this extraction

should contain additives preventing the microbial activity leading to fermentation during the extraction. Starch is allowed to settle in tanks or separated by centrifuging. In this process, the bitter compounds and the HCN are washed out. Starch is then dried to a moisture of 10-14%, pulverized, sieved, and packed. Final product should be white in colour.

Cassava starch is used in cooking and cassava flour is used in puddings, biscuits and another confectionary. Various industries use it as a binding agent because it is an inexpensive source of starch. Cassava starch is used in the production of paper (sizing paper) and textiles and as monosodium glutamate (MSG), an important flavouring agent in Asian cooking.

Tapioca is a special product made from cassava starch, produced when the moist starch is heated to about 70°C. At this temperature, the starch gelatinizes and becomes more easily soluble and digestible. Tapioca comes in the form of sago-like small (seeds) or large (pearls) particles, and it can also be bought in the form of flakes.

Cassava starch is also used for direct consumption in parts of western Africa. The starch is stirred with boiling water to produce semi-solid paste used as a food.

Ethanol and starch-based sweeteners production

Alcoholic beverages and ethanol for fuel are made from the tubers. The advantage of cassava for ethanol production is that the tubers may be stored in the ground for many months before processing; thus, extending the factory window. The production of starch-based sweeteners especially glucose and fructose are becoming important, especially in SE Asia. Similarly, in Zambia the beverage industry is a promising sector and cassava can be used as an ingredient for brewing. Currently, eagle beer is produced from cassava ingredients in Zambia.

Industrial uses of cassava derivatives in the manufacture of paper products, wood processing, artificial sweeteners, ethanol and other manufactured goods offer a significant potential market for Zambian cassava. In land-locked Zambia, where petroleum-based fuels cost in the range of K 15 per litre, ethanol production from cassava could potentially absorb on the order of 100,000 tons of fresh cassava per year, given current volumes of fuel consumption and assuming a 10% substitution between ethanol and petroleum-based fuels without

modification of vehicle carburetion systems. Cassava-based sweeteners could likewise absorb significant volumes, possibly in the range of 40,000 tons of fresh cassava per year.

Cassava leaves

The young leaves, rich in protein and vitamins, are eaten as vegetables, which provide a cheap and rich source of protein and vitamins A and B (young leaves are cooked like spinach). The leaves are crushed, boiled and then consumed. Some forms *M. esculenta* or other *Manihot* species (*Manihot glaziovii*) are cultivated especially for their edible leaves. The mature leaves are used as fodder. Cassava leaves also contain considerable amounts of cyanogenic glucosides, but no accidents have been reported in relation to their consumption. It is advisable, however, to cut the leaves into pieces before cooking and to throw away the cooking water. In Mongu and Zambia at large, the cassava leaves are considered a rich nutritious vegetable that is widely consumed. The leaves are pounded and cooked as a fresh vegetable.

Sauces

The liquid which is a by-product of starch extraction is often boiled down and used for sauces in Latin America (West Indian pepper-pot *cassaripo*, and *tucupi* in Brazil). The Zambian scenario is still limited in processing cassava sauces and they are non-existent.

Environmental uses

The plant itself is also grown as a shade plant for young plantations of coffee and cacao, especially in South America. This utilization aspect could be also considered in the agroecological systems of cassava production, especially in mixed cropping systems including staple food crops and suitable indigenous perennial as well as annual useful plant species.

2. Aims of the survey

2.1. The main aim of the study

The main aim of this study is to document and analyse the existing market chain of Zambian agrarian products in Western province using cassava (*Manihot esculenta* Crantz) in Mongu district as a case study.

2.2. Specific objectives

The main aim of this study will be reached via the following specific objectives:

- (i) Describe cassava as a product and its marketing possibilities
- (ii) To identify supply chain actors in the cassava chain
- (iii) To determine the role played by different actors along the cassava chain
- (iv) To determine the profitability of cassava production among small holders

2.3. Research questions

Following research questions were set in order to understand the overall context of the survey:

- (i) What are the existing supply chain actors of the cassava chain in Mongu district?
- (ii) What are the roles played by different actors along the market chain of cassava in Mongu district?
- (iii) Who are the actors and category benefits in the market chain of cassava production in Mongu district?

3. Methodology

3.1 Study site characteristics (Western province and Mongu district)

Western province is characterized by difficult geographical and climatic conditions. It has limited arable land resources that can sustain crop production. Since independence, the province has experienced a period of economic relative isolation compared to other provinces. The province is also characterized by high population densities in certain areas especially the river valleys and the plains.

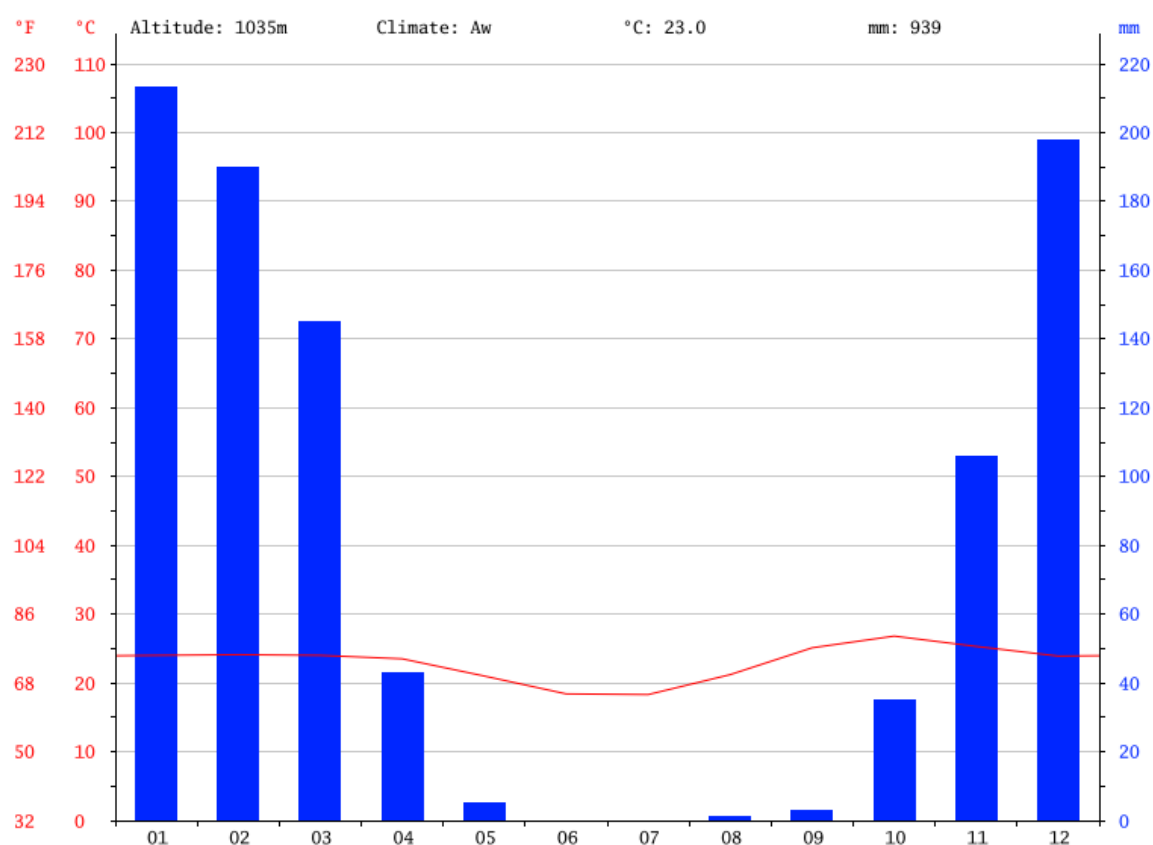


Figure 5 Climatogram of Mongu town, administrative centre of Western province and Mongu district (Climate Data, 2019)

Western province is the second province with the highest poverty levels in Zambia. The first is Luapula Province. About 80% of the population in the province is regarded as being poor and at least 70% of those in the poor category are women. The main stay of the people in

western province is low subsistence-oriented agriculture with low productivity in crop and livestock production supplemented by fishing. Crop production is the main contributor to daily subsistence. In reasonably good rainfall years, most areas are, at aggregate level, self-sufficient in staple food. However, food security varies across agro-economic zones and within these areas there is a large variation among households.

Mongu district has a population >142,000, which represents 13.47% of the population of the western province. Since 1990, population grew by 20,000, around 1% annually. Considering the total area of the district 6,360 km², average density is 22.42 per km².

3.2. Data collection

Mongu market

A survey was conducted for each of the selected cassava products. A semi-structured in-depth qualitative interview was employed. Interviews were conducted with consumers and vendors with each questionnaire taking approximately 15 minutes. The consumers' questionnaire comprised of questions pertaining to quantification of purchases, the prices of different cassava products, some factors that influence the purchase of cassava products, satisfaction with purchases and their willingness to pay a higher price if quality of the product is improved. The questions in the vendors questionnaire covered the quantification of the sales, some factors that vendors think influence the consumers to buy, and challenges that vendors face. The characteristics of market location were permanent stall, temporary stall, street ones and farm gates. The permanent stalls were found in Kashumba and Harbour markets.

