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NAMIBIAN AGRONOMIC BOARD

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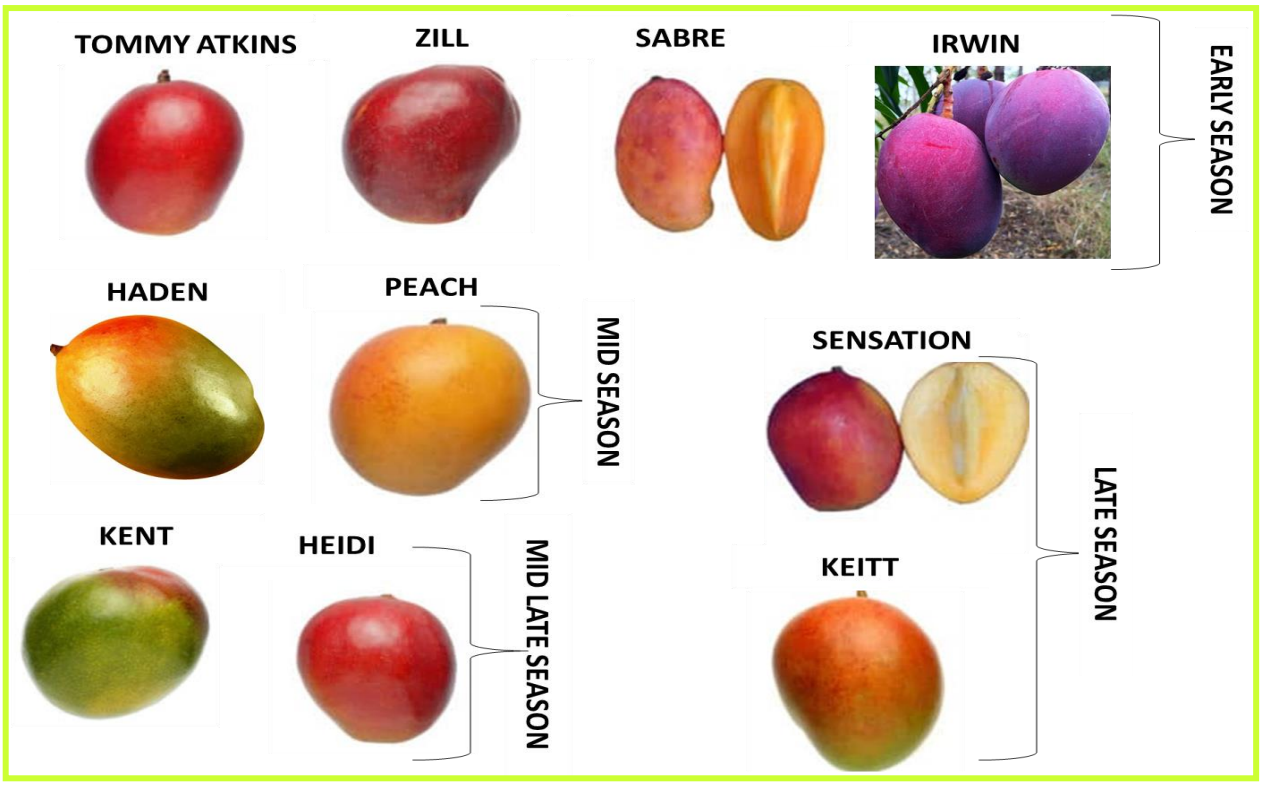
AGRONOMY AND HORTICULTURE MARKET DEVELOPMENT DIVISION

MANGO VALUE CHAIN ANALYSIS: THE CASE OF NAMIBIA



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ABSTRACT

This study investigated Namibia's mango value chain. Eighty (80) value chain actors including nurseries, orchards, and traders were interviewed using structured questionnaires. Data were analysed using descriptive statistical tools. More than 51,000 mango seedlings are supplied by local nurseries annually, whilst over 13,200 mango seedlings were imported, though some orchards (53%) produce their seedlings. Namibia produces more than 1,662 tons of fresh mango fruits annually, whereas the formal market uptakes 569 tons (238 tons locally supplied & 331 imported). The study recorded an oversupply of mixed varieties of mango fruits, hence more than 81% of local production is marketed via informal markets, where value addition is lacking. Over 200 000 litres of mango juice worth over N$ 4 million is locally produced annually, using imported mango concentrates.

The study revealed multiple challenges within Namibia's mango value chain such as high fruit imports (formal market), high start-up capital costs and operation costs, absence of record keeping, oversupply of unidentified mango varieties (+51 000 seedlings annually), lack of local grafting, lack of value addition, weak industry affiliations, traditional production practices, lack of appropriate skills, non-compliance with regulatory requirements, low uptake of local mango fruits by the formal market, and loose government protection. Other challenges facing the mango value chain are fruit flies, poor fruit quality, high cost of locally grafted seedlings, inaccessibility to financing, long payback period, absence of regional mango collection points and pack houses, high transport costs, foreign competition, and complexity in obtaining import and export documents.

Given the mango favourable climate, land, and water availability in some parts of Namibia, the main opportunities to unlock the potential of the mango value chain were identified as the exchange of information with countries advanced in mango production and processing, importation of good quality planting materials for grafting, grafting mango seedlings locally, fruit import substitution, fruit export market, formation of strong associations or cooperatives and fruit processing (value addition).

The study recommends local grafting of mango seedlings, mango grower's capacity building programmes, mango trees variety identification programme, research trials, nurseries and orchards certification systems, proactive pests and diseases surveillance, tailor-made financing facilities and mango production and processing manuals. The study strongly recommends value addition, where surplus mango fruits should be processed into products such as concentrates, juice, canned/bottled mango, mango jam, mango cream/dessert, mango pulp, mango strips, mango chutney, mango chucks, and mango kernels/animal feed. Given the local over-supply of mango fruits, mango should be a Special Controlled Product at NAB. There should be active associations or cooperatives with collection points/pack houses and processing facilities at Karst, Zambezi, Kavango and North-central production zones.

Key Words: *Mango, value-chain, Namibia, mango orchards, mango seedling suppliers, traders, value addition*

ABBREVIATIONS AND ACRONYMS

Agribank	Agricultural Bank of Namibia
AMTA	Agro Marketing and Trade Agency
FOAOSTAT	Food and Agriculture Organization Corporate Statistical Database
GAP	Good Agricultural Practice/s
HACCP	Hazard Analysis Critical Control Point
ITC	International Trade Centre
MAWRL	Ministry of Agriculture, Water and Land Reform
NAB	Namibian Agronomic Board
NDA	National Department of Agriculture, South Africa
NSA	Namibia Statistics Agency
SAMGA	South Africa Mango Growers Association
SARS	South African Revenue Service
VCF	Veterinary Cordon Fence
WFP	World Food Programme
ZAMAFA	Zambezi Mango Farmers Association

1 INTRODUCTION AND BACKGROUND

Tropical and sub-tropical fruits can make a significant direct contribution to small-scale farmers by providing locally generated nutritious food and income (Honja et al., 2017). Mango is one of the most widely cultivated and globally traded tropical and subtropical fruit trees in the world (Honja, 2014), with U$ 500 million worth of mangoes exported each year (Griesbach, 2003). As it ripens at the end of the dry season and the start of the rainy season, mango is a fundamental source of nutrition for rural populations, providing a crucial source of micronutrients, vitamins, and other phytochemicals and phenolic compounds that play an integral part of human wellbeing and evolvement (Pham et al., 2022). Mango (*Mangifera Indica*) is a fleshy stone fruit belonging to the panes Mangifera, consisting of numerous tropical fruiting trees in the flowering plant family Anacardiaceae (Honja et al., 2017). It is produced in most frost-free tropical and subtropical climates, whereby more than 85 countries in the world cultivate mango. The total production area of mango in the world is around 3.69 million hectares, whereas, the total world production is around 54.83 million tons (Statista, 2020).

A total value of almost N$194 million worth of the top 10 fruits was consumed in Namibia during the 2021/2022 reporting period, of which only about N$ 11.8 million (6%) is from local production (NAB, 2022). Mango is the 10th among the top 10 formally traded fruits in Namibia in terms of consumption value, of which its total consumption value was nearly N$ 5.5 million during 2021/2022.

Due to low mango production, Namibia is a net importer of both fresh mango fruits and processed products. Out of 569 tons of fresh mango fruits consumed by Namibia's formal market, 331 tons are imported mainly from South Africa. Out of 281 tons of fresh mango produced locally and marketed to formal markets, 43 tons (15%) were exported during 2021/2022. An average of 331 tons of fresh mango fruits was imported into Namibia at a value of about N$4 million during 2021/2022 as contrasted to 238 tons supplied to the local market.

Although mango has a significant contribution to the livelihood of small-scale farmers in the country and plays a potential role in the creation of business and employment opportunities, its value chain analysis has not yet been conducted from the production point in Namibia to different spatial markets. Mango fruits have both local and export markets, as well as processing opportunities.

Therefore, this study investigated the mango value chain from production to markets and further identified constraints and opportunities along the supply chain to the end consumer. The study was conducted by the Namibian Agronomic Board (NAB) in partial fulfilment of its strategic objective to provide comprehensive and efficient information services on agronomy and horticulture through applied research. This study focused on mangoes meant for commercial purposes and not household production or consumption.

2 PROBLEM STATEMENT

The production of mango is common both at the household and commercial levels in the northern and northern-eastern regions of Namibia. However, the presence of fruit flies in these regions hampers the marketing of mango fruits across the country, beyond the veterinary cordon fence (VCF). On the other hand, Namibia is a net importer of both fresh and processed mango products, importing over N$4 million worth of fresh mangoes per annum, and no data is available on processed mango products being imported. In terms of volumes, Namibia imported 331 tons, whilst domestic producers only contributed 238 tons to the total national consumption of 569 tons of mango fruits per annum (NAB, 2022).

The competitiveness of Namibia's mango fruits industry is sluggish, evidenced by a high annual import share of over 58% of consumed mangoes through the formal market, whilst informal market trades often go unrecorded. Mango is the fourth most exported fruit by Namibia, after grapes, dates, and blueberries (NAB, 2012). On another note, mango is one of the exotic fruit trees that seem to be well adapted to most soils and climatic conditions in Namibia, but there is limited information on the local value chain, thereby making it difficult for developmental interventions. For instance, it has been unknown whether farmers are growing the right mango varieties that the consumer requires. Therefore, the main aim of this study was to investigate the mango value chain, identify constraints and opportunities for production, processing, and marketing in Namibia and elsewhere, and further make recommendations that will stimulate the development of the mango value chain.

3 RESEARCH OBJECTIVES

- ✓ To quantify the current status quo of mango production, storage, value addition, and marketing in Namibia.
- ✓ To analyse the distribution of margins along the mango value chain (where possible).
- ✓ To examine and understand important production constraints and identify opportunities for improving mango production, storage, value addition, and marketing.
- ✓ To suggest recommendations on what should be done to stimulate the growth of the mango industry in Namibia.

4 SIGNIFICANCE OF THE STUDY

Organising and developing a value chain for sustainability requires detailed value chain analysis. Mango value chain analysis can therefore bring about national competitiveness at both domestic and international markets, promote entrepreneurship, promote both local production and formal market

participation by local producers, processors, and traders; reduce reliance on mango imports; and consequently, contribute to improved livelihoods, national food security, and economic growth.

5 METHODOLOGY

5.1 STUDY DESIGN AND LOCATION

A mixed research approach was used and this was based on both deductive and inductive philosophies. Secondary data were collected from the literature, whereas, primary data were collected through value chain actors' field surveys using semi-structured questionnaires. Mango value chain actors consulted include nurseries, mango growers, and traders. A telephone interview approach was also used for follow-up questions with respondents to collect information that was not obtainable from primary study respondents. This study covered all seven (7) production zones (Central, Karst, Kavango, North Central, South Central, Far-south Orange River, and the Zambezi) in Namibia.

5.2 POPULATION, SAMPLING STRATEGY, DATA COLLECTION, AND ANALYSIS

The population of mango growers was not fully known at the time of commissioning this study, hence, the population of 291 actors in the fruits sub-sector of horticulture, which includes 204 fruit growers, 80 traders, and 12 suppliers of seedlings was relied on, from which respondents for the study were sampled. Since the mango value chain is not yet so well organised in Namibia, purposive sampling and snowball sampling strategies were employed to identify key informants at all 7 production zones.

