



**Market chain of Zambian agrarian products in Mongu,
Western Province:
Case study of Mango – Mukande Business Solutions**

**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 mango. Conclusion section summarizes main ideas, recommendations, lessons learnt as well as suggestions for value chain development. All 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

Mango (*Mangifera indica* L.) is a tropical tree from family Anacardiaceae producing popular juicy fruit that grows on extremely large trees that reach over 100 feet in height and 12 feet in diameter. Mangoes are native to South and East Asia, but very soon found its way to African continent (already between 10th and 14th century). Mango fruit are very diverse in shape, colour and taste (Valicek et al, 2002; Derese et al. 2017).



Figure 1 Mangoes can provide important nutrients for resource-poor households

Mangoes are considered as one of the best tropical fruits. Various ethnobotanical studies indicated that the plant is widely used to treat diseases as it has active substances in its composition with high therapeutic potential. The reported pharmacological activities of include also antioxidant, antitumor, immunomodulatory, antiallergic, antiinflammatory, antidiabetic, antiulcer, antiviral, antifungal, antibacterial, and antiparasitic properties, which may support the numerous traditional uses of the plant (Singh et al. 2012; Derese et al. 2017).

Mangoes have a long tradition of cultivation and recently became of the world's most important cash crop. Based on FAO estimations, production of mangoes increased from 43 to 52 million tons during the last 5 years. World largest producers are India, China, Thailand,

Indonesia, and Mexico. Altogether they contribute by >67%. Mango is consumed fresh, but predominantly is being processed in various products, particularly or most favourite for human consumption are juice, jams, or marmalades.

Processing of mangoes is usually a driving force for rural economy development. Selling fresh mangoes to local processing companies is good opportunity for off-farm income generation. Nevertheless, farmers sometimes process mango directly in their homes, usually they use drying or fermentation. Particularly drying is challenging for the tropical regions where mangoes mature during the rainy season. This is example particularly for African countries like Zambia where “mango drying agro-industry” is still underdeveloped.



Figure 2 Traditional harvesting of mango in Zambia

Mango fruit is widely produced and consumed in Zambia mainly during the rainy season play a vital role in providing food and as a source of incomes for smallholder farmers in Zambia and worldwide. Mango contains vitamins and minerals that are required for nutritious diets to balance with the cereal staple foods. The production of mango further enhances employment opportunities especially for farming dependent households. The sale of fresh mango and processing of mango related product is imperative to obtain incomes even at periods beyond

the rainy season. The prices of processed mango during off season is an opportunity for smallholder farmers to obtain attractive and higher prices. The foregoing reasons provides incentives and motivation to the significance of developing the production techniques, value addition and marketing of mango fruit.

However, in Zambia despite the benefits alluded for value addition and favourable conditions, the sector is still at infancy stage and underdeveloped. Directions of development and strategies must from policy makers must focus on the improvement of mango varieties for better quality and quantities of mango produce. This calls for proper planning and strategies such investing in mango seed nursery for continuity of production and to help overcome the use of available old traditional practices. Secondly, the various actors of value chain need knowledge and training to promote awareness on processing and marketing to obtain favourable prices from mango at affordable cost. Training coupled with support to technological investment will help boost the mango sector.

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 (2012) 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.

Mango value chains are usually composed of nursery suppliers, mango producers, harvesters and assemblers, processors and traders, and of course consumers. Most common constraints encountered are (i) lack of inputs, such as seedlings, mineral fertilisers, herbicides, pesticide, etc., (ii) inadequate training on appropriate mango agricultural/production practices, and appropriate harvesting methods and tools, and (iii) suitable processing skills and equipment, including traditional locally-adopted ones. Effectivity and stability of each mango value chain

would be also dependent on external factors, such as soil fertility, favourable climatic conditions, technical and financial support, availability of resources (land, labour, capital), and also overall economic situation (Arinloye et al. 2017).

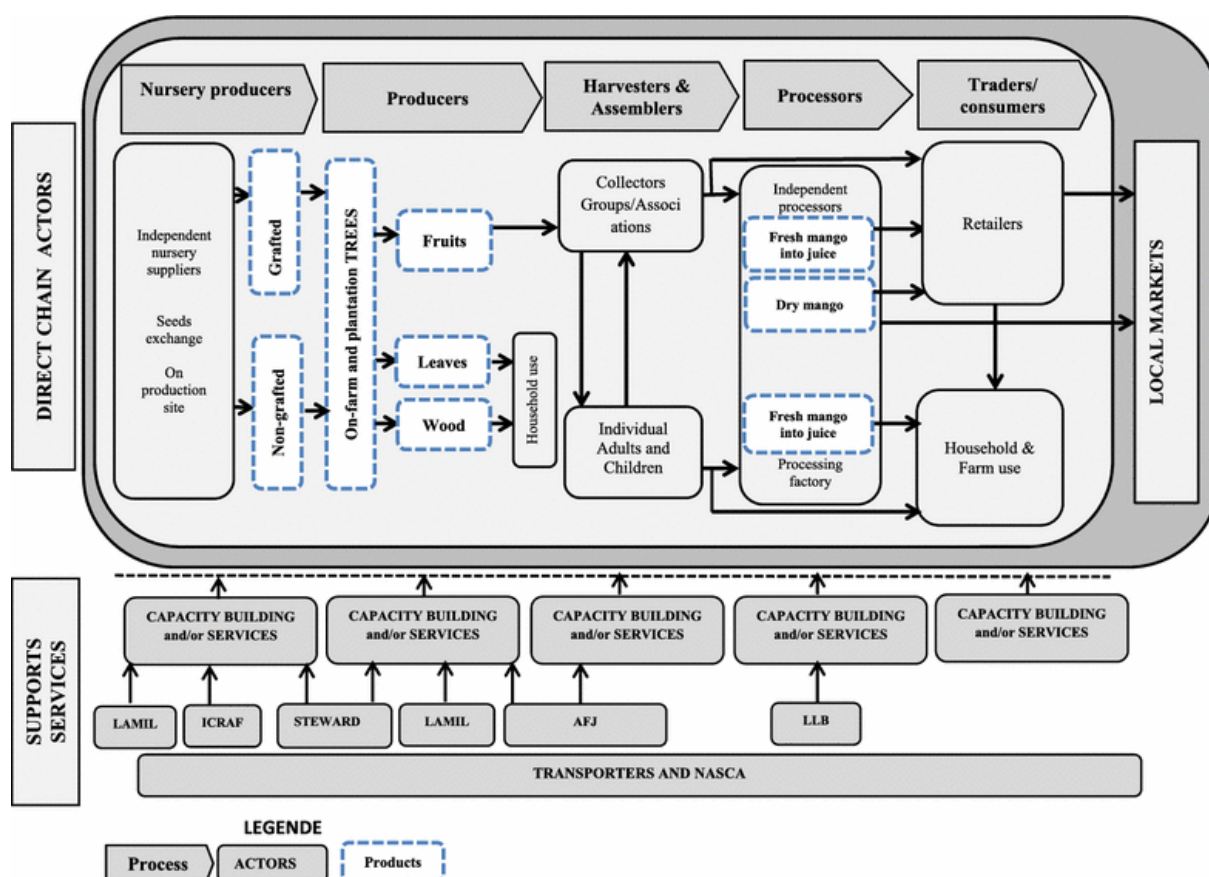


Figure 3 Example of complexity of mango value chain in African countries
(Arinloye et al. 2017)