Lusaka market

The officers for value chain visited the open markets around Lusaka, mostly at the old and new Soweto market, with the aim of finding out how cassava is fairing on the market in terms of price, factors influencing the purchase of cassava and the challenges being faced by the cassava sellers/vendors. The officers also visited potential buyers and suppliers of agricultural inputs/machines around Lusaka. A survey was conducted for each of the selected product (cassava). A semi-structured in-depth qualitative interview was employed.



Figure 6 Collection of data on Kashumba market in Mongu (left) and Soweto market in Lusaka (right)

3.3. Data processing and analysis

The product value chain analysis is done by identifying the opportunities and constraints of the various cassava products (commodities) in Mongu and partly Lusaka markets and presented in the SWOT analysis. The major preference attributes in cassava and products considered are the colour, the texture, taste and meal fineness. Basic economic indicators are also included in the survey to provide brief overview of current situation of particular market chain studied. Methodology for the study is adopted from other studies focused and tropical regions and dealing with similar issues (Umagowri and Chandrasekaran 2012; Narendra et al. 2013; Chagomoka et al. 2014; Hanadi et al. 2018).

4. Findings

4.1. Supply chain actors in cassava production

Figure 7 below illustrates the market chain of cassava in Zambia base on the data collection.

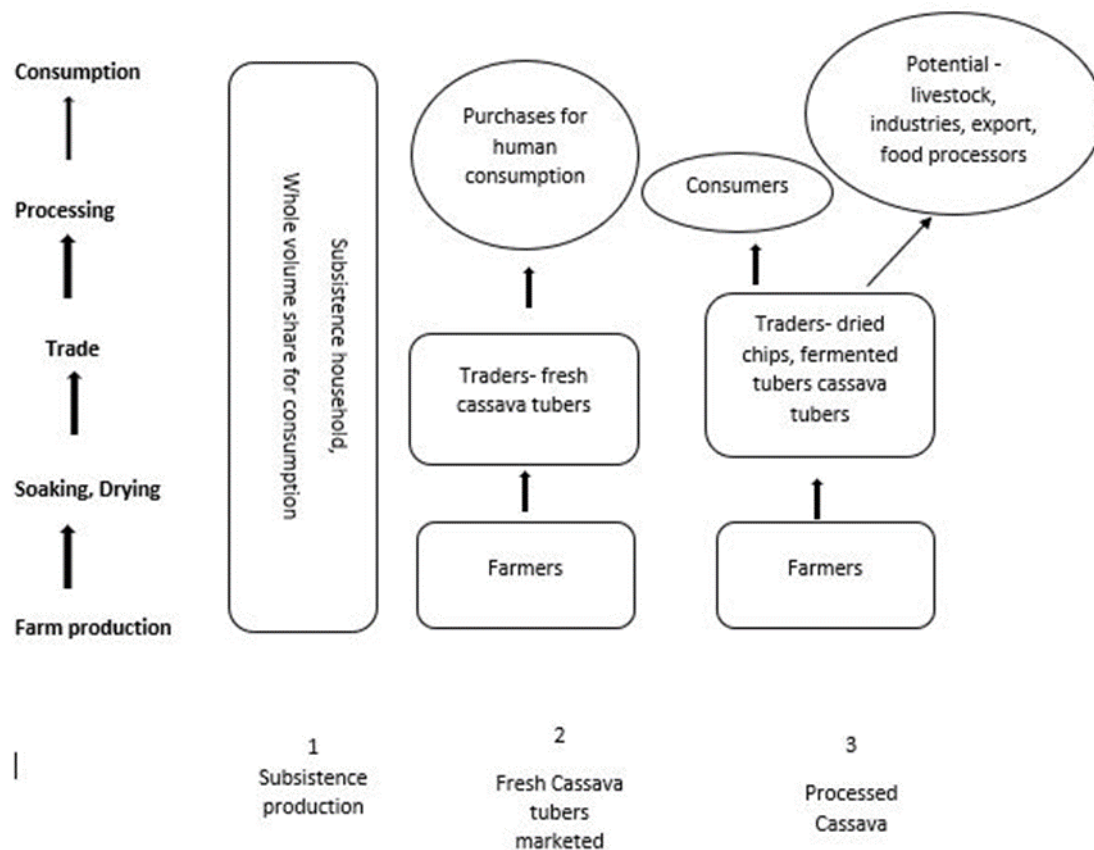


Figure 7 Cassava supply chain

Cassava market chain actors

In other parts of Africa, the value chain actors in cassava production is advanced when compared to the Zambian scenario. This is attributed to the number of cassava products that are processed and generated. For example, in Ghana (Kleih et al. 2013) identified various actors in the cassava value chain namely, Government and NGOs, the farmers, traders, processors, millers, bakers, animal feed industries, and paper and glue manufactures. Regarding Zambia and Mongu in particular, the following actors are involved in the cassava value chain.

Government and NGOs

The government is the main player in the cassava production, processing and marketing with the responsibility of creating an enabling environment to conduct business for actors at each stage of the value chain. The development of infrastructure such as roads and provision of utilities helps to create a conducive business atmosphere. Through the government and NGOs research institutions also play a key role in disseminating information on technological innovations and monitoring the standard.

Financial institutions

The financial institutions have a responsibility of providing credit for investments to farmers, traders and processors. However, for many actors in the value chain, the access to credits is difficult and usually unaffordable particularly for small scale farmers.

Input suppliers

Farmers cooperatives and individual farmers supply the cuttings for planting and are a major actor in cassava production. The actors in input suppliers consists of agro- chemicals suppliers, fertilizers, pesticides and machinery. These help to improve the quality and farm productivity.

Farmers

Farmers are the largest suppliers of the cassava. They are the main suppliers of raw material and determine the quantities, quality and also the pricing. Majority of the cassava suppliers for Mongu district originates from farmers in Kaoma district. Kaoma district is located 200 km from Mongu on the Lusaka-Mongu road. Farmers cultivate cassava at household farms. The farmers have market information and can bargain for the price of their products. However, the selling price of the cassava is usually not different at the market.

Traders / Vendors

Some of the vendors/traders have contacts with the suppliers from Kaoma. This makes it easy to arrange for scheduled deliveries at the market while others opt to wait for the supplier's convenience delivers of the cassava at the markets place. The traders also have some bargaining power with the farmers especially for those purchasing in bulk or larger quantities.

Processors and millers

Overall the millers in the cassava market are small scale with limited capacity. The processors and millers contribute towards the value chain by providing cassava chip milling services for the traders and vendors that sell cassava meal. The vendors/ traders then supply to local markets for retail sell. The other responsibility of millers is to determine on quantities and quality of cassava to be processed for market.

Consumers

The retailers supply of the cassava products is sold to consumers mainly through operations at the markets. The major consumers of the cassava are households, and restaurants lodges and hotels. For cassava, some of the restaurants and eating places purchase the meal from the contracted traders.

4.2. Cassava as a product and its marketing possibilities

Cassava market opportunities

Trade in dried cassava, which accounts for about 60% of marketed volumes, originates predominantly in the core of Zambia's cassava belt, in Luapula Province. Surpluses there regularly find their way into the Copperbelt, the Democratic of Congo and to a lesser extent south into Lusaka. Significant intra-regional trade also exists given that the fishing communities along the lakes of Luapula and Northern Provinces depend on regular purchases of dried cassava.

Angola has likewise begun importing small volumes of Zambian cassava, primarily via Northwest Province but generally sourced from Luapula. During the early post-conflict years, when this export trade first opened up, Angolan traders purchased most of their supplies in the Copperbelt markets, particularly the Nakadole market in Kitwe. However, since about 2006, they have begun buying primarily from the Mansa area where prices are far lower. Despite poor roads on the Angolan side, wide price differentials motivate this spatial arbitrage.

In Mongu, the major market of cassava includes the households, food industries, the breweries and local millers. The buyers for the cassava tubers, meal and chips are the local western province district such as Nalolo, Sesheke, Limulunga and Kalabo districts.

The value chain officers visited the company called CHC commodities in Lusaka. CHC Commodities is involved in the commercialisation of small-scale farmer crops such as groundnuts, sorghum and cassava. Currently CHC acts as buying agent for white sorghum and cassava on behalf of Zambian Breweries plc (SAB Miller) for use in its Eagle Lager beer. CHC is also developing markets for cassava for use in stock feeds, brewing and glucose production. CHC commodities buys raw cassava chips in different quantities such as K1.90/kg and in some months of November – December the price goes beyond K2.90 per kg due to the scarcity of the commodity. Currently CHC commodities source most of their raw cassava chips in Luapula, they buy only the raw cassava chips which has under gone their recommended type of processing the cassava tubers into cassava chips, they don't soak the cassava in water, instead they just peel fresh cassava tubers, cut it into the desirable size of cassava chips and directly dry it using heat from the sun.