At least eighty (80) interviews were successfully conducted, namely, 16 seedling suppliers (nurseries), 42 mango growers, and 22 traders. Structured questionnaires were used to obtain primary data within Namibia's mango value chain. The questionnaires covered matters related to production, value addition, storage, industry affiliation, industry protection, regulatory compliance, and marketing of mango in Namibia, including constraints and opportunities. Microsoft Excel was useful in analysing the field-collected data, whereas the value chain mapping model was instrumental to present the results of the study.

6 RESULTS AND DISCUSSIONS

This section presents, illustrates and discusses the results obtained from the mango value chain analysis in Namibia. Detailed information ranges from production information, regulatory compliance and industry protection, financing information, marketing and price information, training, and industry affiliations to the opportunities and constraints within the mango value chain in Namibia's context.

6.1 PRODUCTION INFORMATION

The production information subsection entails the analysis of mango's optimal soils, climate and elevations, seedlings (production & supply), trees (number, yields & varieties), seedlings and fruits cost of production and lastly, the handling, value addition, and transportation of mango fruits.

6.1.1 Soils, Climatic Conditions, and Elevations

Mango prefers well-drained deep sandy or loam soils, preferably with 25% clay content and pH ranging from 5.5 to 7.5, whereas rainfall ranging from 500mm to 1000mm annually can be sufficient (SHE PLUS, 2019 & Griesbach, 2003). Mango trees are capable of tolerating various climatic conditions such as swampy, very hot, or low to moderate relative humidity (National Department of Agriculture [NDA], 2010). Griesbach (2003) also indicates that "Mango is relatively tolerant of drought, occasional flooding and poor soil conditions" (p.12). Slaven (2017) similarly proffers that mango trees tolerate dry conditions, waterlogging and moderate salinity. However, for optimal growth and yield, the temperature in winter should not fall below five degree Celsius (5^{o}C) and they grow well in the temperature range of 27^{o}C and 36^{o}C degrees (NDA, 2010).

As shown in Figure 1, areas with an average minimum temperature of below 5^{o}C during the coldest month and a high average number of frost days per year are riskier to plant mango trees according to NDA (2010). In terms of both temperature and frost, Northern, North-Eastern, and Far-Southern areas seem to be best suited to grow mango in Namibia when compared to South-Central and Central areas, provided there is water for irrigation. Hence, mango is rarely grown in Central and South-Central production zones due to their frost and extremely low-temperature susceptibility. At least one mango plantation exists in the Far South and Orange River production zones.

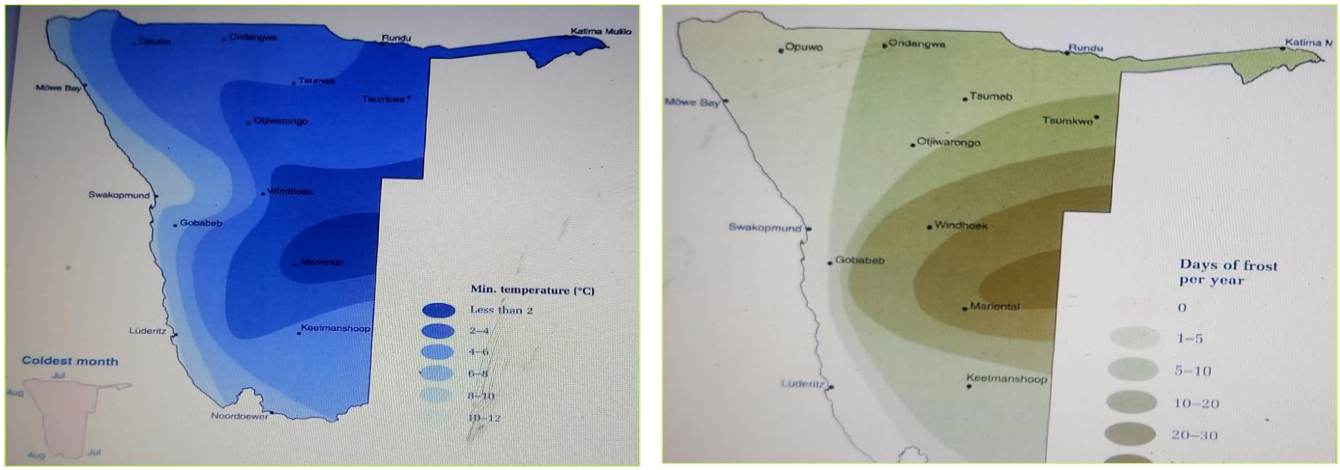

Figure 1: *Minimum average temperatures in the coldest month and average days of frost per year*
Source: *Mendelsohn et al. (2002)*

According to NDA (2000), mangoes are grown in various altitudes from 350m to 1200m above sea level, however, areas above 600m above sea level are regarded as not commercially viable in South Africa. Nonetheless, other literature argues that mangoes can optimally grow from sea level up to 1500m above sea level (Shep Plus, 2019). Except for Windhoek, the altitudes of major towns in Namibia fall below 1500m above sea level as illustrated in Figure 2.

Figure 2 illustrates how elevated the towns in which the horticulture production zones are found are. The lower the altitude, the more viability of mango production, provided there is water and suitable soil (NDA, 2010). Nonetheless, high windy areas like Henties Bay might not be suitable due to fruit damage as some literature has alluded to.

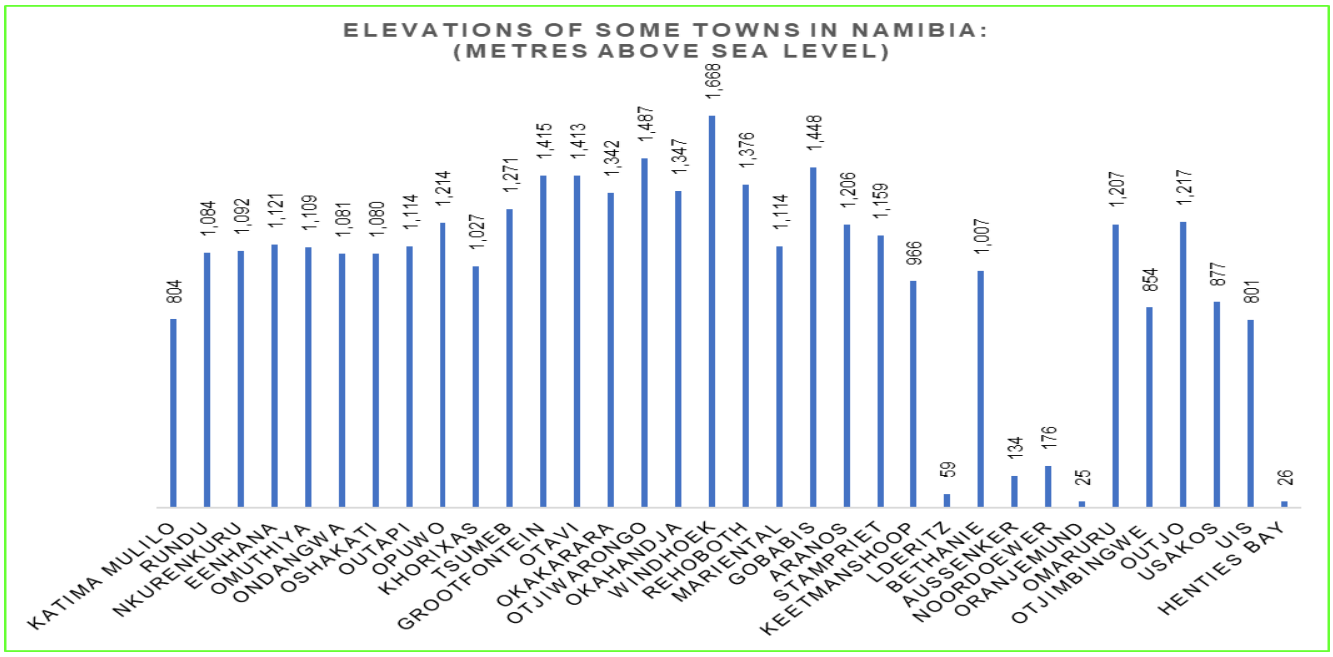

Figure 2: *Elevations of some major Namibian towns in meters above sea level*

Source: *Namibia Elevation and Elevation Maps of Cities, Topographic Map Contour (floodmap.net)*

6.1.2 Seedlings Production and Supply

The current study interviewed 16 nurseries, of which 15 are nursery owners (producers) and one is an agent for a nursery in South Africa. A combined area of 1.2ha at various production zones was revealed as under mango seedlings production. When asked about the availability of land for future mango seedling production expansion, surveyed nurseries indicated a total of 10ha of extra land available for seedling production expansion. More land could be available for seedlings production expansion as these numbers were just from 16 nurseries surveyed across the country.

About 56,586 mango seedlings (imports included) are supplied by 16 nurseries to local farmers annually. Out of these supplied mango seedling quantities, only nine percent (9%) or 5,200 mango seedlings were mentioned as imported per annum from South Africa. The average price of imported

mango seedlings is N$212.50 per seedling but it can go as high as N$250.00 per seedling depending on the variety. The average price for locally produced mango seedlings in communal areas is N$25.33 per seedling, whilst the locally grafted seedlings are priced as high as N$340.00 in the Karst production zone.

Based on Table 1, about 5,200 grafted mango seedlings are imported annually by Namibia, sold at N$212.50 on average, which translates into a total monetary value of N$1.04 million. Interestingly, one (at North Central) of the nursery owners imports mango seeds from abroad for producing seedlings and selling. About 50,686 mangoes are locally produced annually and sold at an average price of N$25.33 per seedling, which translates into a monetary value of N$1.33 million annually. Mango seedlings raised in the Karst production zone are grafted, hence they are sold at N$340.00 per seedling.

A total of six (6) local nurseries were revealed as producing a few mango seedlings by grafting, whilst 12 nurseries produce seedlings by direct seeding, including some of those using grafting. At least one nursery was found practising air layering. When asked about the irrigation types and technology they use in seedlings production, most nurseries indicated that they use manual, whereby hosepipes, buckets, and watering cans are mainly used. Only two of the surveyed nurseries were found using micro irrigation systems. Except for one that is operating under trees, all nurseries were found operating under green shade nets.

Table 1: *Number and value of mango seedlings imported and locally produced annually*

Production Zones	Number of Imported Grafted Seedlings	Number of Locally Produced Seedlings	Average Selling Price for Imported Seedling (N$/Seedling)	Average Local Selling Price (N$/Seedling)	Import Value (N$)	Local Value (N$)
Central	3,500	0	200	0	700,000	-
Karst	900	120	200	340	180,000	40,800
Kavango	0	15,270	0	36	-	549,720
North Central		22,340	0	23	-	513,820
Far South & Orange River	800	0	200	0	160,000	-
Zambezi	0	12956	0	17	-	220,252
Totals	**5,200**	**50,686**	**-**	**-**	**1,040,000**	**1,324,592**
Average Prices N$/ Seedling			**212.5**	**25.33 (excluding Karst)**		

6.1.2 Number of Trees, Yields, and Production Practices

Table 2 presents the enumerated total number of trees, hectares, and yields obtained by the orchards surveyed at each production zone. A total of 25,267 mango trees were enumerated at 42 orchards in various production zones in Namibia, except the Central and South-Central production zones. Out of 25,267 mango trees, 10,365 (41%) are young trees that are not yet bearing material yields, mostly younger than 5 years, whilst 14,902 (59%) trees are mature trees that are older than 5 years and bearing material yields. The majority of the farmers interviewed could not tell how big their mango orchards are because they never measured them, whereas mango trees are mixed with other trees on the same plot in some of the orchards, especially for small and medium-scale growers in the communal areas.

An aggregated area of 153ha is under mango production at 42 orchards in various production zones, where 37ha (280 trees/ha on average) account for immature trees that are younger than 5 years, whilst 116ha (129 trees/ha on average) account for mature trees that are normally 5 years and older. These numbers of trees per hectare seem to be too widely spaced.