1.3. Production opportunities and challenges for mango

Geographic aspects

As stated earlier, Mango (*Mangifera indica* L., Anacardiaceae), is one of the most important tropical fruits (Rehm and Espig, 1991). It is evergreen tree originating in the Indo-Burmese

region. From this region, mango spread throughout SE Asia and to the east coast of Africa and subsequently to Australia, West Africa and the Americas (Sukonthasing et al, 1991). Currently, it is widely distributed in the tropics and subtropics. India has been the largest producer since time immemorial (two third world production, over 1 million ha), followed by Brazil, Pakistan, Mexico, Bangladesh, Haiti, China, and Philippines (Valicek et al, 2002).

There are basically 3 agroecological production zones distinguished within Zambia. The target region of this survey (Western Province, Mongu) belongs to the agro-ecological zone II. More specifically to the zone IIb.

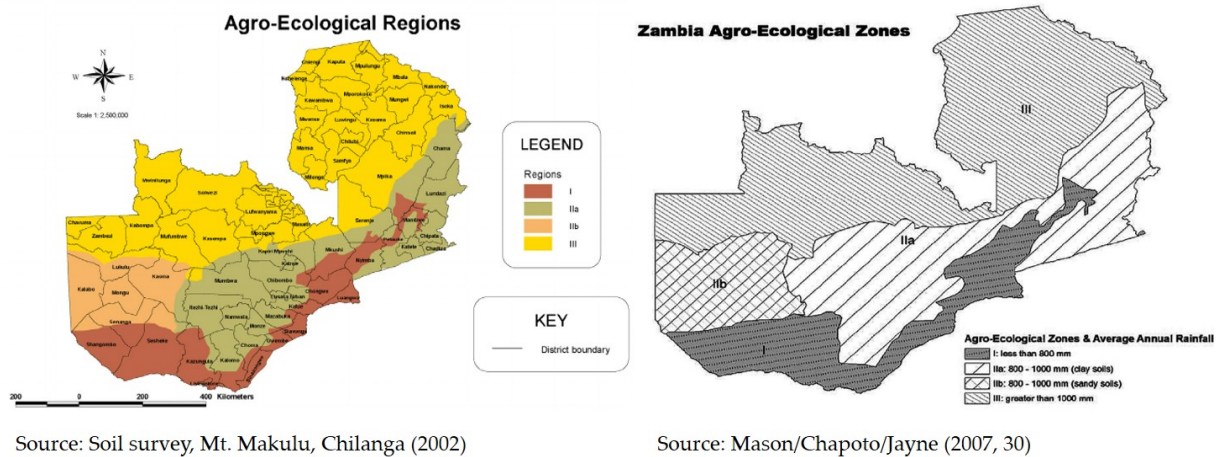


Figure 4 Zambia's Agro-Ecological zones

Mango is suitable for different soil types and adaptive to soil pH levels of 5.5 to 7.5 including the sandy soils that characterise the Western province of Zambia as they provide well drained soils and avoid water logging for growth. In Mongu, the farmer s enriches the soils by applying compost and organic manure to improve the soils on mango grow stations.

The mango requires temperatures range of 15-35°C as lower temperatures limits the growth rate while the excess temperatures results in effect of flowering of mango and the recommended favourable temperatures is 24 to 27°C. which is optimum for Western province. The production of mango thrives in rainfall amounts of 500 to 1000 mm; however,

very high humidity increases cases of disease break out such as fungal powdery mild on the leaves, buds of fruits and if uncontrol may rest in lower yields due to few and poor fruit development. In Zambia, Mongu the spraying against mango disease is not usually a routine activity and in extreme cases the farmers use wide spectrum pesticides. During off season some farmers prune off infected branches as a way of increasing productivity during the rainy season and preventing the spread of diseases (International Fruit Network).

Status of mango production in Zambia

In Zambia, its production is characterized by small scale farmers cultivation. Mango is one of the second important fruit crop that is widely distributed. Mango trees are found on most of the household, farmyards and little care is given to the trees as they are not growing under specific plantations. In western province, the mango tree density is higher and is one of the regions that produce and supply mango to main cities such as Lusaka. In Zambia, Mango is a seasonal crop that grows during the rainy season from November to March season. The harvesting season ranges from 4 months to 5 months depending on the varieties. The major regions of with high mango production include Eastern province, however, fair shares of production are obtained from many provinces of Zambia. The mango and processed products provide food, incomes for many agricultural dependent populations. The limitation is that its contribution to the local economy is little because of losses because of underdeveloped strategies and processes to maximize the potential from mango.

Agroecology and harvesting aspects

The mango can be cultivated in both, subtropical as well as the tropical regions up to 1,200 m elevation (Sukonthasing et al, 1991). However, the optimal areas for mango cultivation are tropical regions with summer rainy seasons with temperature being around 24-27°C and annual rainfall between 750-2500 mm. The trees show tolerance to drought and moderate tolerance to waterlogging. Several months of dry season as well as cold months in the subtropics stimulate the flowering and the fruit setting. Mango has generally moderate requirements on soils (Rehm and Espig, 1991). Rather poor soil is preferred, because good availability of water and nutrients tends to stimulate vegetative growth at the expense of flowering (Sukonthasing et al, 1991).

Many cultivars can be generatively propagated, for example by grafting or by budding on seedling rootstocks. Usually, mango trees start to bear fruits 5 years after planting, although some cultivars can even bear fruit in their third year of cultivation. Regular yields can be expected in the 12-15th year of cultivation. A mango plantation at its production peak yields 10-25 tons/ha/year (Rehm and Espig, 1991).

In Zambia mango is a seasonal fruit that is available during rainy season and widely distributed among many farmers and households. The mangoes are not much priority by many farmers when compared to other staple crops. Inappropriate harvesting and post-harvest handling of mangoes. Another limitation is lack of a diverse of varieties suitable for production of different mango related product. Mangoes generally mature and on average about 120 days after flowering. In Mongu, the mangoes are harvested when unripe especially during early season for production of chutney. The mango for other processing products such as drying, and juice ripen on tree before harvest.