Potential markets

On the market, cassava and its products are usually found whole year round with variations in quantity and quality of supply and prices according to the seasons.

The milling sector has potential to explore various cassava product. For instant, the milled flour can be utilized by bakeries as a supplement for wheat flour. This provides new opportunities for consumers to try new products from cassava bakers (for example biscuits, crisp). However, the use of cassava flour as supplement in bakers is not common in Zambia. Therefore, the feedback and acceptance rates may not be positive in comparison to wheat flour and that is a possible weakness.

The other possible market of cassava is the paper and glue sector. In West Africa (Nigeria, Ghana) the cassava by- products are used to make the glue. The demand from the farmers is to produce high quality cassava that provide better bonding properties for glue production.

The use of cassava as livestock feed is developed in other African countries. In Zambia, the poultry, piggery farming is well established and widely distributed, thus, it is a potential market for cassava products to target. The processed dried cassava can be used as raw material for animal feed. Therefore, promotion, raising awareness and learning from other countries where cassava product is used in making animal feed will be of benefit to widen the market.

Cassava products and prices in Mongu

In Zambia, cassava production is mainly for home and subsistence consumption and the excess for the market. On a larger scale, the market for cassava is primarily for industrial purposes such as breweries specifically for producing eagle beer. The survey by Kleih et al. (2013) found that cassava flour is used as an alternative for wheat flour in bakeries, ingredient in glue manufacturing and peels for animal feed. In Nigeria, cassava and its products include flour, meal, pellets and ethanol production. Other products include dried peels for animals, cassava leaves and cassava meal and chips. The cassava products that are found in Mongu are cassava leaves, tubers, chips and cassava meal as highlighted below.



Figure 8 Fresh cassava on the market

Cassava leaves

The cassava leaves are a rich nutritious vegetable. It is widely consumed in home, many different eating places and served with *nshima*. The leaves are powdered and prepared like spinach. The leaves are easily accessed on the market.

Tubers

The cassava tubers are classified into two main types namely, the fresh and fermented roasted.

Fresh tubers

The fresh tubers are eaten raw and sold in unit of per tuber or piece. The prices range from K5.00 kwacha depending with the size of the tuber. Some of the important attributes for the fresh tubers which are important for consumer purchase are the sweetness of the variety such as Nakamoya, Mutembo and Kapumba (usually boiled). The price for a 50 kg bag of fresh cassava in Mongu is K220.00.

Fermented roasted tubers

The second type of tuber sold on the market is the fermented roasted cassava. The price for a piece of roasted cassava ranges from K1.00 to K3.00 depending on the size. Some of the consumers include households, taxi drivers and administrative officers. Most of the consumers were interested to purchase sour tasting roasted tubers and eaten with the groundnuts.

The common variety for fermentation is Nalumino, which tastes bitter. The consumers who expressed dissatisfied with the fresh and fermented roasted tubers indicated that in some cases the products are not very fresh given the distances from the sources.

The views of the Lusaka cassava traders on cassava coming from western province is that, the size of the tubers are smaller compared to those coming from Rufunsa and Luapula, even the way they process their cassava, for western the time of soaking cassava in water is short as compare to the way they soak in Luapula as a result, the desired colour (pure white) is not

really attained and their cassava will still be bitter. Most traders pointed on the difficulty in selling western province cassava and how it fetches less on the market as compared to others.

On the Lusaka market, it was found that most of the cassava comes from Rufunsa district of Lusaka province, it is fondly called rufunsa variety by the locals and it is eaten raw fresh as well as boiled.

Table 2. Cassava tubers - processing and marketing (SWOT analysis)

Strengths	Weakness
Good selling price	High spoilage / short shelf life, e.g. when larger quantities bought at once
Low demanding crop in terms of agroecological conditions	Low variability of cassava products, including lack of value-added products
Established relations in cassava supply chain	Low processing capacity especially in rainy season
Opportunities	Threats
Interest to source local supply	Increase of supplies from other provinces
Economic development (roads, incomes)	Content of HCN in low processed cassava
Increasing role of traditional knowledge and preferences on cassava production	Climate dynamics and reduction of cassava varietal diversity

Cassava chips

Raw dried chips

The raw dried cassava chips are sold for the purpose of making cassava meal and fried chips in the households. The dried chips are sold in different quantities such 50kg, 10kg, 8kg and 1 kg. The price for the 50 kg bag of the dried chips range from K140.00, 10kg (K30.00), 8 kg (K25.00).

One key factor that influence the purchase of cassava chips is the quality as the consumers need products without infestation of insect or fungi.

Cassava vendors experience various challenges. The vendors indicated that the consumers preferred the long-soaked cassava chips as it gave a better meal (white colour). In addition, the vendors perceived knowing the seller as an influence to buying the cassava as they provided credits and discounts. Further, the vendors revealed that poor supply from out growers especially in drought season as a major drawback.

The different packaging of the dried cassava chips is shown below.



Fig 1. Dried chips (K160.00)



Fig 2. Dried chips (K30.00)



Fig 3. Dried chips (K3.00)

Figure 9 Dried chips sold on the market (various amount and prices)

On the Lusaka markets most of the cassava chips comes from Luapula. A 90 kg-bag of cassava chips in Luapula is bought at K 150 and it is normally sold at K 330 in Lusaka. The cassava chips are also sold in smaller quantities of bunches at K 20 and K 10 respectively.

Fried chips

The fermented and peeled chips are fried in cooking oil and served as a snack for consumers in the market. The fried chips are sold as per piece and the price is K 1.00.



Figure 10 Fried chips sold on the market

Table 3. Processing and marketing cassava chips (SWOT analysis)

Strengths	Weakness
Already known product and commonly consumed by the locals	Low processed product (no added value)
Popularity of the product among consumers	Concerns of poor soaking
Easy preparation	Challenges with storage of the product
Opportunities	Threats
Potential to explore and generating more products	Seasonality variations - unreliable supply of cassava chips
Global knowledge share on multiple uses/products of cassava	Stiff standards on the market
Agro-tourism development in the area (popularity among tourists)	HCN content in low processed cassava products

Cassava meal

The cassava meal is a powder obtained after processing and milling the chips to extract an edible starch. The consumption is widely distributed in almost all the sampled households, others include restaurants, lodges and hotels as it is mixed with maize meal.

The prices of the cassava meal on the open markets are 10 kg (K 45.00), 5 kg (K 30.00), 2 kg (K 15.00) and 0.5 kg (K 4.00), in Shoprite packaged 2 kg of cassava meal cost K 27.

Concerning the factors that influence consumers to purchase the cassava meal, the prominent ones include the colour of the meal. Many of the consumers favoured the whiteness of the cassava meal that gave a whiteness of the *nshima* when compared to the brown looking one. The other reason was the texture of the cassava meal of which the consumers preferred a fine or smooth pounded meal than the coarse pounded cassava meal.



Figure 11 Cassava meal sold on the market

In Lusaka, the highly noted factor that influences the purchase of the raw cassava chips and cassava mealie meal was the quality and colour respectively. It was pointed out that, most customers like fine white cassava mealie meal and very quality cassava chips in terms of colour (white preferred) which is triggered by the way the cassava was processed.

Regarding the willingness to buy higher quality cassava meal, those that were for the idea expressed that they would pay for a higher price as the hygiene levels were increased with packaging. On another hand, those that did not opt for package meal as they preferred to see the meal before packaging to be sure with the type and quantities they wanted to buy. Another dissatisfaction and suggestion were to have the cassava soaked for many days to obtain a whiter colour of the meal. Concerning the quantity, a larger number were not interested in increasing their purchase.

Table 4. Processing and marketing cassava meal (SWOT analysis)

Strengths	Weakness
Available markets make selling easier	Sometimes inferior quality of the production
Widely consumed	Expensive when compared to maize meal
Higher processed product (higher added value)	Inconsistence supply
Opportunities	Threats
Potential to improve the grade of cassava meal to supermarket standards	Stiff competition from maize meal
More sophisticated and traditional processing methods exist	No technological advancement in milling process
Potential in rising rural economy and demand for local food	Substitutes from other products (e.g. maize)

5. Evaluation of Bmuka Cassava production & Marketing Enterprise

5.1. Summary of the business plan

Business plan titled Bmuka Cassava Production & Marketing Enterprise is aiming at satisfying the demand for various cassava products. The vision of the company is to increase the share on cassava market, otherwise supplied by farmers from neighbouring districts, by local (Mongu) companies and to respond to high unemployment rates in rural areas of Mongu district.

Thus, plan is to produce six products: fresh cassava tubers, soaked cassava tubers, cassava flour (meal), cassava chips, cassava cuttings, and cassava dry leaves. Most of the consumers are expected to be local households, in some cases also vendors who will re-sell the products.