Table 2: *Estimate area planted, number of trees, and yields obtained per production zone*

Production Zone	No of Young Trees	Area Under Young Trees (Hectares)	Number of Mature Trees	Area Under Mature Trees (Hectares)	Yields in Tons	Yield (Tons) per Hectare
Karst	1,030	3.00	130.00	1.3	15.5	12
Kavango	6,694	19.00	145.00	17	15.2	1
North Central	982	7.40	11,233.00	67.1	890.7	13
South & Orange River	0	0.00	800.00	10	33.6	3
Zambezi	1,659.	8.00	2,594.00	21	707.0	34
Total No of Trees, Yields, and Average	**10,365.00**	**37.40**	**14,902.00**	**116**	**1,662**	**14**
Total Number of Trees						**25,267**

According to Farmers' Weekly (2021), some of the improved mango varieties can be spaced as follows: 6m x 1.5 m (1,110 trees/ha) for the Tommy Atkins variety, 5m x 1m (2,000 trees/ha) for Keitt variety and 4m x 1m (2,500 trees/ha) for sensation variety to attain high yields per hectare. However, the productivity of mango trees does not only depend on varieties, age, and population (spacing) but also depends on several factors such as the quantity of the previous harvest, weather, soil condition, altitude, control of pests and diseases, and fertilization (Griesbach, 2003).

An estimated total annual yield of 1,662 tons of mango fruits was obtained by 42 orchards surveyed, hence the average yield of 14 tons per hectare. These annual yields of 1,662 tons revealed by

farmers are greater than Namibia's annual total consumption by the formal market, which was 569 tons of mango fruits during the 2021/22 reporting period according to the NAB data. Boston (2022) and Farmers' Weekly (2021), revealed that an average mango orchard yields an average of 18 to 85 tons of mango fruits per hectare depending on the age of the trees (Boston, 2022; Farmers Weekly, 2121). Although the yield of 14 tons/ha is not worse, this yield is quite poor when compared to the above-mentioned average yields of mango fruits per hectare.

As indicated in Figure 3, most of the mango tree population enumerated during this study was found in the North Central production zone, which is 12,215 trees (48%), followed by the Kavango production zone which has 6,839 mango trees (27%), Zambezi production zone with 4,253 trees (17%), Karst production zone with 1160 trees (5%) and lastly, Far South and Orange river production zones with 800 trees (3%). However, these numbers of mango trees exclude mango trees at Katima Mulilo town in the Zambezi production zone, which could not be enumerated due to the limited time that was available to carry out the survey. Katima Mulilo town was found to have mango trees in almost every townhouse yard, however, the study could not establish how many mango trees are there.

On another note, the high population of mango trees in the North Central production zone is mainly attributed to the 64ha of mango plantation in Etunda Irrigation Scheme, UNAM Ogongo Campus, and Orchards under the Directorate of Forestry, and this excludes mango trees at Mahenene research station as the data could not be obtained due to respondents' unavailability. On the other hand, the Kavango production zone has a big plantation of about 20ha with 6000 mango trees near Nkurenkuru town. Mango trees are likely to suffer from frost, and that could be the reason why they are not grown in high frost-risk areas like the Central and South Central production zones.

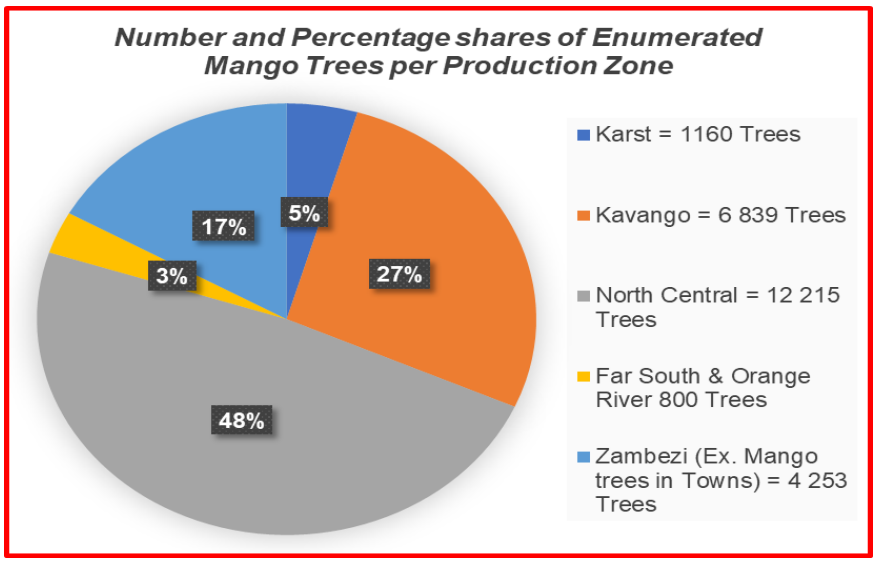

Figure 3: *Number and percentage share of enumerated mango trees per production zone*

When asked about the availability of extra land for future mango production expansion, surveyed mango growers indicated a total of 3,976ha as available land for expansion, of which 2,000ha was expressed by respondents in the Zambezi, 1,489ha in the Karst and 276ha in the Kavango production zone. Respondents in North Central and Far South and Orange river expressed 138ha and 73ha respectively as extra land available for expansion. More land could be available for expansion in these production areas as these numbers were just obtained from 42 mango orchards surveyed.

All orchards surveyed in the Karst and South and Orange River production zones are growing imported grafted mango seedlings only. Twenty-two (22) orchards in the North Central, Kavango, and Zambezi production zones purchased non-grafted seedlings from local nurseries, mainly from the Directorate of Forestry, as well as from private nurseries. Twenty (20) of the orchards surveyed collect mango seeds they buy from the retail shops or from the streets to make their seedlings for later transplanting, whereas two (2) of the surveyed orchards received donated mango seedlings from the Directorate of Forestry.

Hose pipes and buckets are the most used irrigation systems by small-scale orchards, whereas surveyed medium-scale orchards use micro jets and drip at various production zones. Only one orchard was found using centre-pivot irrigation in the Kavango production zone. Regarding the use of fertilisers, about 77% of surveyed orchards use organic fertilisers in growing mango trees, while 11.5% use unspecified inorganic fertilisers, and 11.5% use mixed farming (both organic and inorganic fertilisers). Due to different soil types and mineral properties, leaf and soil analysis are best to determine the type and quantities of fertilisers required as fertilisers may burn the mango trees (SHE PLUS, 2019).

6.1.3 Mango Varieties

According to the National Department of Agriculture [NDA], (2010), “many types of mangoes are cultivated in South Africa including Tommy Atkins (medium to large sized thick-skinned fruit), Kent (greenish-yellow sweet juicy fruit with fibreless flesh), Keitt (rounded oval-yellow fruits in colour with red blush) and Sensation (oval, oblique and less beaked fruits that are medium to small). The varieties like Heidi and others are also produced”. The South Africa Mango Growers Association (SAMGA) classifies mango varieties into early season (Tommy Atkins, Zill, Sabre, and Irwin), mid-season (Peach and Haden), mid-late season (Kent and Heidi), and late season (Sensation and Keitt).

Figure 4 below illustrates the main mango varieties produced in South Africa, Namibia being one of their retail export markets, as well as the mango varieties that are grown in Kenya which Namibian orchards may need to adopt. Cultivars produced in South Africa and their fruit size include Tommy Atkins (450-700g), Zill (230-400g), Kensington (>450g), Irwin (340-450g), and Neldica (400-500g)

described as early cultivars, whilst Kent (500-700g), Heidi (450-600g), Sensation (200-350g) and Keitt (400-500g) are described as late cultivars (NDA, 2000).

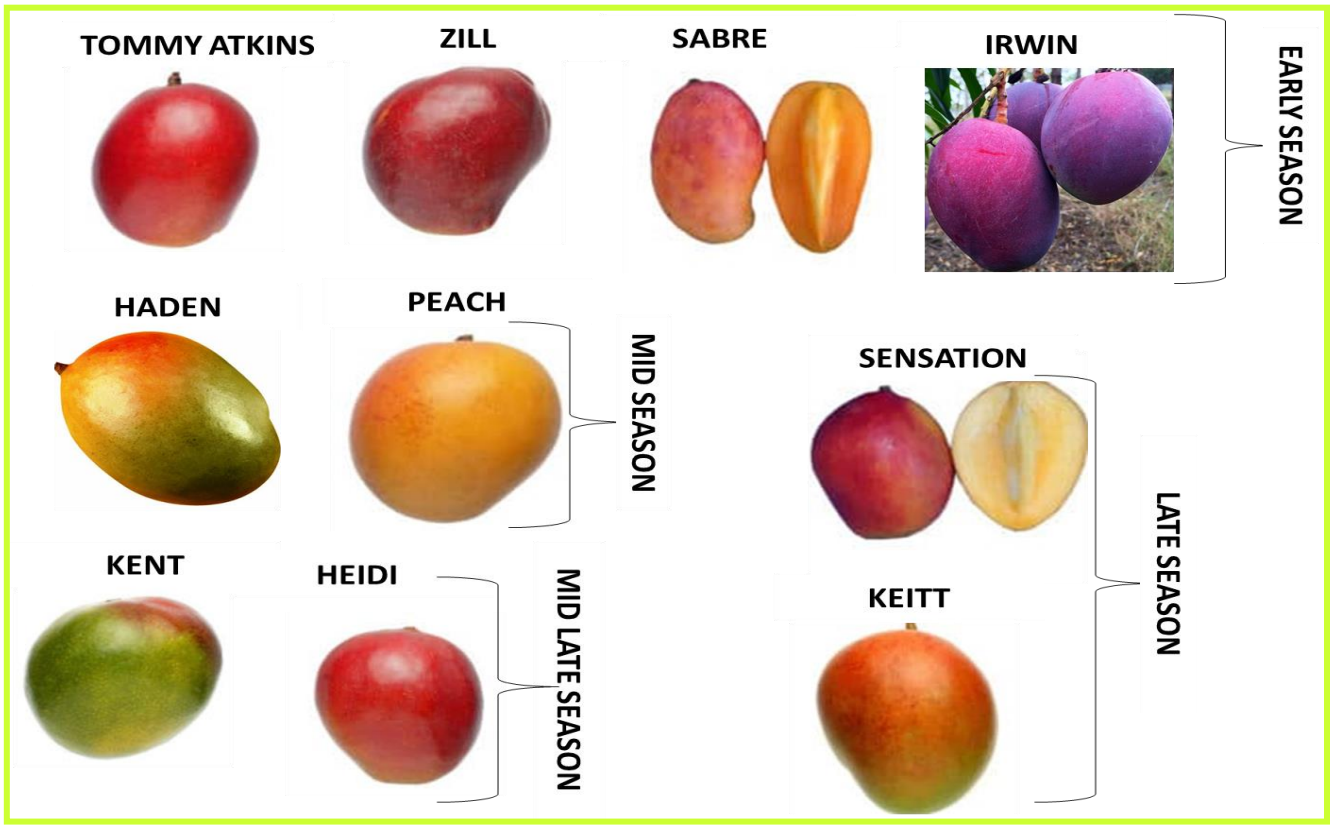

Figure 4: *Selected mango seasonal varieties*

Source: *SAMGA (2022) and* ***SHEP*** PLUS (2019)

"Mango fruits of various cultivars differ greatly in shape, size, appearance, and internal characteristics, with the quality of fruit-based mainly on the scarcity of fibre, sweetness, and minimum turpentine taste" (SHEP PLUS, 2016). Almost all of the nurseries and orchards surveyed in the North Central, Kavango, and Zambezi production zones do not label or know the type of mango varieties they multiply or grow, except for one large-scale mango grower in the Kavango production zone. One of the mango growers interviewed in the Zambezi production zone cautioned that mango growers should focus more on early mango cultivars so that they are not heavily affected by fruitflies. Traders surveyed did not also indicate being aware of the varieties they purchase by name but rather accept the fruits based on their size and orientation.