Mango contains high level content of vitamins and it is constituted in the skin, flesh and about 70% composed in the stone. Beside the vitamins, mango provides energy, macro elements such as calcium and phosphorus as well as micro element iron (Prota4u database).

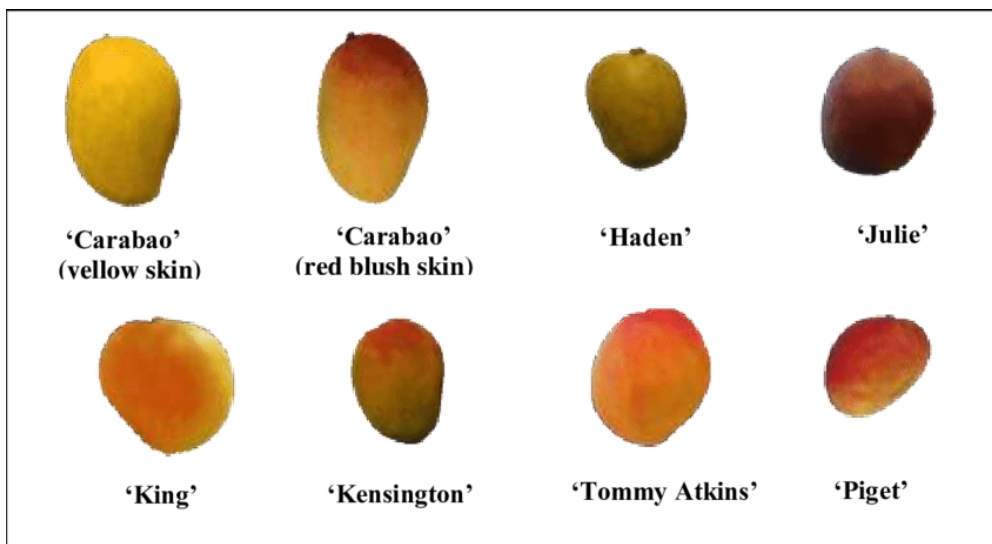


Figure 5: Most common mango varieties

Mango properties

The mango cultivars vary in fruit shape, fruit size, flesh texture, taste, and ecological requirements. Huge number of cultivars exist worldwide particularly in India (more than 1,000), which produces two thirds of the total world's production (Rehm and Espig, 1991).

The mango fruit is composed of 11—18% skin, 14—22% flesh and 60—75% stone. The flesh nutritive value per 100 g of edible portion consist of water (78—85 g), protein (0.3—0.8 g), fat (0.1—0.2 g), carbohydrates (13.2—20 g), fibre (0.6—0.7 g), calcium (9—25 mg), phosphorus (10—15 mg), iron (0.1—0.2 mg; Sukonthasing et al, 1991), a lot of provitamin A and a significant amount of vitamins B and C (14—62 mg; Valicek et al, 2002, Sukonthasing et al, 1991). A total energy value reaches 225—350 kJ per 100 g (Sukonthasing et al, 1991).

Based on the technology used, following products may be produced from mango a number of flavourful and nutritious products. Currently, chemically preserved, canned, dried, and frozen forms of mango pulp and jams, jellies, canned slices, dehydrated pulp, frozen chunks and slices, traditional pickles, and chutneys. Moreover, pulp and puree serve as a base for a variety of processed mango products, e.g., nectar, beverages, jam, jelly, and leather. Last, but not least, mango processing waste, which contains high amounts of many nutrients and antioxidant compounds, present opportunities for their value-added utilization in functional foods (Siddiq et al. 2017).

Mango Products

The ripe fruits are used as dessert fruit, for making juice, tarts, jams, jellies, ice-cream, candied fruit, confectionery, canned or dried products and preserves. Unripe fruits are used in SE Asia for pickles and chutneys and unripe fruits and young leaves as vegetables and salad (very popular in Thailand and the Philippines). The green fruit is also used to flavour fish and meat dishes similarly as tamarind and other sour fruits (Sukonthasing et al, 1991). Fruits, leaves, flowers, roots, bark and resin have a medicinal importance (e.g. dried flowers or bark and decoctions of the kernels serve as astringents). The bark contains 78% resin and 17% tannins and serves as a natural dye applied to cotton, wool and silk (<http://mansfeld.ipk-gatersleben.de/apex/f?p=185:1:::NO:::>). Especially, the markets for conserves (e.g. juice and chutney), can be increased. All remains from the plant, including the nutritionally rich kernels

and any fruit which is unsuitable for sale, are valuable as animal fodder, especially for pigs, cattle and poultry (Rehm and Espig, 1991, Sukonthasing et al, 1991). In India the kernels are also important as a famine-food, but the astringency has to be removed by boiling, roasting or soaking the kernels for a long time. Extracts of unripe fruit and of bark, stems and leaves have shown antibiotic activity. The bark or leaves treat diarrhea and have a diuretic effect. The wood is used to make excellent charcoal and is also used to cultivate wood decaying mushrooms (Sukonthasing et al, 1991). Mango can also be successfully frozen. The leaves can be fed to cattle in limited quantities, whose urine is then used as an excellent natural yellow dye for fabrics and carpets. In S and SE Asia many other species of local importance are grown or collected, such as *M. caesia* from Malaysia, Indonesia and the Philippines (young leaves and fruits are often used as a side dish), *M. foetida* from SE Asian islands, *M. laurina* from Malaysia, *M. odorata* from Malaysia and Indonesia, *M. zeylanica* from Sri Lanka, etc. (Valicek et al, 2002).

Postharvest handling, processing and storage aspects

Postharvest handling and packaging are an important aspect that is key for smallholder farmers. The shelf life is not advanced and follows the tradition way of handling. The first step involves grading the mango according to size and colour. The sorting helps to prevent uniform ripening and transfer of spoilage. This is done by producers at the farmyard immediately after harvest. This is followed by packaging the mango in baskets, crates are ventilated and for easy transportation for sale. Storing of mango is dependent on lower temperature as there is a lack of cooling rooms for smallholder farmers. Methods of processing and respective products



Figure 6 Investments into modernization of mango processing within World Bank projects

Mango fruits need very careful handling due to the sensitivity to bruising (Rehm and Espig, 1991). However, in Zambia, mango processing is relatively weak and underdeveloped. Majority of the produced mangoes go to waste and as it is mainly consumed fresh and straight from trees and when mangoes are abundant. The mango losses are rampant, and the losses are exacerbated by low technological aspects and challenges to process the mangoes in different products such as juice, dried, chutney and jam. Some of the challenges with mango processing include: Lack of technological equipment to process the mangoes including storage facilities and lack of capital to invest in processing improved value, supply chain and high packaging of the mangoes and its products.