5.2. Production and quantity estimates

Cassava yields are slightly lower in most parts of western province in relation to the national average of about 9 tonnes per hectare. Good agronomic practices and the introduction of other high yielding varieties such as those that are grown in the northern part of Zambia would greatly increase the productivity. Considering the expected production in the table below, it is a clear indication that the author overestimated the production capacity of his business plan. To produce the tonnage as estimated, the farmer needs on average land size of more than 12 hectares, which is quite a big hectarage for a small to medium scale farmer who ranges between 1 -5 hectares.

The chosen location of his farm has close proximity to the Mongu markets, and he owns the land although not on title but on traditional agreements. It would be good to put it on title which could leverage in the acquisition of loans in future.

The set prices are very reasonable and similar to the gathered prices during the marketing survey, for instance, the price of cassava meal and chips in 10 kgs were K25 and K30 respectively as shown in the table below.

Production and quantity estimates						
Product name	Units	Price (K)			Expected production (bags, packs)	Expected benefits (K)
		Consumer s	Competitor s	Proposed		
Fresh cassava tubers	50-kg bag	105.00	105.00	100.00	625.00	62,500.00
Soaked cassava tubers	50-kg bag	85.00	80.00	75.00	625.00	46,875.00
Cassava Flour/meal	10-kg bag	35.00	35.00	30.00	1,875.00	56,250.00
Dry cassava chips	10-kg bag	25.00	25.00	20.00	1,875.00	37,500.00
Cassava cuttings (cultivars)	Bundle	75.00	100.00	75.00	180.00	13,500.00
Dried cassava leaves	500-g pack	6.00	7.00	7.00	4,850.00	33,950.00
Total						250,575.00

5.3. Cost of technology/ equipment

The attractiveness of this business plan is the use of mainly simple and sustainable technology. The technology suits the medium scale farmer who is trying to do business in agriculture. Almost all the equipment and other resources can easily be sourced locally. No items listed in the table below require any importation from abroad or neighbouring countries. The technology itself is very cheap in the sense that it doesn't require any high-technology repairs and maintenance. It suits the small-medium scale farmers that envisaging to grow in a sustainable manner. The prices of all the equipment is realistic to the current prevailing market prices. There is a great use of renewable solar energy for the processing the cassava which is eco-friendly and cheap source as compared to other sources.

Storage is an important component and very important part of every agricultural production. In it comes the success of post-harvest handling of all agricultural produce and the safety and hygiene aspect. However, in the infancy of any business, alternative measures can be put across to aid in the storage of these important produce. For instance, could be the erection of temporal storage structures made from available local materials such as wood and grass. The K25,000 for the construction of storage building is quite on the lower side to construct a reasonable shed for agricultural purposes.

It would be important to note that, the business plans were compiled in 2019 when inflation rate was quite low as compared to 2020. Factoring in inflation in the prices of the equipment and technology would be a wise idea that would put the farmers in a better position.

Equipment / business premises	Unit	Number	Price (K)	Total Amount	Depreciation	
					Life span	Amount
Construction of storage room	number	1.00	25,000.00	25,000.00	30	833.00
Plastic drums	number	10.00	350.00	3,500.00	7	500.00
Ox cart	number	1.00	10,000.00	10,000.00	10	1,000.00
Plough and trek chains	number	1.00	2,000.00	2,000.00	7	286.00
Drying tents	number	2.00	1,500.00	3,000.00	5	600.00
Hand hoes	number	10.00	50.00	500.00	5	100.00
Weighing scales	number	2.00	250.00	500.00	10	50.00
Buffalo bicycles	number	1.00	1,500.00	1,500.00	6	250.00
Solar driers	number	1.00	10,000.00	10,000.00	15	667.00
Total				56,000.00		4,286.00

5.3. Investment Cost Evaluation

a) Lifespan of the business project.

To evaluate the viability and profitability of the business plan, we are using the concept of Net present Value (NPV), Internal rate of return (IRR), the Payback Period (PB) and the sensitivity analysis of the prices of the products. Two scenarios of 10- and 5-years life span are used to see how the business fares in both Scenarios.

The figures in the tables below show that the NPVs have a positive value which translates to the businesses being accepted and quite a lucrative venture. We would go for a 5-year business life span looking at the levels of investments and virtue of the projects being for the medium scale farmers. Which requires a sizeable investment. At the discount rate. of 173%, NPV is zero, therefore the IRR is 173%, making it greater than the discount rate of 46% and 47% respectively. In this case the business plan is accepted and has a very high rate which would definitely translate into a shorter payback period

Business Plan life span 10 years

Year	B-C	Disc.	Disc.	PV	PV	Benefits	Costs	Benefits	Benefits	Costs	Costs
		58%	59%	58%	59%			58%	59%	58%	59%
1	112,924	1.58	1.59	71,471	71,021	276,080	227,767	174,734	173,635	144,156.53	143,249.88
2	112,924	2.50	2.53	45,235	44,667	276,080	163,156	110,591	109,204	65,356.80	64,537.29
3	112,924	3.94	4.02	28,629	28,092	276,080	163,156	69,994	68,682	41,365.06	40,589.49
4	112,924	6.23	6.39	18,1199	17,668	276,080	163,156	44,300	43,196	26,180.42	25,527.98
5	112,924	9.85	10.16	11,468	11,112	276,080	163,156	28,038	27,167	16,569.89	16,055.33
6	112,924	15.56	16.16	7,258	6,988	276,080	163,156	17,745	17,086	10,487.27	10,097.69
7	112,924	24.58	25.69	4,593	4,395	276,080	163,156	11,231	10,746	6,637.51	6,350.75
8	112,924	38.84	40.85	2,907	2,764	276,080	163,156	7,108	6,758	4,200.96	3,994.18
9	112,924	61.36	64.95	1,840	1,738	276,080	163,156	4,499	4,250	2,658.83	2,512.06
10	112,924	96.96	103.27	1,164.	1,093	276,080	163,156	2,847	2,673	1,682.81	1,579.91
total PVs				192,688	189,543			471,091	463,402	319,296.07	314,494.58
NPV				128,077	124,932						

Year	B-C	Disc.	Disc.	NPV	NPV	Benefits	Costs	Benefits	Benefits	Costs	Costs
		46%	47%	46%	47%			46%	47%	46%	47%
1	112,924	1.46	1.47	77,345	76,819	276,080	227,767	189,096	187,810	156,005	154,943
2	112,924	2.13	2.16	52,976	52,257	276,080	163,156	129,518	127,761	76,541	75,504
3	112,924	3.11	3.18	36,285	35,549	276,080	163,156	88,711	86,912	52,425	51,363
4	112,924	4.54	4.67	24,852	24,183	276,080	163,156	60,760	59,124	35,908	34,941
5	112,924	6.63	6.86	17,022	16,451	276,080	163,156	41,617	40,220	24,594	23,769
Total PVS				208,481	205,261			509,703	501,829	345,475	340,521
NPV				143,871	140,650						

B) Payback period

10 years life span			
Year	Cumulative benefits	Cumulative costs	Difference
1	174,735	144,157	30,578.00
2	285,326	209,513	75,813.00
3	355,321	250,878	104,442.00
4	399,621	277,059	122,562.00
5	427,660	293,629	134,031.00
6	445,405	304,116	141,289.00
7	456,637	310,753	145,883.00
8	463,745	314,954	148,791.00
9	468,244	317,613	150,631.00
10	471,092	319,296	151,796.00

5 years life span			
Year	Cumulative benefits	Cumulative costs	Difference
1	189,096	156,005	33,091.00
2	318,614	232,547	86,068.00
3	407,326	284,973	122,353.00
4	468,086	320,881	147,205.00
5	509,704	345,476	164,228.00

The initial investment is K64,611, and at about 1 year 5 months is the payback in the 5 years business life span. In the 2nd year, the payback per month is K7,172. To reach the K68,953. As the nearest figure to the Initial investment, 5 months have to be added to the first year reaching an amount of K68,485. It is a very quick recovery from the investments perspective and gives the confidence to venture in such a business provided all measures are put in place for a successful running of the business As for the 10-year life span, the payback is at 1 year 6 months with an amount of K68,485 deduced from adding the 1st -year amount of K30,578 and the 2nd -year monthly recovery of K6,318 (See tables above)

c) Sensitivity analysis of the prices

To determine sensitivity of the business, we used the price variation matrix to analyse the profitability of the business at different prices on the lower and upper level of the proposed price by the author. The computation of these prices and the resulting profits from different products is shown in the tables below:

Definitions of parameters

Break-even point: The amount or level of sales or revenue that a business must generate in order to equal its expenses. In other words, it's the number of units needed to cover the costs. At breakeven point, total volume equal total expenses.