Figure 5 below illustrates the number of mango varieties supplied by 16 nurseries surveyed, irrespective of whether imported or locally produced. As presented in Figure 5, out of 56,486 approximate mango seedlings supplied by 16 nurseries annually, 50,616 (90%) are mixed or unidentified varieties; 2,800 (5%) are Tommy Atkins varieties, making it the most imported variety,

1,100 (1.9%) are Heidi, Kent 570 (1%), Keitt 650 (1.2%), Sensation 400 (0.7%), Van Dyk 300 (0.5%) and Joa 50 (0.01%). No seedlings of apple mango and Maya varieties were mentioned by any of the nurseries. Some cultivars such as Irwin, Kent, Neldica, and Keitt are recommended for hot dry areas in South Africa, whereas Tommy Atkins and Sensation cultivars are recommended for any production area. Heidi is described to be susceptible to sunburn in hot, dry areas and fruit size may reduce in extremely hot areas. Most nurseries surveyed (86%) are not aware of the Seed and Seed Varieties Act 23 of 2018. It was also discovered that only 14% of nursery operators surveyed are aware of this Act.

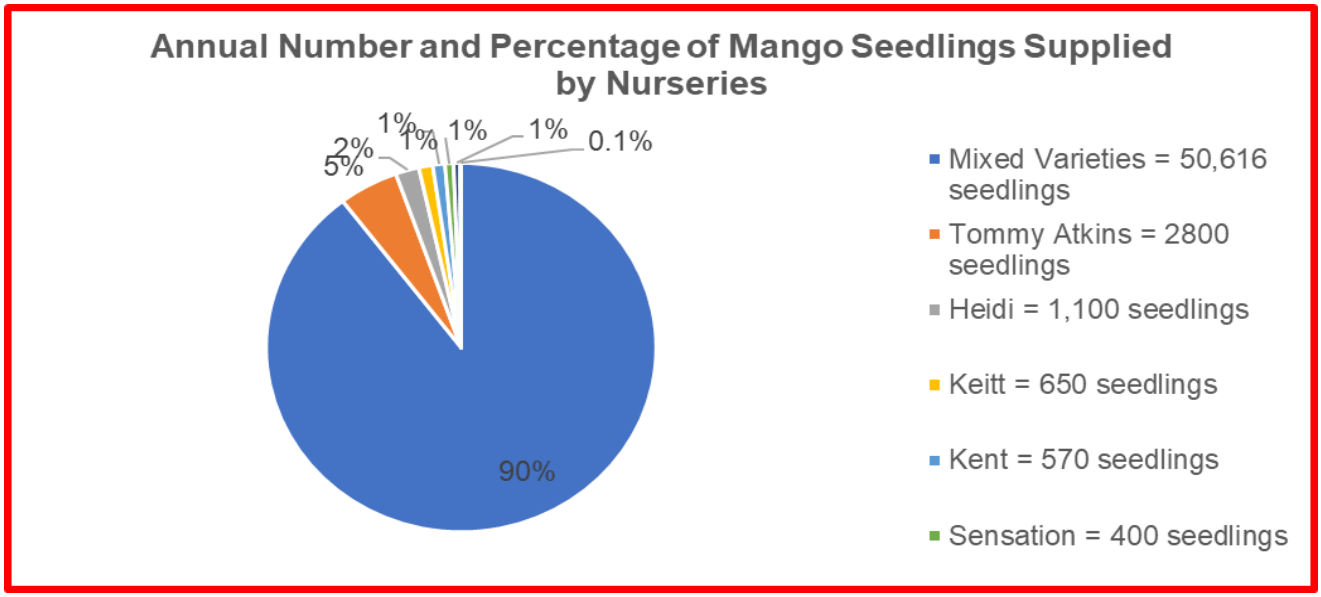

Figure 5: *Number and share of mango seedling varieties supplied by 16 nurseries*
Source: *Current survey data*

6.1.4 Average Cost of Production and Gross Margins

This subsection of the study estimated the average production cost incurred by nurseries, the average number of seedlings produced per nursery, and the average production cost incurred by mango orchards as presented in tables 3 and 4. Thereafter, gross margins were estimated for both the nurseries and orchards.

Table 3 presents the operational cost per seedling, the average operational cost per seedling, the average start-up cost per nursery, and the average number of seedlings produced by one nursery per year. On average, it costs about N$23.00 to raise one non-grafted seedling, whereas, at least an average nursery produces 3 549 seedlings per year. An average start-up cost of N$ 87,276.00 was incurred to start a fruit tree nursery, however, the start-up is shared with other types of trees raised in the same nursery with mangoes. The main components involved in the start-up cost of a seedlings

business are the nursery structure (net house), water infrastructure, transportation of sand, planting Polly pots, and irrigation tools.

Table 3: *Average production cost per seedling, start-up cost per nursery and seedlings produced*

Production Zone	Average Operational Cost Per Seedling: Ordinary trees	Average Operational Cost Per Seedling: Grafted trees	Average Nursery Start-up capital cost	Average number of seedlings raised per nursery
Central	_		N$ 280 000	-
Karst	_	N$ 300/ seedling	N$ 11 000	120 seedlings
North Central	N$ 14/ seedling	_	N$ 49 500	4468 seedlings
Kavango	N$ 27/ seedling	_	N$ 33 500	5290 seedlings
Zambezi	N$ 27/ seedling	_	N$ 62 380	4319 seedlings
Average	**N$ 23.00/ seedling**	**N$300.00/ seedling**	**N$ 87 276**	**3 549 seedlings per nursery**

Figure 6 presents the gross margin estimations for the nursery producing non-grafted seedlings and grafted seedlings. Considering the average number of 3 549 mango seedlings raised per year and a cost of N$ 23.00 per seedling, the estimated average total cost per nursery could be around N$ 81 627.00 per year and therefore providing an estimated total revenue of N$ 89 896.00/ha, hence a gross profit of N$ 8 269.20 (9.2%) for non-grafting nurseries. On the other hand, it costs about N$ 300.00 to raise a grafted seedling, where 3 549 could cost N$ 1,064,700.00, which is sold at a nursery gate price of about N$ 340.00 per seedling, therefore a total revenue of N$ 1,206,660.00 and hence a gross profit of N$ 141,960 per nursery (12%) for grafting nurseries. These calculations show that even though the grafted mango seedlings have higher investment requirement, it has more profit when compared to non-grafted mango seedlings.

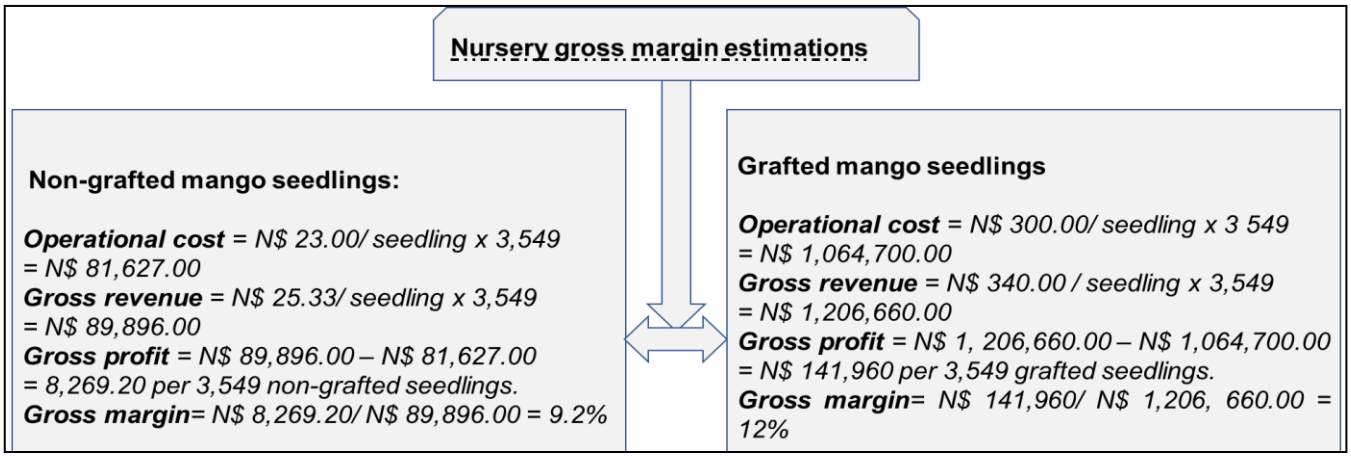

Figure 6: *Estimated gross margin for an average mango nursery*

Table 4 presents the mango orchard production costs in terms of average operational costs per hectare, average start-up cost per hectare, and the average mango tree population per hectare. On average it costs about N$ 19 553.00/ha to manage one hectare of mango trees per year, whereas, an

average hectare has at least 140 mango trees with average yields of 14 tons per hectare. The main contributions to the operational costs are labour, water bills, packaging material, electricity (some orchards), and transport. These production costs are perhaps underestimated due to orchards not keeping records, low plant densities at which farmers have planted and most orchards not applying fertilisers. In comparison to South Africa for example, an operational cost ranging from N$80,000.00 to N$90,000/ha is experienced depending on the plant density (Farmer's Weekly, 2021). High-plant density increases the chances of high yields for more returns and it encourages a farmer to prune the trees, which allows air and sun to reach all the tree's edges (Farmer's Weekly, 2013). Table 4 also shows that an average start-up cost of N$ 63 142.00 was incurred to start a hectare of mango trees. The main components contributing to the orchard start-up cost are fencing, tree seedlings, trench excavations, water infrastructures (water tanks, irrigation pipes, etc), inputs, and irrigation water for the first 3 years because there is no harvest yet.

Table 4: *Average operations cost, start-up capital cost, and number of mango trees per hectare*

Production zone	Average operations costs per orchard annually (N$/ha)	Annual average start-up capital cost per orchard (N$/ha)	Average mango trees population per hectare	Average yields (tons/ha)
Far-south & Orange River	9 333	–	80 trees/ha	12
Karst	6 850	100 000	270 trees/ha	1
North Central	26 942	50 383	164 trees/ha	13
Kavango	32 116	44 285	190 trees/ha	3
Zambezi	22 525	57 901	147 trees/ha	34
Average	**19 553**	**N$ 63 142**	**140 trees per hectare**	**14**

Figure 7 presents the gross margin estimations for a hectare of an average mango orchard. Considering the average yield of 14 tons per hectare, an operational cost of N$ 19 553.00 per hectare per year, and the average price of 10 425.00 per ton provides an estimated gross revenue of N$ 145 950/ha, hence a gross profit (excluding fixed costs) of N$ 126 397.00/ha (87%). These calculations show that an average mango orchard of a hectare is highly profitable in terms of gross profit *ceteris paribus* (holding constant all other factors/variables that can affect profit).

Mango fruits gross margin estimations

One Hectare Orchard (Assumptions):

Operational cost *= N$ 19 553.00*
Farm gate price *= N$ 10 425/ton*
Estimated Yield: *14 tons*
Estimated Gross revenue *= N$ 10 425 / ton x 14 = N$ 145 950.00/ha*
Estimated Gross profit *= N$ 145 950.00 – N$ 19 553 = N$ 126 397.00/ha*
Estimate Gross margin *= N$ 126 397/ N$ 145 950.00 = 87%*

Figure 7: *Estimated gross margin for one hectare of average mango orchard*

Figure 8 presents how each of the nursery operators and mango fruit producers perceives the rate of cost of production inputs at each production zone. The high cost of production inputs is mainly felt by many mango growers in the Karst, North Central, and Zambezi production zones, as well as by nursery operators in Karst and Kavango. However, only a few mango growers in Kavango and Zambezi perceive that the cost of production is low.