In Zambia, the processing of mango and value addition is still at an infant stage and overwhelmed by the mass production during the rainy season. This literally translates that that farmers sell the produce at lower prices as they are forced to sale immediately after harvest when prices are at low price.

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 mango in Mongu district as a case study.

2.2. Specific objectives

- (i) The main aim of this study will be reached via the following specific objectives:
- (ii) Describe mango as a product and its marketing possibilities
- (iii) To identify supply chain actors in the mango chain
- (iv) To determine the role played by different actors along the mango chain
- (v) To determine the profitability of mango 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 mango chain in Mongu district?
- (ii) What are the roles played by different actors along the market chain of mango in Mongu district?
- (iii) Who is the actor in category of benefits in the market chain of mango 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.

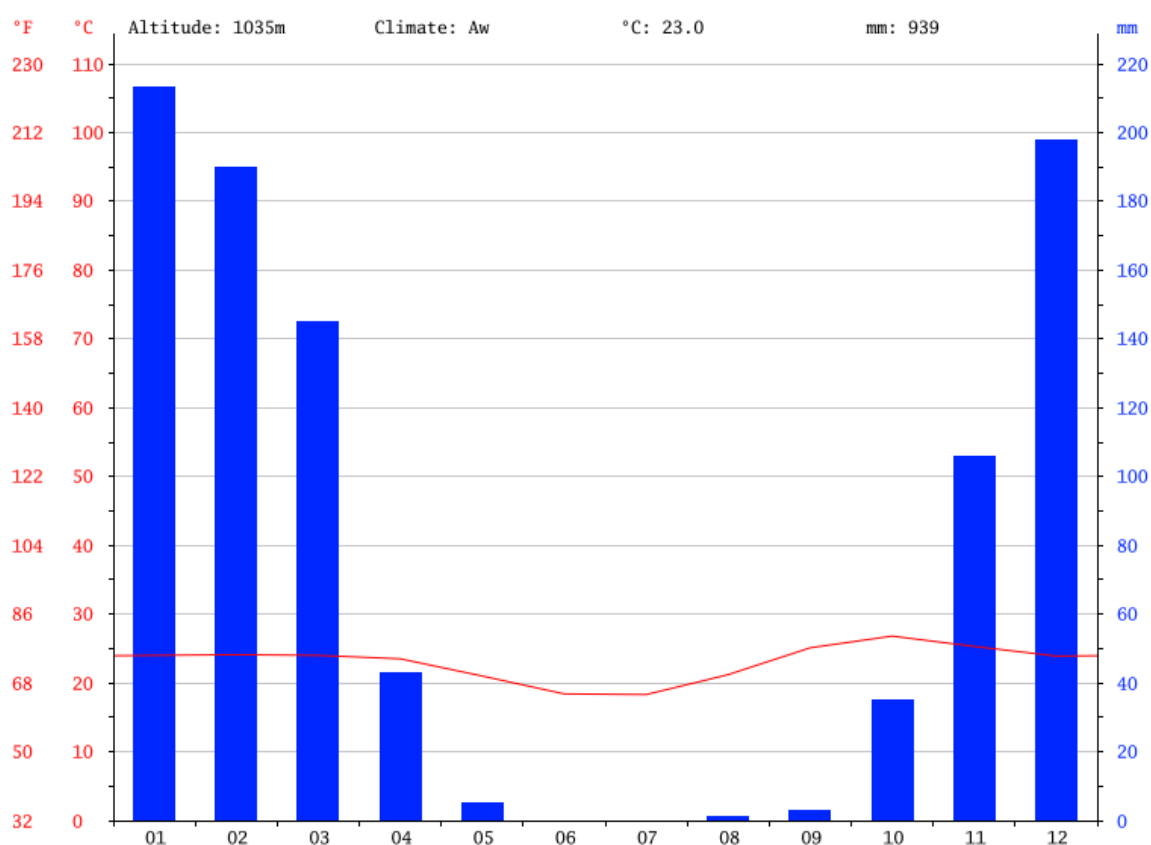


Figure 7: Climatogram of Mongu town, administrative centre of Western province and Mongu district (Climate Data, 2019)

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

A questionnaire survey was conducted for each of the selected mango product on the Lusaka and Mongu markets. Two in-depth interviews were conducted in Mongu, the first with Nutritional Department, Provincial office, Ministry of Agriculture, Mongu with Mr Mulele. The second in depth interview was with the District cooperative office, Mongu. Several structured 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 mango products, some factors which influence the purchase of mango 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 temporary stall, street vending and farm gates.

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 mango is fairing on the market in terms of price, factors influencing the purchase and the challenges being faced by the mango sellers/vendors.

3.3. Data processing and analysis

The product value chain analysis is done by identifying the opportunities and constraints of the various mango 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.



Figure 8: Mango tree as a part of local farming systems

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

Value chain analysis considers the actors and their specific roles that help to contribute to meet the required value of mango commodity for the satisfaction of the beneficiaries from conception to final consumption.

4.1. Supply chain actors in Mango production

In Mongu, the mango supply chain actors comprise of various participants. The actors have respective roles and functions to meet the benefits of mango value chain and these include producers (farmers), local collectors, traders, transporters, marketers, wholesalers, retailers, processors and consumers.

Input suppliers

The role of input suppliers is the provision of raw materials for mango production. The input suppliers constitute of agro chemical shops, research canter from Ministry of Agriculture to enhance technological and modernized production systems. However, in Mongu the production of mango is basically dependent on local varieties and this limits the involvement and contribution from the different suppliers. Currently, there are no initiatives for nursery sites to offer improved mango varieties to the farmers in Mongu. The agrochemical stores offer broad spectrum pesticides for mango production and management practices.

Producers (farmers)

The producers are the small-scale farmers who supply the mango to the consumers. The farmers produce from local resources and varieties of mango. The major activities of the producers involve planting, management of trees such as pruning, manure application and totally depend on rainy season. The producers have several ways of selling the fresh mango from their homes to wholesalers and collectors. The producers also market their product by taking mango to the market to supply to domestic buyers. The mango producers improve the value addition by grading, sorting, drying and cleaning of the product to meet market standards and quality for traders. For packaging materials, the producers use baskets and sacks.

Collectors (Bulking)

Some collectors are contracted by the large traders to help organize and assemble mangoes from farmers (suppliers) and resell to wholesalers. The collectors are usually well informed and go directly to the farmers yards to assemble, grade and sort the required mango, packing in sacks, bulking and load them on trucks for the market. In some cases, the collectors are also farmers who sell directly to wholesalers, retailers and consumers. In Mongu, even the unripe, peak matured mango are collected and bulked by the roadside for collection by transporters.

Wholesalers

The wholesalers purchase the mangoes in bulky from collectors or directly from farmers. The wholesalers purchase mango in larger amounts and have a better financial resource and pay in cash. The wholesalers usually engage the collectors to collect the mango from producers in villages. In Mongu, the mango wholesalers target the provincial markets outside Western province especially for larger markets such as Lusaka and Livingstone.