Break-even Point (BEP) = $\text{Total fixed cost} / \text{Price per unit} - \text{Variable costs per unit}$

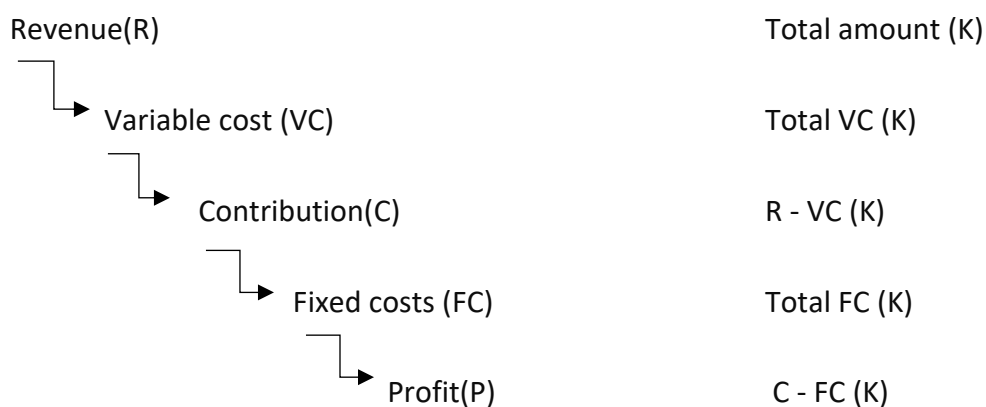
Break-even analysis: It gives an insight into whether revenue from a product or service can cover the relevant costs of the production of that product or service.

Contribution analysis: Describes what a business needs to achieve from selling its products in order to first cover its fixed costs and thereafter make a profit.

Total contribution = Total revenue - Total variable cost

Contribution per unit = Selling price per unit - Variable cost per unit

- Net profit model



Product 1: -Cassava tubers				
Price per unit	80.00	90.00	100.00	110.00
BEP-Minimum production of 50-kg bags	259.77	223.36	195.90	174.45
Expected production	625.00	625.00	625.00	625.00
Profit	22,403.11	28,653.11	34,903.11	41,153.11

In relation to **product 1, the cassava tubers** it is seen in the table above that lowering the prices from the proposed K100 by 10 to 20 points still leaves the profit margin high. whilst moving by 10 points higher drastically increases the profits. In the same vein, the break-even point (BEP) is reached at about 35% of the expected production This business idea is quite lucrative in that it doesn't require any advanced technology and uses all materials obtained within western province. The only concern would be satisfying the demand and penetrating the markets outside Mongu such Lusaka and the Copperbelt.

Product 2-Soaked cassava tubers				
Price per unit	65.00	70.00	75.00	80.00
BEP- Minimum production of 50-kg bags	419.33	370.57	331.97	300.65
Expected production	625.00	625.00	625.00	625.00
Profit	7,815.61	10,940.61	14,065.61	17,190.61

The **soaked cassava tubers** have a serious higher preference to the other types by the customers/Consumers in western province. Most of it is coming from Kaoma district and can be expensive and usually scarce in certain times of the year especially during the rainy season. It is seen in the table above that, either lowering the prices from the proposed K75 by 5 points and increasing by 10 points still leaves the profit margins quite high. In the same vein, the break-even point (BEP) is reached at about 52 % of the expected production This business idea is quite lucrative in that it doesn't require any advanced technology and uses all materials obtained within western province. The only concern would be penetrating the markets outside Mongu such Lusaka and the Copperbelt that are not really used to the that kind of processing.

Product 3-Cassava flour/meal				
Price per unit	20.00	25.00	30.00	35.00
Minimum production of 10-kg bags	1,389.22	967.48	742.17	601.98
Expected production	1,875.00	1,875.00	1,875.00	1,875.00
Profit	5,571.86	14,946.86	24,321.86	33,696.86

Product 4: - Dry Cassava chips				
Price per unit	15.00	20.00	25.00	30.00
Minimum production of 10-kg bags	1,780.38	1,142.25	840.86	665.32
Expected production	1,875.00	1,875.00	1,875.00	1,875.00
Profit	846.86	10,221.86	19,596.86	28,971.86

In the near future, **cassava meal and cassava chips** will become a major substitute of the maize meal due to the persistent droughts in the southern and western parts of Zambia and the neighbouring countries of Angola, Congo, Namibia and Zimbabwe. Currently packaged cassava meal is only found in supermarkets such ShopRite, while on the open, markets it is displayed in open buckets on open stalls, which is very unhygienic due to dust contamination and other pathogens. Since this business idea factors in packaging, it will be at an advantage in terms of penetration to other lucrative markets within and outside the province. From the table above, in the cassava meal, it is evident enough that this product has a very good return. Even at lower price than proposed such as at K25, the BEP is at 50% of the expected production. Equally in the Dry cassava chips, the trend is the same with high returns even at lower prices than the proposed. Since the business is in the infancy, the expected production in this case could be a little bit higher but can be attainable as the business grows.

Product 5: -Cassava cultivars				
Price per unit	50.00	75.00	100.00	125.00
Minimum production of cultivars	362.15	230.93	169.51	133.90
Expected production	180.00	180.00	180.00	180.00
Profit	-8,014.39	-3,514.39	985.61	5,485.61

Product 6: -Dried cassava leaves				
Price per unit	5.00	6.00	7.00	8.00
Minimum production of 500g packs	15,321.52	7,810.97	5,241.57	3,944.15
Expected production	4,850.00	4,850.00	4,850.00	4,850.00
Profit	-10,890.39	-6,040.39	-1,190.39	3,659.61

Traditionally people share cultivars for reproduction purposes and have been using fresh and dried leaves as relish. They share the same unimproved varieties of cultivars that they spread among themselves. Breeding and selling of improved Cultivars could be a very innovative idea since most farmers lack the source of improved varieties during planting time. Cultivars are sold mainly in bundles of 5-10 stems per bundle. The prices seem to be on a lower side if they are certified improved varieties as indicated in the business plan. Generally, the business idea is good and could need to be improved on the pricing and the general turn over. At the proposed price, it will run at a loss and the BEP of more than 90% of the expected production. It is a similar scenario with the dried leaves, the pricing is quite off the profitable level and requires more market research for realistic pricing and a BEP of at least less than 60% of the expected production.

6. Final remarks and recommendations

Based on the market and field survey as well as considering proposed Business Plan, following recommendations and suggestions should be taken into consideration by involved stakeholders in cassava value chain development in Western province of Zambia:

6.1 Specific remarks and recommendations

- The needs of the small and medium -scale farmers in Zambia is basically the lack of financial assistance to grow their farming business. The business proposal is quite unique and needs special assistance to help it thrive. Farmers on their own cannot manage to access any funds from commercial banks or micro-finance institutions because most of them are collateral based. For government programmes and grants, are not easy to obtain due to limited numbers and competitiveness and bureaucracy.
- Looking at the affordable technology the author is willing to use in order to grow his business, special attention could be given to support the immediate needs of the business such as the improving of the productivity of the farm by providing agricultural inputs and purchase of the solar driers. For sustainability, introduction of other cassava varieties that are good, fast growing with a shorter period and drought resistance. In a nutshell, a special needs assessment would greatly help identify the best approach to

giving help. To have a meaningful impact, Close monitoring of the use of the support and the growth of the business will be required.

- In running this business using the proposed technology, the costs mainly are incurred from rentals, wages, depreciation, transport, water /energy, promotion, insurance, and taxes. The business will use the cheapest possible technology with most of it being solar suitable for the rural set up. The government of the republic of Zambia has installed some solar powered mills in most rural areas of Zambia is an indication that the solar technology is the most favourable for the rural farmers and is very cheap once installed. The composition of the work force is mainly family labour and few seasonal workers making the wages to be manageable by the business. Looking the figures in the business plan, they are as realistic as possible and reflects the minimum wage on the ground.
- The author has a track record of selling the said cassava products and other related horticultural crops around Mongu open markets. The simplicity of the proposal to grow his business highlights the absolute need for assistance of any kind in any way possible. The production figures could be on the higher side but the technology and equipment is as simple as a small – to medium scale farmer would require to grow in business. A continual and gradual assistance would greatly help his business. Identifying urgent needs and capitalizing on them to bring about that thrust in is income generation and further investments. His broader knowledge and expertise in the cassava value chain puts him at an advantage to succeed.

6.2 General remarks and recommendations

- On the research side, dissemination of information from research institutions to the farmers concerning planting materials (cassava cuttings), more yielding and early cropping varieties is a favourable approach to consider. Furthermore, the farmers must understand the specific varieties as required to meet the targeted markets and cassava products to be processed. Improve linkages and synergies between farmers and the input suppliers such as Agro dealers, research institutions and extension services.

- Training of value chain actors in areas of production, processing and marketing will raises the awareness required in handling cassava products. The knowledge attained is imperative to continuously provide improvements and maintain the quality and quantity.
- In order to improve quality and quality of the cassava products, investment in better technologies to add value from farmers and processors is cardinal. The technological value will help to increase the number of cassava products generated.
- Since local markets offer the greatest opportunities as observed by the demand around Mongu and Lusaka, it would be good to improve on the processing standards and types to meet the consumers' demands and preferences. Generally, consumers prefer the processing methods from Luapula and other parts of the northern Zambia.
- Establishment of bulking centres around western province will enhance availability of cassava market.
- Expand the export linkage with Congo and Angola and other neighbouring countries, since there is already an existing informal export market.
- Enhance and develop the private sector into cassava processor, livestock feed and starch for various industrial usage.
- Increase financial support and access for the small-scale farmers and other SMEs.