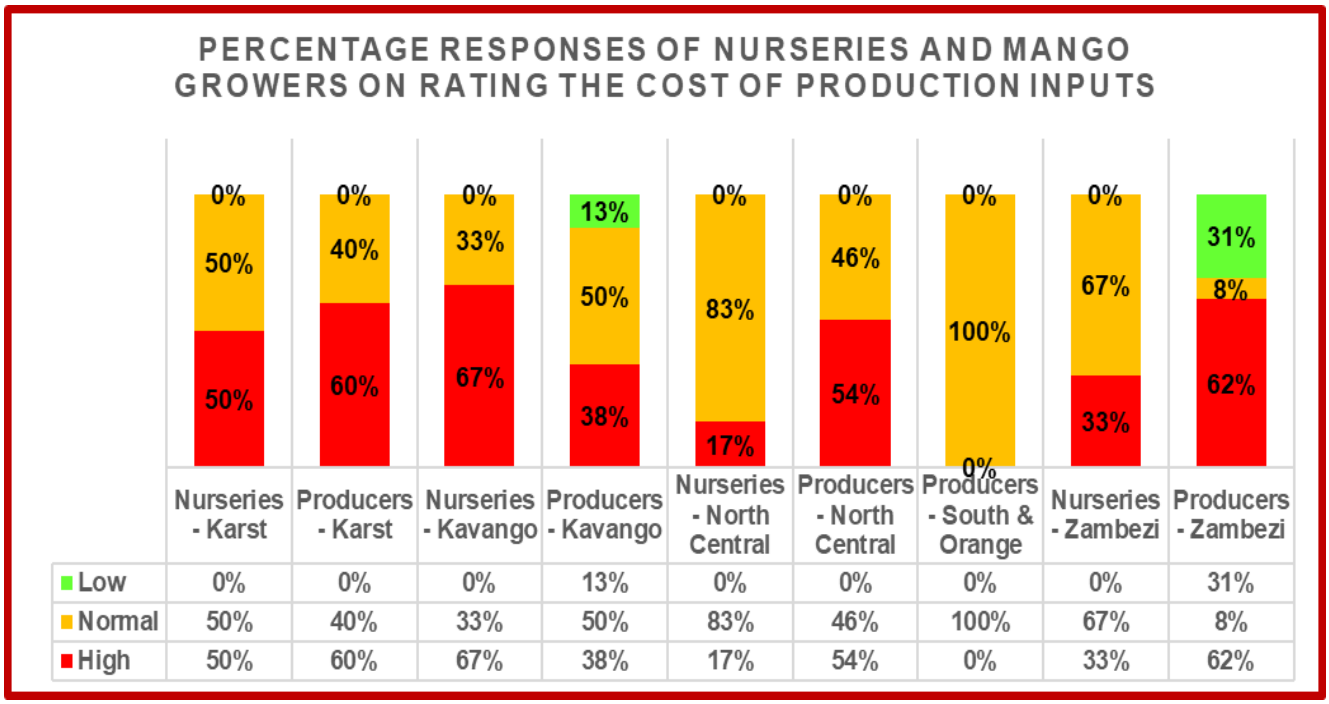

Figure 8: *Percentage of mango nurseries and producers' perceptions of production cost*

In terms of transport, most nurseries do not bear the cost of transport as usually the buyer comes to buy at the nursery, whereas, only a few provide their own transport and bear the cost when delivering seedlings to the buyers. However, in the case of mango producers, they mainly use their own or hired transport to take their mangoes to the markets. For mango producers that export immature pickle mangoes from the Zambezi region to South Africa, the buyer provides own transport and bears the costs.

6.1.5 Handling, Transportation, and Value Addition of Mangoes

Handling, transportation, and value addition are among the very important aspects of a successful crop value chain; hence the sampled mango value chain key actors were interrogated to enlighten their status regarding handling, transportation, and value addition to mango fruits.

a) Handling

Mangoes are harvested by hand and handled with care, and when breaking the panicles, the latex should not be allowed to drip on the fruit or other fruits as it can burn other fruits when packed into a

crate (SHE PLUS, 2019). In South Africa for instance, mangoes are packed according to various shapes before they are shipped worldwide, whereas, some are processed (NDA, 2010).

When survey respondents were asked whether they have packhouses, packing or sorting line facilities for their fruits, only 14% of the respondents were found with such facilities, whereas 86% did not have any packhouses, especially medium and small scale farms in the Northern and North-Eastern areas. All of the 22 traders interviewed indicated that they have refrigerated storage facilities for fruits at their business premises, except for one trader in the Kavango production zone who indicated having a warehouse/packhouse.

b) Transportation

Of the interviewed traders, 82% of them indicated that they have their own refrigerated trucks whereas the remaining 18% hire refrigerated trucks at an average of N$29.00 per kilometre. One of the traders argued that fruits do not always need immediate refrigeration and they can be transported at ambient temperature. The majority (88%) of the orchards surveyed indicated having their transport and bearing the cost whenever transporting mango fruits to the buyers, whereas, only 12% hire transport to take their mango fruits to the market.

For farmers that export pickle mangoes to South Africa, the foreign buyers provide their own transport and bear the cost. Transportation by road is the mode of transport used in Namibia's mango value chain. In South Africa, on the other hand, mangoes are transported by sea or air, in addition to the road, whereas for exports, ocean cargo is a long process but the cost is much lower. So, if it has to be sent by sea, the picking of mangoes has to be done quite earlier and shipped when they are relatively fresh (NDA, 2010).

c) Value Addition

A broad definition of value addition is to economically add value to a product by changing its current place, time, and form characteristics to characteristics more preferred in the marketplace, hence a process of changing or transforming a product from its original state to a more valuable state (Coltrain et al., 2000). All 42 mango growers interviewed indicated that they are not adding value to the mango fruits they harvest. Only one (1) out of twenty-two (22) traders/processors interviewed indicated having processed mango fruits into mango strips, jam, and juice but at a very small scale. The majority of surveyed traders (64%) do not import mango juice but rather buy from local processors who import mango concentrates for making the final product (juice) locally, whereas, only 36% directly import mango juice from South Africa. Table 5 in this paper presents the quantities and value of mango juice and concentrates imported into Namibia from South Africa from 2017 to 2018. On

average, 99,331 kg of mango juice and concentrates are imported per annum at an average value of N$ 1.05 million (SARS, 2018).

Table 5: *Mango juice and concentrates imported into Namibia from 2017 to 2018*

Year	Import Quantities (KG)	Import Value (N$)	Import Value per unit N$/kg
2017	28,574	333,231.00	11.66
2018	169,688	1,771,375.00	10.44
Average	**99,131**	**1,052,303**	**10.62**

Source: *SARS (2018)*

This study also attempted to gather precise data on the mango products manufactured locally and those exported. Unfortunately, most of the databases such as that of the NAB, NSA, FOAOSTAT, and ITC do not have the disaggregated data of the local manufacturing, exporting, and importing of finished mango juice and other finished products made out of mango fruits. However, four (4) main brands of juices were identified in the retail shops during this study, namely; Rietfontein from Namib Dairies, Liquid Fruit from Bokomo, Fruit Tree from Nam Breweries, and Vita Juice from Interpack. These brands import mango concentrates from South Africa to manufacture the final products in Namibia. Mango juice is among the top 3 fruit juices manufactured in Namibia, others being guava juice and orange juice. Although there are no specific data on the quantities of mango juice manufactured by each of the four (4) abovementioned main brands, research shows that 1kg of concentrate makes 4 litres of finished juice (0.1 litres of concentrate to 3.2 litres of water).

In reference to the kilogrammes of mango concentrates imported during 2017 and 2018 according to SARS (2018) and under the assumption that 50% of the imported mango juice and concentrate could be mango concentrates only, this study deduces that 57148 litres and 337376 litres of mango juice were manufactured in Namibia during 2017 and 2018 respectively, hence an average of 197 262 litres being manufactured per annum. As of 2022, the average price for the main brands manufacturing juice in Namibia was N$ 19.5 per litre of juice. Therefore, the domestic value of domestically manufactured mango juice was about N$ 1.1 million in 2017 and N$ 6.6 million in 2018, resulting in an average of nearly N$ 4 million per annum, as shown in table 6.

Table 6: *Estimated domestic bottling of mango juice from 2017 to 2018*

Year	Bottled Quantities (Litres)	Total Local Value (N$)	Local Value per unit N$/Liter
2017	57,148	1,114,386.00	19.50
2018	337,376	6,578,832.00	19.50
Average	**197,262**	**3,846,609**	**19.50**

Source: *SARS (2018) and various retail shops in Namibia (2022)*

In South Africa, mango fruits are processed into canned mango, mango pulp, mango juice, dried mangoes, frozen mango chunks, mango jams, and creams. Immature mango fruits (especially the fibreless types) known as achar fruits are sliced and salted and processed into various products like pickles and chutney (NDA, 2010). Figure 8 shows various value-added products of mango fruits, which Namibian mango producers may consider manufacturing or processing.

Figure 8: *Various value-added products made out of mango fruits*

Source: *Various internet sources*

6.2 REGULATORY COMPLIANCE AND PROTECTION

This subsection presents the level of compliance with regulatory frameworks and governmental protection required to safeguard domestic enterprises in the mango industry. These include certification of nurseries and trees, quarantine pests in production areas, food safety, quality assurance certification, and government protection needed by value chain members.

6.2.1 Registration and Certification of Varieties, Nurseries, and Orchards

Section (9) of the Seeds and Seeds Varieties Act No. 23 of 2018 requires a horticulture nursery to be registered whilst subsection (1) states that “no person may conduct or carry on the business of a horticulture nursery unless such a nursery is registered with the Registrar under this section”. For the nursery to be registered and certified, it must meet the prescribed requirements relating to

infrastructure, equipment, and technical ability and knowledge. Furthermore, a subsection of section (10) of the same Act requires any holder of a certificate of registration to “keep a complete record of origin or source of all planting material and performance a record of mother trees in the nursery”. Other aspects required of the nursery by the same Act include a layout plan, performance records, control of infectious and contagious insects, pests, and diseases affecting plants, as well as the stock, sales, and prices of planting materials.

Imported seedlings are also supposed to be only of the varieties entered in the Seed and Seed Varieties register and must comply with prescribed requirements and enter the country through the prescribed port of entry. Furthermore, the imported seedlings are subjected to the phytosanitary certificate from the exporting government or country and vice versa when Namibia is exporting (Plant Quarantine Act No. 7 of 2008). During the survey, enquiries were made with a Quarantine Officer who said that mango orchards in quarantined areas intending to export or sell fruits in protected areas are supposed to inform the Quarantine Officers in advance so that they can start with the surveillance to smoothen the certification process. However, only orchards that are 500m from the mango trees that are not controlled may qualify for surveillance, according to quarantine officials.

It is against the aforementioned that nursery operators and mango growers were asked to indicate whether their nurseries are certified or they have sourced from certified nurseries. The 81% of interviewed nursery operators confirmed that they do not have any certification and 75% of mango orchards surveyed indicated that they sourced from uncertified nurseries, whilst all imported mango seedlings are from certified nurseries in South Africa.

Table 7 shows the number of respondents with or without certifications in all categories as orchards in terms of sourcing mango seedlings, nurseries in terms of local production, and imported seedlings. Northern and North Eastern production zones, especially in communal areas, have the greatest number of uncertified nurseries and mango growers sourcing seedlings from uncertified nurseries. As was stated earlier under Section 6.1.4 of this report, 86% of nursery operators are not aware of the aforementioned Seed and Seed Varieties Act No. 23 of 2018.

Table 7: *Certification status of the orchards and nurseries surveyed*

	Producers: *Are the planted trees sourced from a certified nursery?*		**Nurseries:** *Are the imported mango seedlings from a certified nursery?*		**Nurseries:** *Is your nursery certified?*	
Production Zone	**Orchards with trees from certified nurseries**	**Orchards with trees from uncertified nurseries**	**Nurseries importing from certified nurseries**	**Nurseries importing from uncertified nurseries**	**Local nurseries certified**	**Local nurseries uncertified**
Central	0	0	0	0	2	0
Karst	2	1	1	0	1	1
Kavango	3	9	1	0	0	3
North Central	3	12	0	0	0	6
South & Orange River	1	0	1	0	0	0
Zambezi	2	11	1	0	0	3
	25%	**75%**	**100%**	**0%**	**19%**	**81%**

6.2.2 Quarantine Pests

Mango growers were asked whether there are any quarantine pests in the production areas or orchards. Table 8 below illustrates the number and percentage of interviewed orchards that experienced any quarantine pests. Thirty-one percent (31%) of respondents indicated that there are quarantine pests in their area or orchards, mainly those from communal areas. The quarantine pest referred to by mango growers is the fruitflies. Even though 69% of farmers interviewed have said there are no quarantine pests in their areas, it seems that they don't know or are not aware of the presence of fruit flies in their area. According to the Surveillance Officials from the Plant Health Division in the Ministry of Agriculture, Water and Land Reform (MAWRL), a surveillance that was carried out recently revealed that fruit flies were detected in North Central regions, North Eastern regions, and Otjozondjupa region (as far as Okahandja area). Hence fruit flies are a potential threat to the mango industry in Namibia.