Transporters (Truck drivers)

After bulking of mango, the transporters are hired to deliver the products to intended markets. The transporters are truck drivers who after are usually making deliveries for different types of goods and services to Western province. The truckers load the mango and mainly transport them to Lusaka Soweto market and to Livingstone.

Retailers

The retailers procure the mangoes from the wholesalers and deliver them to the consumers. The retailers prepack the mangoes in smaller packs or single fruits as deemed convenient for the consumers.

Processors

The processors add value to the mango fruits to generate juice, dry and fresh cut pack mango. Mango value addition is vital to create employment, improve income and to reduce poverty levels.

Processed Juice

In Mongu, the processed mango juice is at initial stage and less developed. Adastra fruit juice company is the only local firm that processes juice from local mango and the company serve as a first entrant for mango juice in the area. The company purchase mango from the producers through their field employees who are conversant with the product requirements for juice making. The quality of juice produces is still of low quality. The competitors concerning juice are the imported mango juice that is flooded in the local supermarkets.

Dried mango

Mango drying is done on individual basis. for example, Mr Sibeso Mulele in Mongu has a solar drier with an input capacity of 300-500 kg of fresh mango and with estimated output of 60-100 kg of dry mango.

Consumers

The consumers consist of various actors such as which include individual households, supermarkets and hotels.

4.2. Mango as a product and its marketing possibilities

A wide range of products can be processed from the mangoes depending with the stage of maturity and type of mangoes. The maturity stage consists of two major types, the green mangoes and the ripe ones. Secondly, the mangoes are described in two types namely small and the big mangoes. There are a diversify of products that can be generated from the green fruit mangoes are among them Chutney, pickle and mango slice brine. The ripe mangoes are processed as fresh ones, juice, jam and dried. The consumption of mangoes is mostly within the country. The fresh fruit market takes the largest share of the mango market. The unripe mango is purchased by Indian companies through transporters mainly for making chutney.

In Western province and Mongu in particular, there is abundance of mangoes during the rainy seasons from October through March. This indicates that the supply is higher than the demand especially that the harvesting time is similar for mango for all producers. Mostly, the farmers sell the mango on local market as fresh fruits. In other situations, the farmers sell the fruits at

their farm gates for retail and wholesale prices. There is significant potential to explore the market both local and neighbouring countries. However, from the export side currently it is non-developed and non-existence.

Mango attributes and price

The factors influencing the purchase of mango is the freshness of the mango as well as the type and variety of the mango. Many customers prefer small mango as compared to big mango as they believe that the smaller the mango, the tastier and sweet. The firmness of the mango is a key attribute as it is linked to better shelf life. The colour of the mango in the eye is another feature that attracted the consumers.

The mango markets are characteristic by more supply during the peak season and lower in after rainy season. The officers also were fortunate enough to have found mango on the market for this season (2019/2020 season). The source of the early mango is Mfuwe in eastern province of Zambia. The retailer buys from wholesalers at K200/ 50 kg-bag and resell in small quantities at K15/kg. In western province the mangoes have high market value and established comparative advantage on the main Lusaka market. Majority of the mango in Mongu come from Limulunga districts with a 50 kg bag selling at K35.00. The same quantities of mango are sold at K55.00 in Mongu districts. Mango from Kalabo district sell for K65/ 50 kg.



Figure 9 Market survey on mango products in Lusaka market

Processed mango (dry)

The mangoes are processed in different forms these include drying mango. The major market for dried mango is from Shoprite and individuals. The price for the mango is K15.00 per 100 g from individual driers. The major competitor on supply of dry mango to Mongu is COMOCO company from Eastern province of Zambia and they are the main suppliers to Shoprite supermarket. In supermarket the price of a 100 g dried mango cost K25.00.

The officers also had access to suppliers of mango seedlings (Lutawo paradise garden), they supply different species and varieties such as grafted big mango costing K35/plant, improved mango costing K40 and improved mango (Kent) costing K50.



Figure 10: Drying of mango in southern part of African continent

Table 1. Mango products - processing and marketing (SWOT analysis)

Strengths	Weakness
Availability of land, good climate for mango cultivation and labour force	Lack of appropriate technology for mango harvesting and processing
Existing (Lusaka) but rather undeveloped market	Inadequate skills, investments, food safety issues, and not facility for processing fresh mango into juice
Good nutritional benefits (e.g. for children) and environmental services	Lack of traditional knowledge and modern research on mango processing
Opportunities	Threats
Ongoing research on new processing technologies	Insecure land tenure system under customary ownership
Growing demand for mango products at domestic and international markets	Climate dynamics (drought)
Rising popularity of trees proper planting technique among farmers	Barriers to adopt improved technologies for storage of mango / mango products
Improving access to new types of processing, e.g. lyophilisation	

Mango marketing constraints

Some challenges faced by traders of this commodity is transport being too expensive with more records of damages/spoilage of their product due to long distance and lack of permanent stalls for trading. The marketing of fresh mango and its product is limited due to the short shelf life of fresh mangoes, lack of proper storage facilities and inappropriate handling during sorting and transporting of the mango. The major challenges in mango marketing in Mongu include the quality of the mango is sometimes compromised and does not met the required standards due to spoilages. Inappropriate handling and packaging of mangoes especially in cases where the fresh mangoes are transported on long road to Lusaka market in non-cooling trucks further compromise the quality of mangoes. Another limitation is that during the months of December the markets are flooded with mango, therefore, there is lack of market to absorb the excess produce. This further lowers the prices since there is mango everywhere on the market. In addition, poor coordination and lack of organization from the mango producers contributes to lack of knowledge due to poor training in production, processing and marketing aspects and poor to bargaining for better prices. The other constraint towards mango production is dependent on rainfall hence seasonal and it is difficult to prioritize when compared to staple foods.

5. Evaluation of Easy Cassava Meal business plan

5.1. Summary of the business plan

Business plan titled M.Mukande Business Solutions is based on selling fresh and dried mango. Fresh slices would be sold to individuals at the street markets, such as travellers via public transport, children on their way to school, or just to random customers. Added value is in slicing mango into pieces with total weight of 500-grams and pack them into plastic or to more biologically degradable, e.g. wooden-made or leaf-made, box. This amount is the most preferred one if one is demanding fresh mango. Next product is more sophisticated as it is based on drying. This would require some energy from the businessman and also some investments into technology. As most of the mangoes are harvested in rainy season, any changes in climate may influence the business idea. Price for the product is still affordable for the population, and they may even prefer local production to imports.