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Annexes

1. Address book for suppliers, Processors, and financial institutions

Bmuka Cassava production & Marketing Enterprise Bravo Mushaukwa Kabombo					
Institution	Relevance	Contact /Focal point person			Location
		Name	Position	Phone/Email	
Financial Institutions (Loans &Grants)					
1) Citizens Economic Empowerment Commission (CEEC)	Grants and loans in different value chains	Michael Mulenga	Business Development Support Officer	+260 978022570 +260 966359081 MulengaM@ceec.org.zm michaelmulenga23@gmail.com	Mongu
2) National savings And Credit Bank (NATSAVE)	Loans/Asset financing in conjunction with CAMCO and SARO	Tembeya T Sinyangwe	Branch Manager	+260 977837774 +260 967837774 Tembeya.Sinyangwe@natsave.co.zm	Mongu
3) Indo Zambia bank	Security based loans/ asset financing in conjunction with Tata Zambia. MOU in place.	Shanobe Clifford	Branch Manager	+260 977844755 +260 955844755 abmmongu@izb.co.zm	Mongu
4) AGORA	Loans in different Value chains for Individuals and Small groups. Collateral based loans	Tellia Sakala	Field officer	agora@gmail.co.uk	Mongu
5) Pilot Programme for Climate Resilience (PPCR)- Provincial administration.	Grants in different value chains- Livestock, Small livestock and crops	Mukuni Kapumpa	Logistics Officer	+260 9745997449	Mongu
6) Christian Empowerment Micro Finance	Loans in different value chains	Akamandisa Sitali	Accountant	+260 974445535	Mongu
7) Musika	Reducing poverty and creating wealth in rural Zambia			+260 211 251 371, +260 211 250 355, +260 211 253 989 +260 211 255 502	Mongu
Financial Institutions (Loans &Grants)					
8) African Development Bank Zambia	Spur sustainable economic development and social progress	Ms Mary Monyau	Country Manager	+260 211 257868 Fax: +260 211 257872	Lusaka
9) Zambia Development Agency	Promote and facilitate investment, trade and enterprise development in Zambia.			+260 211 220177 +260 211 223859	Lusaka

Bmuka Cassava production & Marketing Enterprise Bravo Mushaukwa Kabombo					
Institution	Relevance	Contact /Focal point person			Location
		Name	Position	Phone/Email	
10) Development Bank of Zambia	Support farmer development projects			+260 211 228 577 +260 211-425501 dbzmail@dbz.co.zm	Lusaka
11) International Fund for Agricultural Development (IFAD)	Transform rural economies and food systems by making them more inclusive, productive, resilient and sustainable.	Ambrosio Nsingui Barros	Country Programme Manager	a.nsinguibarros@ifad.org +260 211 25.1711 +260.21.125.1711	Lusaka
Agriculture Input Suppliers					
1) Export Trading Group (ETG)	Agro Input / output markets;	M. Ndiyai	Manager	+260 977430928 Mukebai.ndiyai@gmail.com	Mongu
2) Kalu's Agro shop	Agro Input supplier- E-voucher partners	Idah Kalaluka	Director	+260 9778874851	Mongu
3) Mongu Agro-Mart	Agro Input supplier- E-voucher partners	Musha Mubonda	Director	+260 977525625	Mongu
Agriculture Input Suppliers					
4) Tapiwa Agro Centre	Agro input suppliers	Shibachris Chinhare	Director	+260 978696330 shichinhare@gmail.com	Mongu
5) Limpo Agro shop	Agro input suppliers	Ivy Limpo Saboi	Director	+260 976651737 Limpoisaboi34@gmail.com	Mongu
6) Mongu Agro vet	Agro inputs suppliers	Geofrey Solochi	Director	+260 977414280	Mongu
7) D.I grow Mongu	Agro inputs suppliers	Tobby Lufunda Kakoma	Sales manager	+260 0969508966 tobbykakoma@gmail.com	Mongu
8) Farmers shop	Agro input suppliers	Mr kanchele	Director	+260 964680966 +260 0979377209	Mongu
9) Zamseed Mongu shop	Agro input suppliers	Esther Phiri	Extension Officer	+260 978025504	Mongu
10) Syngenta Zambia	Suppliers of all types of chemicals and agro inputs for tree plants and many other crops			+260 977273275	Lusaka
11) Sonas, Indian engineering machinaries	Suppliers of agriculture machinery	Patel	Marketing manager	+260 977454499	Lusaka
12) Pasonny Zambia limited	Suppliers of agriculture machinery			+260 965965965	Lusaka
13) D.I. GROW	Suppliers of organic fertilizers			+260 211232377	Lusaka
Agriculture Input Suppliers					

Bmuka Cassava production & Marketing Enterprise Bravo Mushaukwa Kabombo					
Institution	Relevance	Contact /Focal point person			Location
		Name	Position	Phone/Email	
14) Lamasat international LTD	Suppliers of water tanks and pipes			+260 973926814	Lusaka
15) AgroZ	Suppliers of shade nets, Storage bags			+260 962535400	Lusaka
16) Farmers' Barn	Suppliers of all types of chemicals and Agro inputs for tree plants and many other crops			+26 0 97 5457601	Lusaka
17) CAMCO	Chinese agro and industrial equipment.	Ken Chisungu	Marketing manager	+260977525496 +260 972249988 Sales-zm@camco.cn Whatsapp:+26096978730	Lusaka
18) SARO	Agriculture machinery and Equipment	Naviety Simutowe	Sales and Executive	+260978110777 +260 211 241477	Lusaka
Agricultural Commodity Processors and buyers					
1) Mwana ishi enterprises	Buyers and processors of cassava chips	Kaumba Kaumba	Director	+260 978873056 +260 965873056	Mongu
2) Shoprite Chain stores	Retail supermarket. Buys and sells from local and international commodities (Mangoes and cashew and cassava).			+260 217 221 623	Mongu
3) CHC Commodities	Buyers of cassava chips from farmers and other commodities	Eugene Manda	Marketing manager	+260 978771152 +260960283617 eugene@chc.com.zm	Lusaka.
4) Export Trading Group (ETG) Agri Inputs	buying of commodities such as cashew and cassava	Mr Chetan Mr Nyambe		+260 974772838 +260 963906765 +260 962329774	Lusaka
5) Pick" N" Pay chain stores	Retail supermarket. Buys and sells from local and international commodities (Mangoes and cashew and cassava).			+260.21 126 0508	Lusaka
6) Local Markets (Council markets)	Open trading for most of the commodities including cassava chips, meal and fresh tubers.	Kelvin Mukanda	Market committee member-Mongu	+260 977205509	Lusaka Mongu Solwezi Kitwe



PRODUCT CERTIFICATION MANUAL FOR:

CASSAVA PROCESSING

(Fresh Cassava, Dried Cassava Chips, And Cassava Flour)



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INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a woody shrub extensively cultivated as an annual crop in tropical and subtropical regions for its edible starchy enlarged roots. Cassava is a staple crop that is important for food security in the tropics. Cassava is the third-largest source of human food and animal feed carbohydrates in the tropics, after maize and rice. Cassava chips are dried granules derived from clean, fresh cassava. The production of dried cassava chips involves peeling, slicing or chipping, and drying. Dried cassava chips are the most common form in which cassava roots are marketed because the dried chips can be stored much longer, are cheaper to transport and can be further processed into cassava root meal or livestock feed. However, one of the limiting characteristics of cassava used for food and feed is the cyanogenic glycosides content of its roots and leaves. High concentrations of cyanogenic glycosides may result in higher concentrations of hydrogen cyanide or hydrocyanic acid (HCN). HCN may be toxic to humans and animals, and the severity of the toxicity depends on the quantity consumed.

Certification is a voluntary process that involves an independent body giving written assurance (a certificate) that a given product, service or system complies with a set of requirements (standards). This is done through an assessment that is usually accompanied by a test report. Certification is a market-based mechanism that promotes compliance. For some industries, certification is a legal or contractual requirement, while in most industries it is purely voluntary and at the discretion of the supplier.

In Zambia, the Zambia Bureau of Standards (ZABS) has a legal mandate to provide various certification schemes meant to support standardization activities for commerce, trade and industry. ZABS mainly offers two types of certification schemes – Product Certification and Management Systems Certification. Recently, a third scheme called Certified Local Supplier Scheme was launched. It is specifically designed for Micro Small and Medium Enterprises MSMEs. The main highlights of the Certified Local Supplier Scheme include affordability, flexibility and possibility of group certification.

There is a growing trend in the market for certified products. The demand for certified products is much higher within elite markets such as chain stores which usually offer more space to

accommodate a variety of goods as well as a wider customer base, including high-income earners. Certification helps address the quality and food safety concerns among consumers.