Table 8: *Responses by mango growers regarding quarantine pests in orchards or production areas*

	Orchards: *Are there any quarantine pests in the production area or orchard area?*	
Production Zone	**Yes**	**No**
Karst	0	3
Kavango	3	9
North Central	5	10
South & Orange River	1	0
Zambezi	5	8
	31%	**69%**

According to NDA (2000), “mangoes can be severely damaged by female fruitflies laying eggs in the fruit and by the maggots (larvae) which then develop in the flesh of the fruit”. Fruitflies are controlled in a combination of four (4) methods, namely;

- ✓ Eradicating host plants (bug trees and brambles),
- ✓ Regularly removing all the mangoes dropped in orchards and destroying them,
- ✓ By use of traps that help in determining the fruitflies' population build-up by making weekly counts of the number of flies on the traps to justify chemical control, and
- ✓ Chemical control of adult fruitflies in mango orchards is based on the weekly application of poisonous bait on the trees, which is a mixture of insecticide, lure, and water (NDA, 2010).

The Plant Quarantine Act No 7 of 2008, Section 10 (subsection 1) stipulates that “The minister may declare, by notice in the Gazette, all or any part of Namibia or any land, areas or premises which is infested or suspected of being infected with any plant pest to be a quarantine area, either in respect of all pests or such pests are specified in the notice”. Subsection 2 (b) of Section 10 requires an owner or occupier of land within a quarantine area to take such measures as are imposed in the notice for the control or eradication of a pest specified in the notice. Section 11 of the same Plant Quarantine Act No 7 of 2008 stipulates that “The Minister may declare, by notice in the Gazette, any plant pest specified in the notice to be a quarantine that presents or is likely to be a threat to the production, trade in plants or plants products, including the products used or intended for propagation, or to the environment”.

Subsection 3 of the same Act requires that owners or occupiers of any land or premises who discover the presence of a quarantine pest on the land or premises to immediately notify a plant quarantine officer and furnish the plant quarantine officer with the information required. Due to the presence of quarantine pests in some areas as indicated in Table 4, it is highly significant for mango growers and other actors in the mango value chain to acquaint themselves with the Plant Quarantine Act No. 7 of 2008 in limiting the pest spread and pest damage and ensuring access to markets beyond their production areas.

6.2.3 Food Safety

Food safety is a key component of food security, whereas, food security exists when “all people at all times have access to sufficient, safe, and nutritious food to maintain a healthy and active life” (Namibian Food Safety Policy, 2014). Section 29 of The Namibian Food Safety Policy (2014) requires

business or service operators to be responsible for ensuring the traceability of products in their possession". All food business operators are required to implement Hazard Analysis Critical Control Point (HACCP) as per Section 43. In addition, Section 45 of the same policy requires farmers to implement Good Agricultural Practices (GAP) principles. It is against the above backgrounds that the key actors in the Namibian mango value chain were asked whether they have any food safety certification or system in place.

As shown in Table 9 below, 93% of orchards do not possess any food safety certification in place, whereas The Namibian Food Safety Policy requires all farms to implement GAP principles. At least 95% of traders interviewed have at least a food system in place, but not necessarily the HACCP as per the requirement of The Namibian Food Safety Policy. Most of the food safety certification systems possessed by traders are NAB Inspections certificates and a certificate of Good Standing from municipalities, while some have private certification systems in place.

Table 9: *Number and percentage of responses with food safety certification or system in place*

	Orchards: *Do you have any food safety certification or system in place?*		**Traders:** *Do you have any food safety certification or system in place?*	
Production Zone	**Yes**	**No**	**Yes**	**No**
Central	0	0	5	1
Karst	1	2	2	0
Kavango	1	10	5	0
North Central	0	14	4	0
South & Orange River	1	0	2	0
Zambezi	0	13	3	0
	7%	**93%**	**95%**	**5%**

6.2.4 Government Protection

Study respondents had mixed feelings when asked whether there is a need for any kind of Government protection along the mango value chain. Only 44% of nurseries responded in the affirmative when they were asked whether there is any kind of Government protection along the mango value chain. Whereas, 96% of farmers and 68% of traders interviewed indicated that there is at least a need for some kind of government protection for the local market. Various kinds of government protection needed as mentioned by each category of stakeholders are listed in Table 10 hereunder.

Table 10: *Suggested kinds of government protection needed in the mango value chain*

Nurseries	Orchards	Traders/ Processors
Locally produced seedlings' market protection	Market protection against dumped mangoes from South Africa	Control/regulate informal traders
Access to appropriate skills in mango seedling production	Control the smuggling of mangoes from Zambia	Assist farmers in importing quality plant materials (mango seeds or seedlings) to boost production
Subsidised training and exposure visits	Control the importation of mangoes infested with fruit flies from South Africa	Extend market share promotion to fruits
Assistance in accessing high-quality mango varieties materials that satisfy formal markets	Encourage local production by subsidizing inputs and infrastructures (seedlings, fencing, boreholes and irrigation systems)	Control borders and prices when borders are closed to avoid exorbitant local prices
Capacity building to promote grafting of mango seedlings locally to improve quality	Provide training, advisory, and expert services to local farmers	First, boost local production before considering local market protection
	Ease the process of issuing water permits for irrigation	
	Introduce Market Share Promotion (MSP)	
	Subsidize exposure visits regarding mango production and processing in other countries	
	Introduce mango production and processing targeted loan facility	
	More hands-on fruit fly regulation and control to guarantee markets.	
	Export market accessibility	
	Motivate local production by subsidizing infrastructure (boreholes & irrigation systems)	

6.3 FINANCING INFORMATION

Actors in the mango industry, namely, nursery operators, mango growers, and mango fruits traders were asked to reveal the source of capital used in financing the setup of their businesses as presented in Figure 9 hereunder.

In terms of nurseries, 63% used their funds, whereas, 37% are financed through donations from the Government and other organisations, and none of them borrowed from banking institutions or private investors. For mango orchards, 83% have used their funds to set up orchards while 17% received donations to set up orchards and none of them borrowed from banks or private investors.

Long payback periods from orchards, lack of loan collateral, and absence of a tailor-made loan facility were the main reasons that prevented mango orchard owners to borrow money for orchard establishments.

Regarding traders, 77% used their funds to set up their fruit trading businesses, 9% borrowed from the bank, 9% was financed by private investors, whilst 5% was established through donations.

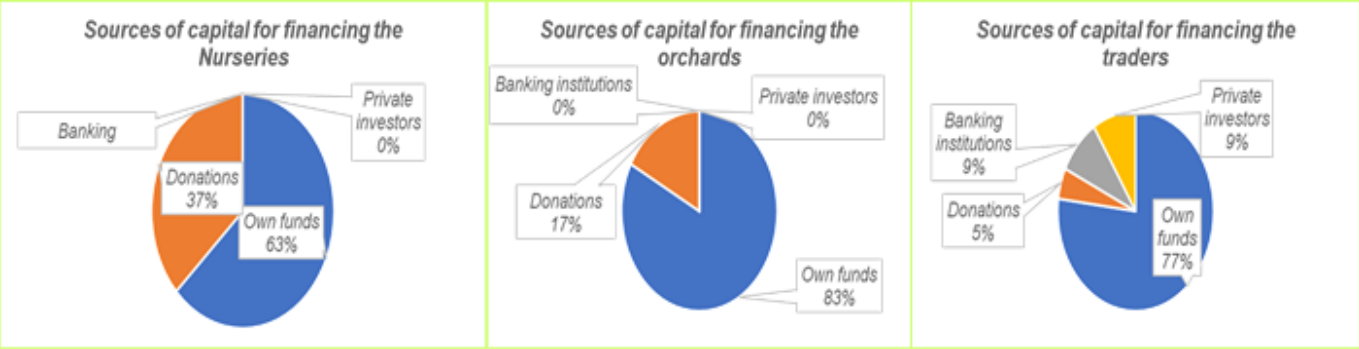

Figure 9: *Sources of capital used to finance various businesses along the mango value chain*

6.4 MARKETING AND PRICE INFORMATION

The marketing and price information is a subsection that presents the trade statistics and price information of mango seedlings, fruits, and juice as outlined under the following subsections.

6.4.1 Seedlings Marketing, Price, and Value

Table 11 presents the number and value of seedlings marketed from both domestic supply and imports. More than 63,085 mango seedlings were marketed in Namibia during the 2021/2022 production season, at a total value of more than N$2.6 million and this only accounted for the surveyed 16 nurseries.

The majority of the marketed seedlings, 50,686 (80.34%), were domestically produced and these were mostly ungrafted, whereas 12,400 (19.66%) seedlings were imported. The average prices per mango seedling were found to be different in various production zones, with the Zambezi region having the cheapest while Karst was the most expensive when it comes to selling mango seedlings.

Table 11: *Estimated number of seedlings marketed by 16 nurseries and producers during 2012/2022*

Production Zones	Locally Produced Seedlings			Imported Seedlings			Total No. of Seedlings Marketed	Total Value (N$) of Seedlings Marketed
	No. of seedlings	Average Local Value (N$/ Seedling)	Total Value (N$)	No. of seedlings	Average Import Value (N$/ Seedling)	Total Value (N$)		
Central	0		0	3,500	200	700,000	3,500	700,000
Karst	120	340	40,800	900	200	180,000	1,020	220,800
Kavango	15,270	36	549,720	8,000	50	400,000	23,270	949,720
North Central	22,340	23	513,820	0	250	-	22,340	513,820
Far South & Orange River	0		0	0		-	-	-
Zambezi	12,956	17	220,252	0		-	12,956	220,252
Total	**50,686**		1,324,592	**12,400**		1,280,000	63,086	2,604,592

Source: *Survey respondents (2022)*

6.4.2 Mango Fruits Marketing, Price, and Value

Table 12 presents the percentage of quantities sold to the informal, formal, and export markets during the 2021/2022 harvesting season by each production zone as disclosed by interviewed producers, traders, and from the NAB statistics. The informal market uptakes more than 80% of mangoes produced in the Zambezi, Kavango, and North-central production zones. Mangoes produced in the Karst production zone are predominantly sold to the formal markets, whereas, mangoes from the South and Orange River Production Zones are predominantly sold to export markets.

Table 12: *Percentage of markets supplied by orchards surveyed at each production zone*

Production Zone	Informal market (village/community/ street vendor/ open market)	Informal market (on-farm/farmgate stall	Formal market (dealers i.e. retailers, processors, agents, etc.)	Formal market (farmers' market or association's place)	Formal Market (production contract with distributors/ retailers)	Formal markets (GRN agencies i.e. AMTA)	Formal market (Catering companies)	Export markets
Karst	-	-	-	-	100%	-	-	-
Kavango	84%	3%	4%	8%	-	-	-	-
North Central	83%	15%	-	-	-	1%	1%	
South & Orange River	-	-	10%	-	-	-	-	90%
Zambezi	88%	3%	-	-	-	-	-	9%

Table 13 depicts that only 73 tons of mango fruits were disclosed as supplied to informal markets by 42 mango growers during the 2021/2022 harvesting season. However, the same growers gave a total estimated annual production of 1,662 tons as previously presented in Table 2. A total of 238 tons was sold to local formal markets, whereas, 43 tons were exported (NAB, 2022).

However, 331 tons were imported during the same season. In monetary terms, the marketed values were; local value (formal market) N$1.44 million, local value (informal market) N$949,000, import value N$4.02 million, and export value N$352,800. The informal market paid the highest price of N$13,000.00 per ton, whereas the local formal market paid the lowest price of around N$6,036.00 per ton.