5.2. Production and quantity estimates

Availability of mangoes in abundance in Western province, makes this venture a viable and lucrative business. A lot of mangoes go to waste due to lack of processing technologies and value addition. Its seasonality requires an improved technology in both processing and preservations. The 7 tonnes target of the raw materials is attainable and the business being located in Sefula, 15 km from Mongu town has proximity to the natural resources. To further grow the business, planting non-fibrous varieties would be a good investment venture for the farmers.

The set prices are quite reasonably low especially the price for the 50g dry mango pack seems a bit on the lower side in comparison to the competitors' prices which range from 30 zmw to 45 zmw for both a 50g and a 100g pack. See table below

Product name	Units	Price				Expected Production	Expected Benefits
		Consumers	Competitors	Proposed	Proposed		
		ZMW	ZMW	ZMW	ZMW	Bag, Packs	ZMW
Fresh sliced Mango	500g pack			5.00	5.00	7,200.00	36,000
Dried mango	50g pack		10.00	6.50	6.50	2,400.00	15,600
Dried mango	100g pack		15.00	13.00	13.00	24,000.00	312,000
Total							363,600

5.3. Cost of technology/Equipment

The technology suggested in this business endeavour is a simplified technology that uses the locally sourced equipment and resources. No items require any importation from abroad or neighbouring countries. The technology itself is very cheap in the sense that it doesn't require any high-tech. It suits the small-medium scale farmers that envisaging to grow in a sustainable manner. The prices of almost all the equipment is realistic to the current prevailing market prices. There is a great use of renewable solar energy for the processing the mangoes which is eco-friendly and cheap source as compared to other sources. For the Other electrical appliances, Sefula is connected to the grid.

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. Looking at the cost of about 80,000 ZMW (See table below) for the construction of storage building, it would suffice to say it is a good and reasonable estimate for a sizeable 20m by 20m storage building that could outlive its expected life span of 50 years if well maintained and renovated.

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 at a better position.

Equipment and Premises	Units	Number	Price	Amount	Depreciation	
					Life span	Amount
Construction of storage (Building)	number	1.00	80,000.00	80,000.00	50	1,600.00
Furniture	number	1.00	3,500.00	3,500.00	7	500.00
Solar driers	number	4.00	7,000.00	28,000.00	10	2,800.00
deep freezer	number	1.00	5,000.00	5,000.00	7	714.00
cooling cabinets	number	4.00	2,500.00	10,000.00	7	1,429.00
Cooler boxes	number	4.00	500.00	2,000.00	10	200.00
Weighing scales	number	2.00	1,200.00	2,400.00	7	343.00
Laptop and printer	number	1.00	6,500.00	6,500.00	7	929.00
			Total	137,400	Total	8,514.00
					Per Month	710.00

5.4. 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.

From the figures in the 2 tables, it is seen that the NPVs have a positive value which translates to the businesses being accepted as lucrative. 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.

At the discount rate. of 121%, NPV is zero, therefore the IRR is 121%, making it greater than the discount rate of 46% and 47% respectively. In this case the business plan is accepted.

Year	B-C	Disc.	Disc.	PV	PV	Benefits	Costs	Benefits	Benefits	Costs	Costs
		58%	59%	58%	59%			58%	59%	58%	59%
1	180,256	1.58	1.59	114,086	113,369	366660	331,988	232,063	230,604	210,119	208798
2	180,256	2.50	2.53	72,206	71,301	366660	186,404	146,876	145,033	74,669	73732
3	180,256	3.94	4.02	45,700	44,843	366660	186,404	92,959	91,216	47,258	46372
4	180,2556	6.23	6.39	28,924	28,203	366660	186,404	58,834	57,368	29,910	29165
5	180,256	9.85	10.16	18,306	17,737	366660	186,404	37,237	36,080	18,930	18342
6	180,256	15.56	16.16	11,586	11,155	366660	186,404	23,567	22,692	11,981	11536
7	180,256	24.58	25.69	7,333	7,016	366660	186,404	14,916	14,271	7,583	7255
8	180,256	38.84	40.85	4,641	4,413	366660	186,404	9,440	8,976	4,799.	4563
9	180,256	61.36	64.95	2,937	2,775	366660	186,404	5,975	5,645	3,037	2870
10	180,256	96.96	103.27	1,859	1,745	366660	186,404	3,781	3,550	1,922	1805
PVs				307,581	302,560			625,652	615,439	410,213	404442
NPV				161,997	156,976						

Year	B-C	Disc.	Disc.	PV	PV	Benefits	Costs	Benefits	Benefits	Costs	Costs
		46%	47%	46%	47%			46%	47%	46%	47%
1	180,255	1.46	1.4	123,462	122,623	366660	331,988.	251,136	249,428	227,389	225842
2	180,255	2.13	2.1	84,563	83,417	366660	186,404	172,011	169,679	87,447	86262
3	180,255	3.11	3.1	57,920	56,746	366660	186,404	117,816	115,428	59,895	58681
4	180,255	4.54	4.6	39,671	38,602	366660	186,404	80,696	78,522	41,024	39919
5	180,255	6.63	6.8	27,172	26,260	366660	186,404	55,271	53,416	28,099	27156
PVs				332,790.	327,649			676,932	666,475	443,856	437,862
NPV				187,206	182,065						

b) Payback period

1) 10 years business life span

Years	Cumulative benefits	Cumulative costs	Difference
1	232,063	210,119	21,944
2	378,939	284,788	94,151
3	471,898	332,047	139,851
4	530,733	361,958	168,775
5	567,970	380,889	187,081
6	591,538	392,870	198,668
7	606,454	400,454	206,001
8	615,895	405,253	210,642
9	621,870	408,291	213,580
10	625,652	410,213	215,439

2) 5 years business life span

Years	Cumulative benefits	Cumulative costs	Difference
1	251,137	227,389	23,748
2	423,149	314,837	108,312
3	540,965	374,733	166,232
4	621,661	415,758	205,903
5	676,932	443,857	233,076

The initial investment is 145,584 ZMW, and at about 2 years 3 months is the payback in the 5 years business life span. In the 3rd year, the payback per month is 13,853 ZMW. To reach the 145,584 ZMW. Initial investment, 3 months have to be added to the second year reaching an amount of 149,869 ZMW as the nearest figure. It is quite a quick recovery from the investments perspective and gives the zeal and confidence to venture in such a business. As for the 10-year life span, the payback is at 3 years 1 month with an amount of 153,915.81 deduced from adding the 3-year amount of 139,851 and the 4-year month recovery of 14,065.00 (See tables above)

c) Sensitivity analysis of the prices

To determine sensitive 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 show 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.