Benefits of certification include, but are not limited to:

- ✓ Manufacturers, producers, and processors will have better control of their processes resulting in increased efficiency and reduced production waste.
- ✓ Penetration of new markets and maintaining access to markets.
- ✓ Provision of confirmation that relevant legal requirements are fulfilled.
- ✓ Relieves the consumer of the need or burden to verify for themselves that the products were produced in the manner prescribed by the producer

DEFINITIONS

Codex Alimentarius Commission

The Codex Alimentarius Commission (CAC) is a joint intergovernmental body of the Food and Agriculture Organization (FAO) and the World Health Organization (WHO). It is responsible for setting standards, codes of practice, guidelines, and other recommendations relating to foods, food production, and food safety.

Contaminant

Any biological or chemical agent, foreign matter, or other substances not intentionally added to food which may compromise food safety or suitability.

Cross-contamination

The transfer of bacteria from contaminated food (usually raw) to ready-to-eat food by direct contact, drip or indirect contact using a vehicle such as a hand or cloth within the production process.

Food Hygiene

All conditions and measures are necessary to ensure the safety and suitability of food at all stages of the food chain.

Hazard

Biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect.

Standard

A technical document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes, and services are fit for their purpose. A standard can be voluntary or compulsory.

Traceability

Ability to trace the history, application or location of an object. Traceability of a product or service is the set of documented evidence related to the origin of materials and parts; the processing history; or the distribution and location of the product or service after delivery.

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PURPOSE OF THIS MANUAL

The manual is intended to help especially Micro Small and Medium Enterprises (MSMEs) understand and implement requirements for product certification.

PRE-REQUISITES TO PRODUCT CERTIFICATION

Good Agricultural Practices (GAPs)

GAPS are a collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agriculture products.

Good Manufacturing Practices (GMPs)

The aspect of quality assurance that ensures that products are consistently produced and controlled to the quality standards appropriate to their intended use and as required by the product specification.

Good Hygienic Practices (GHPs)

Procedures that are put in place to provide safe food by preventing contamination of food with pathogens spreading from people, pets, and pests.

Key elements of GAP/GHP/GMP

Facility environment: The site or facility should be located and maintained so as to prevent contamination and enable the production of safe products. Surroundings should be clean with no garbage accumulation, no excessive flies/ rodents and no accumulation of stagnant water near the site and no open sewage lines.

Facility layout and product flow: Premises, sites and/or plants should be designed, constructed and maintained to control the risk of product contamination. The layout should be clear. Product flow, as far as possible, should be uni-directional without crisscrossing. There should be adequate separation between storage areas (raw material, packaging material, finished goods, rejected/ accepted materials, etc.), processing area, packing area, utility area, etc. There should be the

provision of appropriate loading and unloading points that facilitate the movement of material and these should be suitably covered to provide adequate protection from pests, rain, etc.

Equipment: Equipment and re-usable containers coming into contact with food should be suitably designed and constructed for the intended purpose so as to minimize food safety risks. Equipment should be located so that it permits adequate maintenance and cleaning, and facilitates good hygienic practices, including monitoring if required. It should be ensured that equipment is adequately cleaned, disinfected where necessary, and maintained to avoid contamination of food. Where necessary, equipment should be movable or capable of being disassembled to allow for maintenance, cleaning, disinfection, monitoring, etc.

Staff facilities: Staff facilities should be designed and should be operated, so as to minimize food safety risks. These may include the following as appropriate; (a) adequate means of hygienically washing and drying hands, (b) toilets/ lavatories of appropriate hygienic design at suitable locations and (c) adequate changing facilities for personnel.

Physical, chemical and biological contamination risk: Appropriate facilities and procedures should be in place to control the risks from physical, chemical, or biological contamination of products. Appropriate controls should be in place to minimize the incidence of foreign bodies, e.g. by the use of effective detection or screening devices (such as filters, sieves, magnets or metal detectors). Annual calibration is necessary for all detection and screening devices.

Stock management (rotation): Procedures should be in place to ensure materials and ingredients are used in the correct order and within the allocated shelf life.

Housekeeping, cleaning, and hygiene: Appropriate standards of housekeeping, cleaning and hygiene should be maintained at all times and throughout all stages of the operations.

Water quality management: The quality of water (including ice and steam) that comes into contact with food, food contact surfaces or hands should be potable and regularly monitored to ensure that it does not present a risk to product safety. Water for post-harvest washing should be potable. Potable water should be checked for contaminants at an appropriate frequency.

Waste management: Adequate systems should be in place for the collation, collection, and disposal of waste material. Waste should not accumulate in processing/ storage areas. Waste bins and areas should be identified, covered and kept clean. Containers for waste, by-products and inedible or dangerous substances should be suitably constructed and where appropriate made of impervious material. Those used to hold dangerous substances should also be lockable and access restricted to authorized personnel.

Pest control: Suitable pest control programmes should be in place for controlling or eliminating the risk of pest infestation on the site or facilities including vehicles. The pest control programmes should identify the pests to be controlled, the area/locations where control is to be applied, the method of control (for example physical, chemical), the dosage in case of usage of chemicals, the schedule, responsibilities, etc.

Transport: All vehicles, including contracted out vehicles, used for the transportation of raw materials (including packaging), intermediate/semi-processed products and finished products should be suitable for the purpose, maintained in good repair, be clean and pest free. Where foods are transported after the transportation of chemicals or other non-foods, effective cleaning or, where needed, disinfection should be carried out between the loads.

Training: A system should in place to ensure that all employees involved in food handling are adequately trained, instructed and supervised in food safety principles and practices, commensurate with their activity.

Documentation and records: Documented procedures for various processes and operations having an effect on product safety as relevant to the activity should be available and implemented. Appropriate records as applicable to the activity in relation to process, storage, transportation, and distribution should be kept and retained for a period that exceeds the shelf life of the product. These should be controlled effectively and readily accessible when needed.

Internal audit: The retailer should have an internal audit system in place in relation to all systems, procedures, and activities that are critical to product safety.

Traceability: Effective and appropriate procedures and systems should be in place to ensure: (a) identification of any out-sourced product, ingredient or service, (b) complete records of batches of in-process or final product and packaging throughout the production process, as necessary; and (c) record of purchaser and delivery destination for all products supplied.

REQUIREMENTS FOR PRODUCT CERTIFICATION

In order to obtain product certification, there are three conditions that must be fulfilled namely; Review of application, onsite assessment of the process integrity (review of documented evidence) and analysis of test report.

At the very least, records for the following processes should be maintained:

- Incoming material checks
- Inspection and tests
- Temperature and time
- Product recall and traceability
- Storage
- Cleaning and sanitation, as appropriate
- Pest control
- Medical and health
- Hygiene inspection for food handlers
- Training
- Internal audit – both regular process and facility audits
- Calibration/ verification
- Non-conforming products
- Waste disposal

The test report is analyzed so as to establish whether the product conforms to the specifications outlined in the standard to which the product will be certified. The product must conform to the given requirements in the applicable standard.

CONDITIONS FOR PROCESSING

Raw Materials

The raw material shall be fresh sweet cassava roots. Cassava roots for the preparation of cassava products should be processed as soon as practicable after harvest. Good Manufacturing Practices (GMP), can be taken to prevent or reduce significantly the concentrations of hydrogen cyanide in cassava products.

The cassava storage roots from which the dried cassava chips are prepared shall be of the following conditions:

- Mature
- Free from diseases and pests
- Not be woody
- Not be spongy

General quality requirements

Dried cassava chips shall be safe and suitable for human consumption and shall conform to the following requirements:

- a) The taste and odour of dried cassava chips shall be typical of the product.
- b) The colour of the chips shall be characteristic of the variety.
- c) Dried cassava chips shall be free from filth, foreign matter, and extraneous matter.
- d) The cassava chips shall not appear mouldy.

The potential cyanide content in cassava varies with the variety of cassava, the environmental conditions in which it is grown (e.g. drought) and the time of harvest.

Varieties with low cyanide content have been developed and might be useful in reducing the occurrence of hydrogen cyanide in cultivated cassava. Where bitter cassava varieties are used then adequate post-harvest processing is essential.

Harvesting should be done at the appropriate time because studies have shown increased cyanide in late-harvested cassava. Harvesting should be done at 7 -9 months for fresh roots and 8 –12 months for the production of starch.

Processing is effective in reducing cyanogenic compound content to minimum concentrations when done appropriately. Inadequate or poor processing as sometimes occurs during famine and periods of social stress or the rush to market can lead to high residues of HCN in the final product. Codex Alimentarius Commission previously developed Maximum Levels (MLs) for HCN in Sweet Cassava, Bitter Cassava, Edible Cassava Flour and Gari (a product obtained from processing fermented cassava roots). These are the following:

- Sweet Cassava – less than 50mg/kg of HCN
- Bitter Cassava (must not be eaten raw) – more than 50mg/kg of HCN
- Edible Cassava Flour -must not exceed 10mg/kg of HCN
- Gari-must not exceed 2mg/kg as free HCN

The production process for cassava products varies with the intended product. Some examples of cassava products include gari, fufu, cassava flour, cassava starch (tapioca), cassava chips.