Table 13: *Mango fruits traded during the 2021/2022 harvesting season*

Production Zone	Informal market (disclosed sales)	Formal market (local)	Formal market (import)	Export markets
	Quantity sold (tons)	Quantity sold (tons)	Quantity sold (kg)	Quantity sold (tons)
Karst *(2 growers)*	Not disclosed	Not disclosed	-	-
Kavango *(11 growers)*	7	-	-	-
North Central *(14 growers)*	43	0.264	-	-
South & Orange River *(1 grower)*		3.4	-	30.2
Zambezi *(13 growers)*	23	5	-	2
NAB data minus disclosed data	-	229.3	331	11
Total	**73**	**238**	**331**	**43**

Source: *Survey respondents and NAB statistics (2022)*

Average Prices (N$/ton):
Informal Market: ***N$13,000***
Formal Market (Local): ***N$6,036***
Formal Market (Import): ***N$12,140***
Formal Market: (Export): ***N$8,235***

Estimated Total Monetary Values:
Informal Market: ***+ N$949 thousand***
Formal Market (Local): ***N$1.44 million***
Formal Market (Import): ***N$4.02 million***
Formal Market: (Export): ***N$352,8 thousand***

6.5 TRAINING AND INDUSTRY AFFILIATION

This subsection explains the training opportunities offered to mango value chain members as well as the existence of relationships in the forms of unions or associations. Training and advisory services can be pivotal to the success of a value chain as they can improve effectiveness. Relationships in the value chains can also improve effectiveness and efficiency, reduce waste, reduce costs, and increase profitability (Dent & Collins, 2021).

6.5.1 Training Opportunities

Of the surveyed respondents, only 19% of seedling suppliers and 27% of the mango growers received training or mentorship from government extension services. Part of the 27% of training was offered by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the rest by the Directorate of Forestry, under the Ministry of Environment, Forestry and Tourism. The mango growers who were provided with training are mainly in communal areas. The training focused mainly on how to plant trees, how to graft trees, and how to set traps to control fruit flies. At least 59% of traders interviewed received training in this kind of business. Those involved in fruit and vegetable sections at retail shops are provided with in-service training on the handling of fruits and vegetables.

6.5.2 Value Chain Member Organisational Affiliations

Value chain members need to act in an interdependent way to address critical control points in the mango value chain, such as genetic materials (varieties), inputs, packaging, food safety, and other standards (Dent & Collins, 2021). These interdependencies will help in reducing costs, waste, and risk and increase effectiveness by focusing on what matters most. When chain members work together in partnership, their success is very hard to copy, and by so doing, this creates an advantage over competitors (Dent & Collins, 2021). The evolutional stages of partnerships of a value chain are classified as fragmented, cooperative, coordinated, or collaborative, hence it is important to understand at what point is the value chain along the journey of each partnership stage.

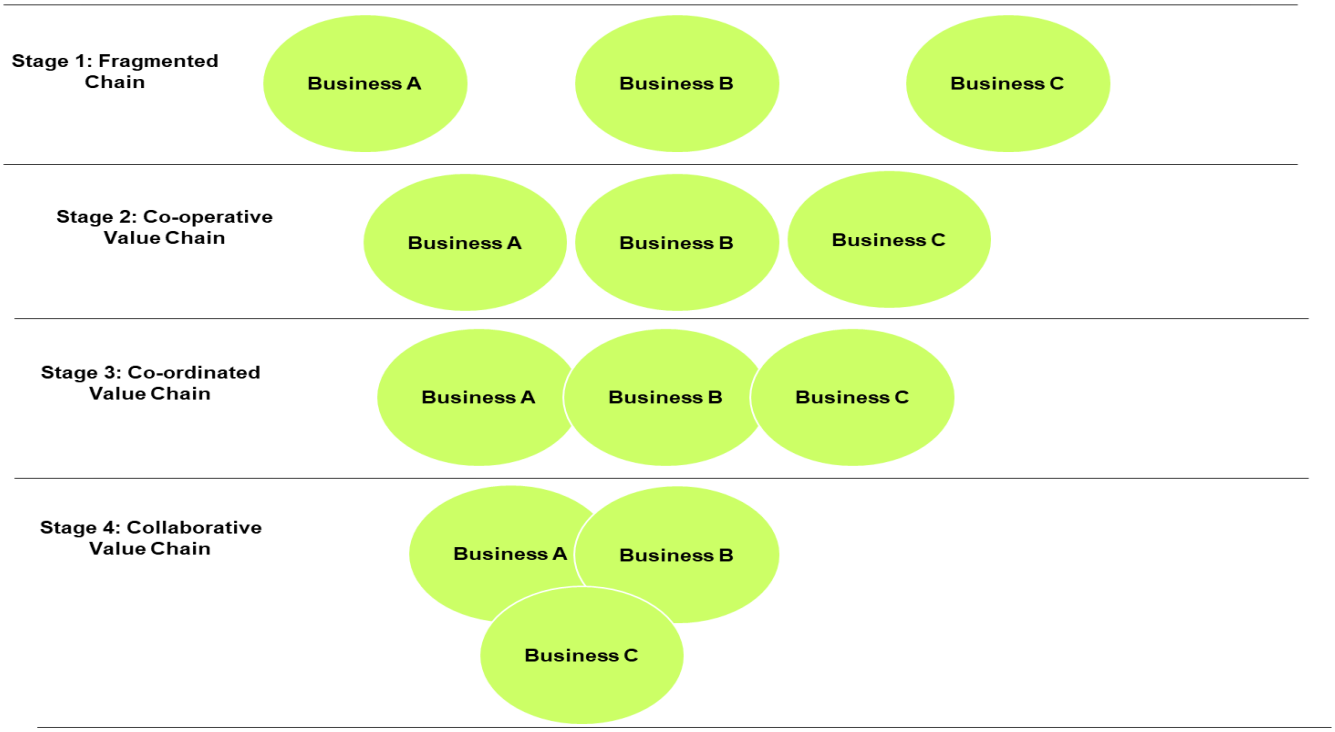

Figure 10: *Evolution of value chain partnership*

Source: *Dent and Collins (2021)*

The Namibian mango value chain seems to be fragmented, which could be the major reason why its growth is sluggish according to the responses as illustrated in Figure 11. Figure 11 presents the percentage of the responses, of which 100% of seedling suppliers, 95% of mango growers, and 73% of traders said that they are not a member of any fruit business association. The 5% of mango growers that confirmed belonging to the association are those in the Zambezi Mango Producers Association (ZAMAFA), which can be pronounced to be at stage two (cooperative) of the value chain evolution in partnerships (Figure 10). Even the traders who indicated being association members are

just members of the general fresh produce traders' association and not necessarily for mango or fruits. Traders who are members of the association benefit by accessing trade information.

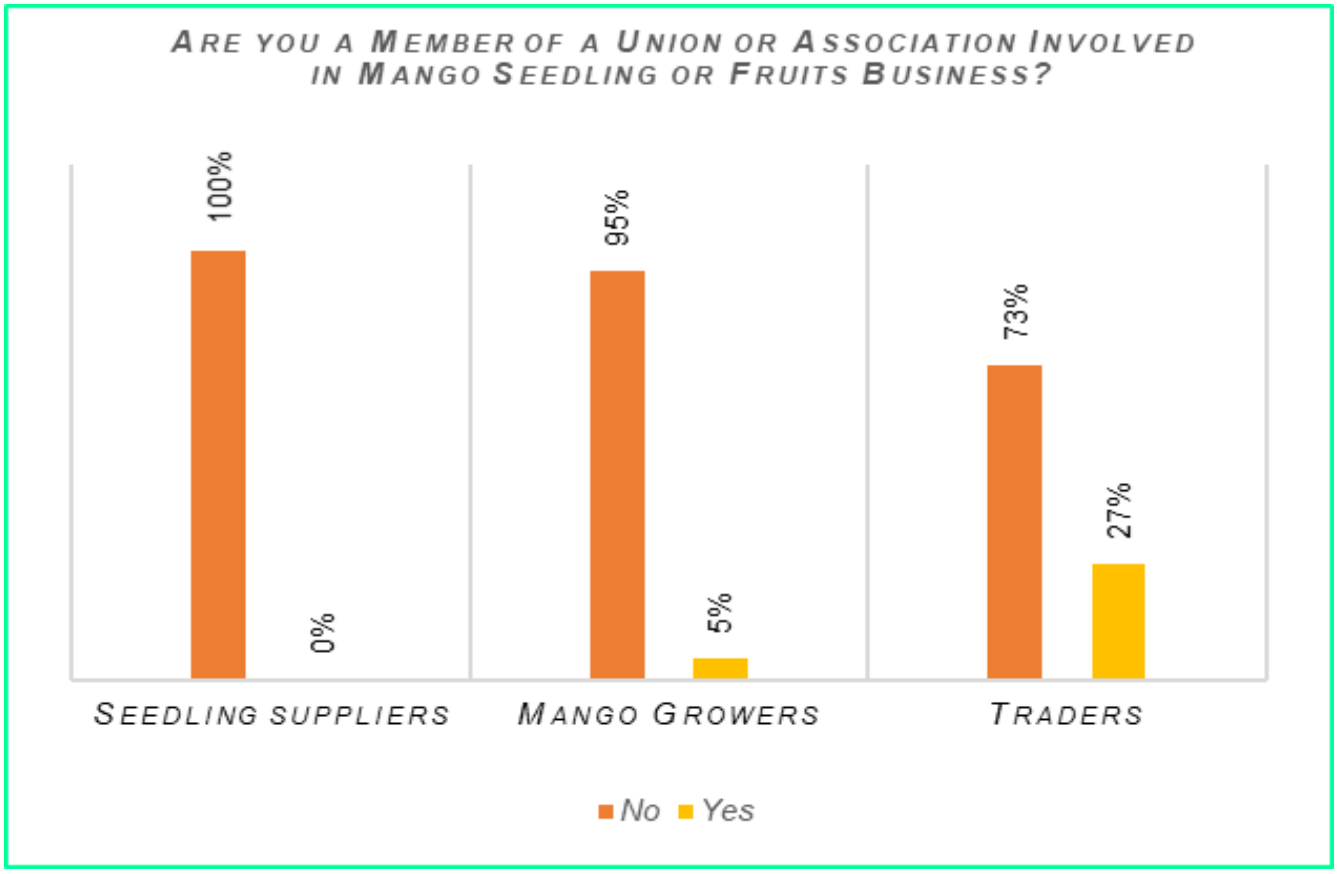

Figure 11: *Percentages of value chain members' membership to unions or associations*

The lack of organised production and marketing of mango fruits and its products is one of the main challenges experienced along Namibia's mango value chain as perceived by mango growers in table 15, with support of statistics in figure 11, which signifies that Namibia's mango value chain is fragmented when it comes to partnerships.

A fragmented value chain needs simple but quick recommendations such as training, attitude change, resource mobilisation, motivation and perhaps starting with the most entrepreneurial members of the value chain (Dent & Collins, 2021). These are some of the remedial actions that Namibia's mango value chain may embrace to shift it from being a fragmented value chain towards the best value chain partnership, which is a collaborative value chain. When chain members work together in partnerships, their success is very hard to copy, hence creating a resilient advantage over their competitors (Dent & Collins, 2021).

6.5.3 Namibian Mango Value Chain Process Mapping and Summary

This section presents the summarised linkages among different actors in Namibia's mango value chain. These linkages are illustrated in Figure 12.

Figure 12, therefore, presents the mango value chain actors and their linkages as shown by arrows and brackets, among others, local and foreign suppliers of inputs and services, local and foreign suppliers of mango seedlings (nurseries), suppliers of fruits (mango growers), processors, distributors, retailers, and ultimate consumers. Figure 12 also indicates that there are limited industry affiliations as only one mango growers association was found in the Zambezi production zone which is also limited to mango collection points only.

It is also illustrated in the above figure that some Namibian mangoes (mature fruits and achar) are exported by Namibia whilst Namibia also imports mangoes and a variety of mango value-added products such as strips, juice, jam, pulp, chutney, pickles, etc. Namibia processes mango juice using imported mango pulp/concentrates, whereas, only one local processor was identified as procuring mangoes from local farmers to process them into pulp, juice, and strips.