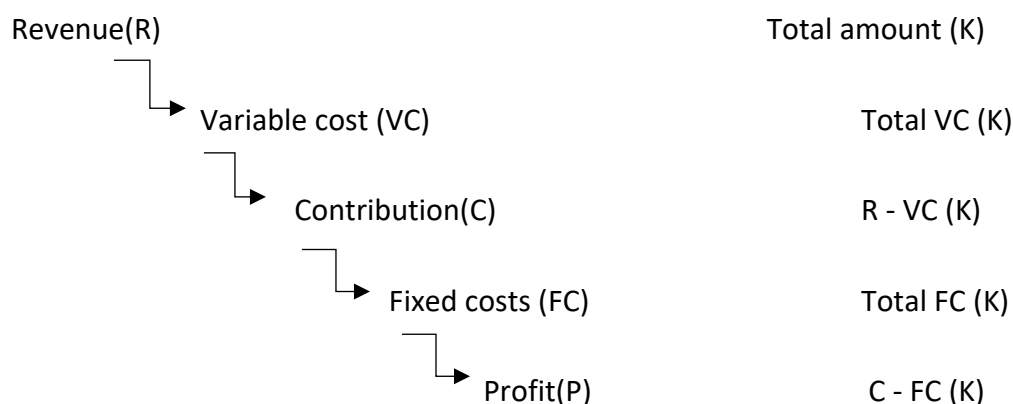
Break-even Point (BEP) = Total fixed cost / Price per unit - Variable costs per unit

- **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: Fresh sliced mangoes in 500g packs				
Price per unit	4.00	5.00	6.00	7.00
BEP-Minimum production of 500g packs	9,871.35	6,580.90	4,935.67	3,948.54
Expected production	7,200.00	7,200.00	7,200.00	7,200.00
Profit	-5,342.70	1,857.30	9,057.30	16,257.30

In relation to **product 1, the fresh mangoes** it is seen in the table above that lowering the prices from the proposed 6 ZMW minimises the profit margin. But moving by one point drastically increases the profits. In the same vein, the break-even point (BEP) is reached at about 60% 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 the market and acceptability of the product by the locals who are already used to eating fresh but un sliced and unpackaged mangoes. Hygiene is greatly improved in this product, and it could be a good pitch to attract customers. Getting the product certified would increase its popularity amongst the customers.

Product 2: Dried Mangoes in 50g packs				
Price per unit	5.50	6.50	11.50	12.50
BEP- Minimum production of 50g packs	6,368.61	4,815.29	2,169.53	1,954.72
Expected production	2,400.00	2,400.00	2,400.00	2,400.00
Total fixed costs	19,742.70	19,742.70	19,742.70	19,742.70
Profit	-12,302.70	-9,902.70	2,097.30	4,497.30

Product 2; Dried mangoes in 50g packs has a poor proposed price estimate. As seen in the table above, the proposed price is 6.50 ZMW. At this price, the profits are negative. Only at double the price do we see the gains in profit, with the BEP only reached at 90% percent of the production. The business would make a lot of great sense if the quantiles are increased and prices are set with a minimum difference with the 100g packs. It is in fact a common trend by most businesses to put prices of same products with different sizes with a minimum difference. Looking at the profitability of the 100g packs in the below table, it clear and an affirmation on how this economics of scales operates for such products.

Product 3: Dried Mangoes in 100g packs				
Price per unit	11.50	13.50	14.50	15.50
BEP- Minimum production of 100g packs	2,946.67	2,269.28	2,035.33	1,845.11
Expected production	24,000.00	24,000.00	24,000.00	24,000.00
Profit	276,000.00	324,000.00	348,000.00	372,000.00

For **product 3, the dried mangoes in 100g packs**, even when prices are set at lower than the proposed levels, the business still makes huge profits and BEP is reached at 12% the expected production. For such a business to be meaningful, it is recommended that the sales volumes are kept at high levels and mass production encouraged with a wide market base.

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 mango 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 Purchase of the solar driers, cooling freezers and cooling cabinets and cool boxes. For sustainability, introduction of varieties of mangoes that are good for such a business in terms of inputs for the plantation would be a great and welcome initiative. For a meaningful impact, Close monitoring of the use 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. Drying of the mangoes will use solar, while the other processes such as freezing will use electricity. The location of this business is Sefula where the area is connected to the national grid, however, in a production sense, electricity would be an expensive source of energy to use hence the need to diversify to solar or LPG sources which are readily available now even in western province. Wages are as realistic as possible and reflects the minimum wage on the ground. The wage bill fits the small business in its infancy.
- The innovation and the availability of the natural resource locally makes this business a viable entity. The author uses the easy but innovative ways of improving the products. Venturing in to this kind of business will definitely yield results and has minimum risks except for the product quality to satisfy the target market in super markets and also to compete with other players. If help of any form of financing is to be rendered, using a multi-tier approach in interventions would be more commendable to help the business gradually grow.

6.2 General remarks and recommendations

- There is need to empower the local actors in the value chain and supply to help increase the quantities that are supplied on the market to increase the incomes of the farmers. One approach is establishment of organization of farmers or producers to help strengthen the market.
- Given that mango is extensively produced in Western province, the development of value addition especially through processing is imperative. The mango market is a viable sector that needs more investments specially to boost the scale of the processed products to enable the small holder farmers to strive.
- Campaign among local lodges to buy locally produced mango (mango served as a special breakfast in the season or as a welcome dish during the season).
- Organizing local Mango festival to increase awareness and higher consumption of mango. This could be particularly linked to local mango varieties that would lead to higher diversity of fair for mango (fruits as well as local special recipes).
- Improving agro-technology of mango planting, e.g. regular pruning for smaller quantity but bigger fruits.

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Annexes

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

M Mukande Business Solutions-Delicious Barotse Fresh& Dried Mangoes Muuba Mukande					
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) Christian Empowerment Micro Finance	Loans in different value chains	Akamandisa Sitali	Accountant	+260 974445535	Mongu
6) African Development Bank Zambia	Spur sustainable economic development and social progress	Ms Mary Monyau	Country Manager	+260 211 257868 Fax: +260 211 257872	Lusaka
7) Development Bank of Zambia	Support farmer development projects			+260 211 228 577 +260 211-425501 dbzmail@dbz.co.zm	Lusaka
8) 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	Lusaka
9) Zambia Development Agency	Promote and facilitate investment, trade and enterprise development in Zambia.			+260 211 220177 +260 211 223859	Lusaka
10) 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					