CONDITIONS FOR FOOD SAFETY

It shall be the responsibility of the manufacturer to identify, list, and establish appropriate chemical, functional, microbiological and organoleptic specifications for all raw materials (including additives, ingredients and processing aids) and in-process materials.

It shall be the responsibility of the manufacturer to establish appropriate chemical, functional, microbiological and organoleptic specifications for finished products.

It shall be the responsibility of the manufacturer to test or have tested, raw materials, in-process materials, and finished products at a frequency commensurate with the risk to the safety of the finished product. These tests shall be carried out in accordance with defined procedures. Supplier guarantees shall be adequate to eliminate or reduce the testing requirement for raw materials.

It shall be the responsibility of the manufacturer to identify, monitor and record all critical parameters in the process to ensure that the finished product is microbiologically safe. Critical parameters shall include any heat processing required to pasteurize or sterilize the product, hygiene and cleaning procedures, the strength of active ingredients and the temperature for each washing cycle and post heat treatment handling.

Food contaminated by pathogenic organisms shall be rejected, or treated, or processed, to eliminate the contamination where this is possible. It shall not be blended with the uncontaminated products, as a means of bringing the food within specification.

The packaging material used in contact with food shall be free of contamination, shall not taint the food.

STEPS TO CERTIFICATION

There are four main stages involved in product certification.

1. REVIEW OF THE APPLICATION. The factory representative correctly fills out an application form. The application form will require details such as the name and address of the manufacturer. The location is important as it can affect the **administration fees**. The form will generally ask for the name of the product and estimated quantity and revenues. The **marking fees** are usually calculated at a given percentage against the gross turnover. The form will also require information on the size of the organization in order to determine the number of **auditor man-days** required. A quotation and proposed schedule are sent by the certifying body to the client for review and approval.
2. ONSITE AUDIT AND FACTORY SAMPLING OF PRODUCT TO BE CERTIFIED. The auditor visits the factory on the agreed date and confirms the details (**audit criteria and scope**) of the audit with the client. The auditor obtains a sample of the product for inspection and laboratory testing. During the onsite visit is important for the client to ensure that the factory is in full production and there exist enough records to demonstrate that there is effective control of the production processes, especially the critical ones. The auditor will

inform the client of the audit findings. **Major non-conformances** should be closed immediately, **minor non-conformances** should be addressed with **corrective action plans** and are reviewed in the subsequent onsite audits.

3. CERTIFICATION DECISION: This is done by an independent committee that will look at the test report and verify product compliance to the standard. They also look at the audit report and assess whether the audit findings were addressed with the appropriate action. The committee ensures that the due process was followed.
4. THE AWARD OF THE CERTIFICATION: Upon satisfying the requirements of certification, the certificate is given to the client. The certificate gives the client the right to use the certification mark on the applicable product only. Product certification is not transferable. The certificate is **valid** for a given period but there are **surveillance visits** arranged within that period to ensure continued monitoring of product compliance.

Certification period goes from 1 to 6 months and is dependent on the findings of the laboratory on the product. Lab tests take 1-8 working days, and the results are valid for 6 months. If the results are positive, and the client is ready financially, ZaBS can issue a certificate within 10 working days.

ANNEX 1: LIST OF RELEVANT LEGISLATION AND STANDARDS

The Plant Pests and Diseases Act Cap 233

An act to provide for the eradication and prevention of the spread of plant pests and diseases in Zambia, for the prevention of the introduction into Zambia of plant pests and diseases.

The Public Health Act Cap 295

This Act is meant to ensure that all commodities meant for sale to the general public are of good quality and in hygienic conditions. Public health regulations are enforced through inspectors from the Ministry of Health or local government authorities (councils).

The Public Health Act is mandated to declare people working in food processing facilities as healthy and free of communicable diseases. This Act empowers authorities to inspect premises such as farms, processing facilities, and distribution outlets.

Food Safety Act No 7 of 2019

An Act to provide for the protection of the public against health hazards and fraud in the manufacture, sale, and use of food; provide for a streamlined process for regulatory clearances for regulatory health requirements for food premises.

The Metrology Act No 6 of 2017

This Act was enacted to provide for the designation, keeping, and maintenance of national measurement standards. This Act ensures that machinery and equipment used for weighing and measuring products are correct and accurate. It covers the scientific and legal metrology.

The Competition and Consumer Protection Act 2010

This Act safeguards and promotes competition; protects consumers against unfair trade practices and provides for the establishment of the Competition and Consumer Protection Tribunal. This Act prohibits unfair trading practice, false or misleading representation of goods and services, prohibits the display of disclaimer, prohibits the supply of defective and unsuitable goods and services.

The Factories Act Cap 441

An Act to make further and better provision for the regulation of the conditions of employment in factories and other places as regards the safety, health, and welfare of persons employed therein; to provide for the safety, examination and inspection of certain plant and machinery.

This act regulates the design and specifications of operating factories to ensure safety standards are maintained in processing factories.

ZS 033: Part 1 2015 Labelling of pre-packaged foods-code of practice. Part 1: General guidelines

Applies to the labeling of all pre-packaged foods to be offered as to the consumer or for catering purposes and to certain aspects relating to the presentation thereof

ZS 034:2017 General principles of food hygiene

Prescribes the general hygienic practice for uniform processing and handling of food and gives guidance on the proper cleaning and disinfection procedures

ZS 700: 2008 Edible Cassava Chips - Specification

Prescribes the requirements and methods of sampling and testing for Edible Cassava Chips intended for direct human consumption.

ZS 701:2008 Edible Cassava Flour - Specification

Applies to cassava flour intended for direct human consumption which is obtained from the processing of edible cassava (*Manihot esculenta* Crantz).

ZS 832:2014 Code of hygienic practice for fresh fruits and vegetables

This code of practice covers general hygienic practices for the primary production and packing of fresh fruits and vegetables cultivated for human consumption in order to produce a safe and wholesome product: particularly for those intended to be consumed raw. Specifically, this code is applicable to fresh fruits and vegetables that are grown in the field (with or without cover) or in protected facilities (hydroponic systems, greenhouses).

ZS 915: 2016 Code of practice for the reduction of Hydrogen Cyanide (HCN) in Cassava and cassava products.

Intends to provide national and local authorities, manufacturers and other relevant bodies with guidance on how to produce cassava products with safe concentrations of residual cyanogenic compounds.

ZS 989: 2016 Fresh sweet cassava - specification

Specifies requirements and methods of sampling and test for varieties of fresh sweet cassava roots of *Manihot esculenta* Crantz, of the Euphorbiaceae family, to be supplied to the consumer. Cassava roots intended for industrial processing are excluded.

ZS 990: 2016 Fresh bitter cassava - specification

Specifies requirements and methods of sampling and test for varieties of fresh bitter³ cassava roots of *Manihot esculenta* Crantz, of the Euphorbiaceae family, to be supplied to the consumer. Cassava roots intended for industrial processing are excluded.

ZS 991: 2016 Cassava flour- specification

Specifies requirements and methods of sampling and test for cassava flour, which is obtained from the processing of cassava (*Manihot esculenta* Crantz) intended for human consumption.

ZS 992: 2016 Dried cassava chips- specification

Specifies the requirements and methods of sampling and test for dried cassava chips intended for human consumption.

ZS 993: 2016 High-quality cassava flour

Specifies requirements and methods of sampling and test for high-quality cassava flour, which is obtained from the processing of cassava (*Manihot esculenta* Crantz), intended for human consumption, industrial use and other applications.

ANNEX 2: SAMPLE SCHEDULE OF ZABS CERTIFICATION FEES

Below is a table showing a sample of the fee structure at the Zambia Bureau of Standards (ZABS). However, it is important to consult with ZABS as this schedule may be subject to change periodically.

Type of fee	Description	Rate
Assessment Audit Initial/Surveillance/Recertification	This fee covers the audit of the factory	Ranges from 1000 to 4000 per auditor (man-day)
Testing	This fee will cover the cost of testing	As per the invoice from the testing laboratory.
Annual Marking Fee (per factory)	This fee is for the license to use the legally protected quality mark.	0.15% of annual ex-factory sales, minimum ZMW 2,000
Travel	This fee will cover travel-related costs incurred by the auditor	At cost depending on the distance covered.
Accommodation	This fee will cover boarding and lodging for factory auditors, when applicable	At cost

N/B: ZABS was restructured. in 2018. The new ZABS, has no provincial offices. What used to be ZABS office in Mongu is now a new agency called Zambia Compulsory Standards Agency(ZCSA), formerly ZABS inspections department. This agency is basically placed to enforce the law by providing inspections as deemed necessary. In an instance where a company/client wants certification from outside Lusaka, they can contact ZABS offices by phone or email and ZABS will provide guidelines.

ZaBS contacts:

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