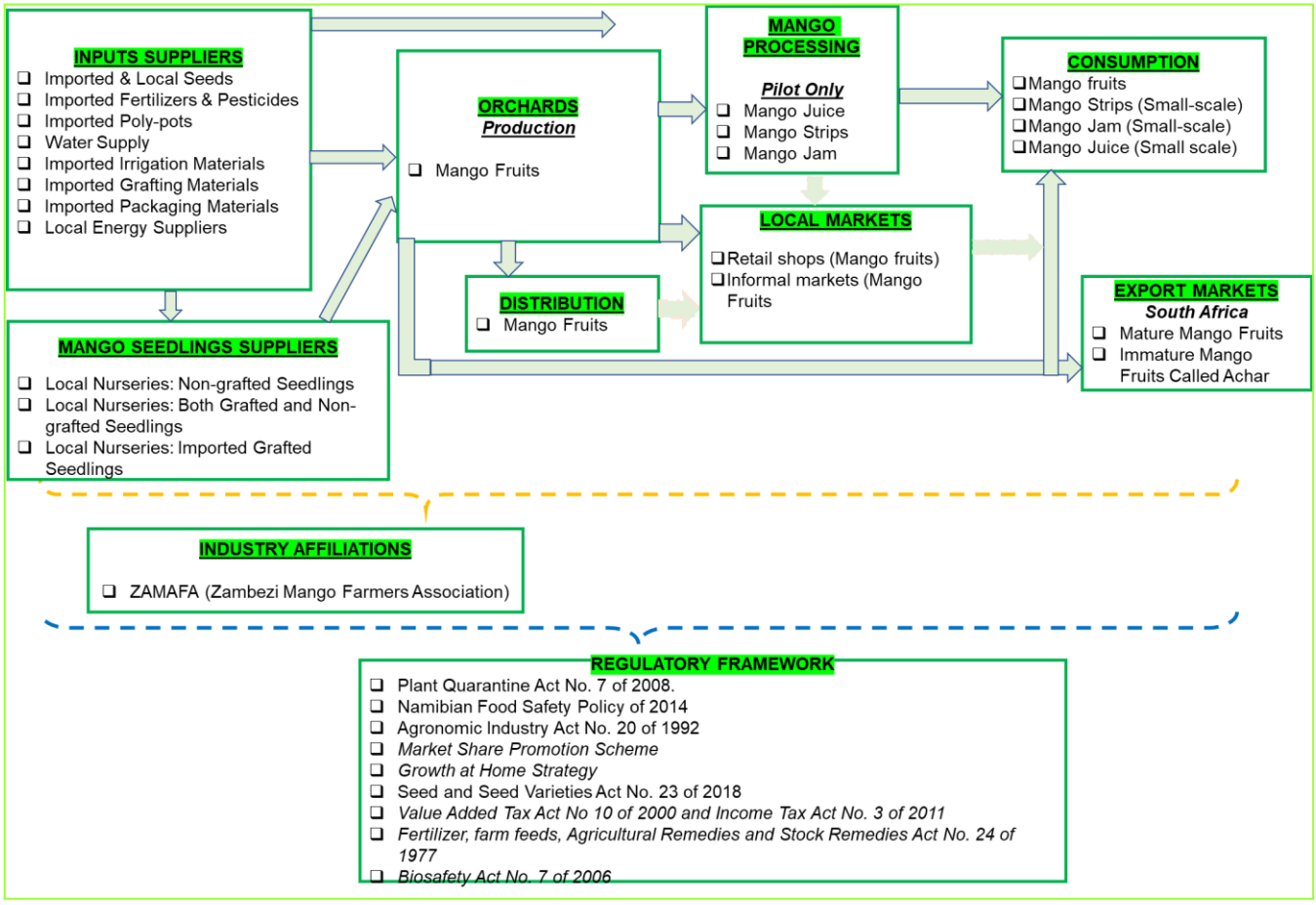

Figure 12: *The Namibian mango value chain process mapping*

Source: *Survey data*

The Government of the Republic of Namibia has established various policies and Acts that are of high importance to mango value chain actors, namely, Plant Quarantine Act No. 7 of 2008; Namibian Food Safety Policy of 2014; Agronomic Industry Act No. 20 of 1992; Seed and Seed Varieties Act No. 23 of 2018; Value Added Tax Act No. 10 of 2000 and Income Tax Act No. 3 of 2011; Growth at Home Strategy; Fertilizer, Farm Feeds, Agricultural Remedies, and Stock Remedies Act No. 24 of 1977; Biosafety Act No. 7 of 2006 and the Agricultural Marketing Policy of 2011. These Acts and policies are either administered directly by the government or by its agents. Other importing governments may also have established policies and Acts that potential exporters should explore for them to succeed in exporting Namibian mangoes and/or mango products.

6.6 CONSTRAINTS AND OPPORTUNITIES

This section presents generic opportunities and constraints perceived by the mango value chain members surveyed (seedling suppliers, orchards, and traders). Responses are presented in the tables below.

6.6.1 Opportunities and Challenges Perceived by Seedling Suppliers

Table 14: *Opportunities and challenges perceived in nurseries and mango seedling business*

Opportunities	Challenges
High demand for good varieties in Namibia	Low demand for local (low-quality) seedlings
Improved varieties in South Africa, Mozambique and Kenya	High water bills for nursery operations
Rainwater harvesting for nurseries irrigations	Scarcity of good seed varieties for multiplication
Research & innovation to substitute imports	High cost of imported good seedling varieties
Export of mango seedlings to Angola	Lack and high cost of grafting materials
	High transport and labour costs
	Inability to meet the demand for good varieties
	Complexities to get import and export documentation
	Difficulty in getting the potting soil
	Lack of skills (seedling propagation & raising)
	Absence of local research on good mango varieties
	Lack of production and market information
	Low demand for local (low-quality) seedlings

6.6.2 Opportunities and Challenges Perceived by Mango Growers

Table 15: *Opportunities and challenges perceived in the mango fruits production business*

Opportunities	Challenges
Value addition/processing	Long payback period
Water & land availability in most production zones	High seedling costs
Export markets (Europe) 90t x 2 flights per week	Pests (rootworms & fruit flies) & birds
Favourable climate in most parts of Namibia	Delays by the government to process export permits
Low labour costs	Lack of finance for investment
High demand for high-quality fruits	High start-up cost
Capacitating mango growers through training & mentorship	Competition from South Africa, Angola & Zambia's fruits
Exposure visits to other mango-producing countries	Lack of water in some areas

Establishment of collection and processing points at each production area	Lack of organised marketing and processing
Forming an association for mango growers	Lack of storage facilities (perishability)
Subsidise infrastructures such as boreholes and irrigation systems	Theft of fruits by community members
	Lack of good quality seedlings/varieties
	Lack of skills on; mango grafting, mango fruits production management and mango quarantine pest and disease management.
	Lack of access to land and water
	Lack of access to formal markets
	High temperature (burning fruits by the sun)
	Lack of production and market information

6.6.3 Opportunities and Challenges Perceived by Traders Including Processors

Table 16: *Opportunities and challenges perceived in the mango fruits trading business*

Opportunities	Challenges
Land and appropriate climate in most production zones	Limited knowledge by local mango growers
Water availability in most production zones	Logistics & consistency problems
Processing mango fruits into different products	Inappropriate vehicles used to transport fruits
High demand for fruits and processing raw materials	Lack of proper transportation channels
Empowering mango growers to boost production	Lack of storage & packaging facilities for fruits
Improving quality by using the right varieties, inputs, and materials	Low quality of fruits & lack of skills in handling fruits
Government assistance in the form of subsidies and training	Growers reluctant to transport fruits to coastal towns
Exposure visits by farmers to countries that are advanced in mango production	Improper packaging of fruits by local growers
	Most fruit suppliers not registered with the NAB
	Some growers are charging exorbitant prices

7 CONCLUSIONS

This study was undertaken to examine Namibia's mango value chain regarding input and seedling supplies, production, value addition, margins, regulatory compliance, industry affiliations, and marketing in Namibia. Government protection needs, constraints, and opportunities necessary to boost the mango value chain were also examined. Eighty (80) mango value chain actors, namely, seedling suppliers (16), mango growers (42), and traders (22) were contacted and they shared their perceptions. More than 25,267 mango trees in 42 nurseries and 153ha in total were enumerated. This includes 116ha with 14,902 mature trees and estimated annual yields of 1,662 tons (about 14 tons/ha), as well as 37ha with 10,365 immature trees.

More than 51,000 mango seedlings were locally supplied by 16 nurseries in 2021 at an estimated value of N$ 1.3 million, in addition to 13,200 imported mango seedlings also valued at nearly N$1.3 million, while some orchards (53%) grow their seedlings. These figures signify prospects of sharp

growth in mango production, especially in the Northern and North-eastern regions. The study reveals a low market uptake of locally produced mango fruits, evidenced by 1,662 tons produced versus 73 tons and 238 tons marketed to informal and formal markets respectively, whilst 331 tons were imported and only 43 tons were exported in 2021. Over N$ 4 million worth of mango juice is locally manufactured using imported mango concentrates.

Nearly 4,000ha at 42 orchards contacted during this study were indicated to be available for fruit production expansion. Furthermore, the study examined and reported on the existing mango production practices such as the technology used, the irrigation methods and fertilizers used, the varieties grown, and the costs involved in start-up capital and operations. Moreover, nurseries, orchards, and traders were surveyed regarding regulatory compliance, protection requirements, access to training, and industry affiliations. Linkages within the Namibian mango value chain were illustrated diagrammatically and explained.

The value chain is challenged owing to the evidenced high imports, high capital and operation costs, unidentified mango varieties, poor planting materials, lack of value addition, weak industry affiliations, traditional production practices (low productivity), lack of appropriate skills, noncompliance with regulatory requirements, low uptake of local mango fruits by the formal market, loose government protection, etc. The main opportunities identified include a favourable climate, land, and water availability, exchange of information with countries advanced in mango production, importation of good quality planting materials, fruit import substitution, fruit export market, fruit processing, and the formation of associations or cooperatives.

The study has also identified constraints such as limited skills, fruit flies, poor quality of fruits, high cost of improved seedling varieties, high start-up costs, inaccessibility of financing, long payback periods, absence of pack houses, high transport costs, foreign competition, complexity in obtaining import and export documents, and complexity of the process to obtain irrigation water permits. Results show that Namibia's mango value chain is indeed fragmented and sluggish owing to some challenges, and yet it is full of opportunities to be tapped to boost its productivity.

8 RECOMMENDATIONS

Namibia's mango value chain as underscored by the current study, is fragmented (not integrated and unorganised) and sluggish (slow to make progress), hence the recommendations to summarily upgrade the mango value chain to satisfy local and international consumers:

- Public and private sectors should establish local nurseries with the capacity to raise and supply grafted mango seedlings that are inclusive of varieties that are acceptable by the formal markets.

- The Mistry of Agriculture, Water and Land Reform (MAWRL) should implement the registration and certification scheme for locally produced mango seedlings.
- The NAB and relevant stakeholders should conduct research trials to test the adaptability of the latest high-yielding varieties of mango e.g. Tommy Atkins, Kent, Heidi, etc.
- Producers should grow mango varieties that are in demand locally and globally.
- Mango value chain actors should consider agro-processing strategies to locally make products such as mango pickles, canned or bottled mango, mango jam, mango cream or dessert, mango pulp, mango juice, dried mango strips, mango chutney, frozen mango chunks, etc.
- The NAB and stakeholders should get the mango industry organised to ensure well-coordinated activities and for them to speak with one voice.
- The MAWRL should apply strict phytosanitary controls.
- The NAB should include mango products in the food safety monitoring systems through the implementation of local GAP at the production level and HACCP at the facility level.
- Stakeholders such as the NAB, AMTA, MAWRL, WFP, etc. should provide incentives to producers, such as subsidising mango seedlings, and the cost of quarantine pest and disease control, mango production and processing grants, and pest control mobilisation programmes.
- Mango producers and nursery operators should be trained continuously in mango production, variety identification and selection of different market targets and mango quarantine pest management. Exposure visits to countries prospering in mango value chains like South Africa, Kenya, and/or India by their associations with assistance from government agencies and other interested parties are also recommended.
- The NAB should develop the mango production and processing manuals and enterprise budgets for the mango growers and processors.
- The NAB and/ or MAWRL or Farmer's Associations should hire a plant identification expert to assist in the identification and registration of mango varieties for mango orchards that are currently under production in Namibia.
- There should be tailor-made financing facilities in Namibia e.g. Agri Bank should consider establishing a tailor-made loan facility to mango nurseries, growers and processors.

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