M Mukande Business Solutions-Delicious Barotse Fresh& Dried Mangoes Muuba Mukande					
Institution	Relevance	Contact /Focal point person			Location
		Name	Position	Phone/Email	
1) Kondwani Nurseries LTD	Suppliers of tree plants (Exotic Mangoes, Paw Paws, Lemons, Hass Avocados etc)			+260 979728952 konwaninurseriesltd@gmail.com	Lusaka
2) Annecha Garden and general dealing	Suppliers of all types of tree plants including mango trees			+260 979618464	Ndola
3) Lutawo paradise garden	Suppliers of all types of tree plants including mango trees			+260 978073434 lutawoparadise@gmail.com	Lusaka
4) Plant a million Zambia	Suppliers of tree plants including Mango seedlings	Emanuel Chibesakunda	CEO	+260 211257800 +260977610450 +260 977610450	Lusaka
5) Sonas, Indian engineering machinaries	Suppliers of agriculture machinery	Patel	Marketing manager	+260 977454499	Lusaka
6) Lamasat international LTD	Suppliers of water tanks and pipes			+260 973926814	Lusaka
7) AgroZ	Suppliers of shade nets, Storage bags			+260 962535400	Lusaka
2) 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
9) SARO	Agriculture machinery and Equipment			+260 211 241477	Lusaka
10) Farmers' Barn	Suppliers of all types of chemicals and agro inputs for tree plants and many other crops			+26 0 97 5457601	Lusaka
Agricultural Commodity Processors and buyers					
1) Shoprite Chain stores	Retail supermarket. Buys and sells from local and international commodities (Mangoes and cashew and cassava).			+260 217 221 623	Mongu
3) 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

2. Product certification manual



PRODUCT CERTIFICATION MANUAL FOR: MANGO PROCESSING

(Mango Juice, Fresh Mango Slices, and Dried Mango Pieces)



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INTRODUCTION

Mango, *Mangifera indica* L., is one of the most celebrated of tropical fruits. The mango tree is erect, 10-30 m high, with a broad, rounded canopy which may, with age, attain 30-38 m in width, or a more upright, oval, relatively slender crown. In deep soil, the taproot descends to a depth of 6 m, the profuse, wide-spreading, feeder root system also sends down many anchor roots which penetrate for several feet. The mango tree is generally long-lived and continues fruiting even beyond 100 years old. According to the Food and Agriculture Organization of the United Nations (FAO), mango is the dominant tropical fruit variety produced worldwide, followed by pineapples, papaya and avocado. Developing countries account for about 98 percent of the total production of tropical fruits, while developed countries account for 80 percent of world import trade of tropical fruits. Global demand for mangos has continued to increase due to the increasing health consciousness and more widespread awareness of the nutritional benefits of tropical fruits.

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 group certification.

There is a growing trend in the market interest or demand 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 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 customer or 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 of the United Nations (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 the requirements for product certification. It applies to fresh mango (whole or sliced) and dried mango slices intended for human consumption.

PREREQUISITES 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 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.

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.

Key elements of GAP/GHP/GMP

According to the Food and Agricultural Organization (FAO), the following prerequisite components are common to the GAP, GHP, and 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 a 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.

In order to get good quality mango products, harvesting and post-harvest conditions must be established and maintained. Below is a guide as per East African Standard:

CONDITIONS FOR HARVESTING AND STORAGE

Harvesting

Mangoes should be picked at the stage of full maturity. In the case of mangoes to be stored for later consumption or processing, harvesting should be carried out just prior to maturity. The principal criteria which may be used to determine the optimum stage of harvest maturity are as follows;

- a) The firmness of the flesh: judged by a fruit pressure tester.
- b) Skin colour: fruits are harvested when the deep green colour of the skin is just beginning to become lighter. For pickles, green fruits are preferable to maintain acidity.
- c) Age: expressed as the number of days elapsed since full flowering.
- d) Total soluble solids content: measured by a refractometer at 20 °C (see ISO 2173) or at room temperature with the application of the corresponding temperature correction.
- e) Acidity: measured by titrating the mango juice with an alkaline solution (see ISO 750).
- f) Flesh colour.
- g) Relative density.
- h) Shape: mangoes with full cheeks are harvested.

The values obtained from these criteria are not universally valid; for a given variety they vary from one region to another and it is for the grower to decide on his own criteria for picking, on the basis of experience.

Quality characteristics for storage

Fruit to be put into storage should be sound, free from blemishes, bruises or obvious physiological disorders, and free from any visible sign of fungal or bacterial attack. It should be clean, and free from traces of water and dirt.

Optimum conditions of storage

Without refrigeration, mangoes may be stored in well-ventilated premises at a temperature of $30\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. The relative humidity should be between 60 % and 85 %.

With refrigerated storage, pre-cooling is necessary. Pre-cooling is recommended when the fruit is to be kept for long periods, and the final temperature should be reached within a maximum of 3 days to 4 days.

Storage life

Depending on the type of storage may range between 3 to 5 weeks.

It is necessary in every case that storage is not prolonged beyond limits compatible with the maintenance of good quality.

It is essential to draw samples of the fruit periodically so as to allow detection of any deterioration which may be taking place during storage.

Fruit may be ripened by the application of ethylene at a temperature between $21\text{ }^{\circ}\text{C}$ and $24\text{ }^{\circ}\text{C}$.

CONDITIONS FOR PROCESSING

Raw materials and ingredients

Raw materials for processing shall not contain parasites, microorganisms, toxins, and decomposed or extraneous substances.

Tropical fruit

The Mango fruit variety to be used for processing shall be prepared from sound, clean, mature fruit and is of a quality fit to be sold fresh for human consumption. The tropical fruit shall be inspected and sorted according to quality before processing

Food additives

All additives shall conform to the food standards required by the Codex Alimentarius Commission and the Food and Drugs Act/ Food Safety Act.

Water

Only clean, potable water shall be used for the preparation and for all the pre-treatment and processing steps of beverage production.

Packaging materials

The packaging materials should be appropriate for the product to be packed and for the expected conditions of handling during distribution and storage. These should provide the products adequate protection from contamination and should be sufficiently durable to withstand mechanical, chemical and thermal stresses encountered during processing and normal distribution. All packaging materials must be clean and free from defects that may affect the product or package integrity. These shall be stored in a clean and sanitary manner.

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 product, 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** arrange 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 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 424: 2004 Mango juice - Specification

Specifies the requirements for liquid mango nectar also referred to as mango juice.

ZS 938: 2016 Mangoes – Specifications

It applies to varieties of mangoes grown from *Mangifera indica* L., of the Anacardiaceae family, to be supplied fresh to the consumer, after preparation and packaging. Mangoes for industrial processing are excluded.

ZS 939: 2016 Mangoes – Cold storage

It gives guidance on conditions for the successful storage of the more usual varieties of mangoes (*Mangifera indica* Linnaeus) for fresh consumption and for processing into various products.

ZS 1180 Dried Mangoes - Specification

This standard applies to dried mangoes from varieties (cultivars) grown from *Mangifera indica*, intended for direct consumption or for food when intended to be mixed with other products for direct consumption without further processing. It does not apply to mangoes for industrial processing.

ZS COMESA 022 2004 Canned Mangoes

Applies to canned fresh mangoes

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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