CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Tropical AgriSciences

Diversity and Use of Cucurbitaceae in Mongu District, Zambia

MASTER'S THESIS

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Declaration

I hereby declare that I have done this thesis entitled Diversity and Use of Cucurbitaceae in Mongu District, Zambia independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In Prague, April 22th 2023

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Kryštof Knejp

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I wish to express my gratitude to doc. Ing. Zbyněk Polesný, Ph.D. for providing me with much valuable advice both regarding my thesis, as well as regarding practical advice, such as about travel and about the conduct of research in the field, and for funding of the research. Many thanks to Mr. Titus Imenda, for the indispensable role he played in the planning, organisation and realisation of the research in the field, as well as for his enthusiasm and good spirits. I extend my gratitude towards Mr. Mukelabai Ndiyoi and his wife for their welcoming hospitality and moreover to Mr. Ndiyoi for his role in setting up interviews with key informants, as well as for his contribution to their execution. In the same vein, I am thankful to Ms. Beauty Muke for her contribution to the on-site research. Overall, I greatly appreciate the time that all the respondents and interviewees were willing to spend talking to me and being a part of this research, and for that they have my thanks. Last but not least, I thank Ms. Markéta Smrčková and Mr. Martin Čermák for their advice, accomodation and pleasant company.

Abstract

Cucurbitaceae crops and wild species represent an important part of diets in the Western Province of Zambia and despite this fact, information about which species and varieties of cucurbits are cultivated and eaten in the province remains unavailable in literature. Additionally, some of the local cucurbits are also utilized for their veterinary medicinal uses and for production of products such as vessels for the storage and transportation of liquids, sponges and musical instruments. To investigate the locally cultivated and harvested-from-wild Cucurbitaceae in the Mongu District and surrounding districts, ethnobotanical methods were employed. Specifically, market surveys, focus group discussions with residents of local communities and interviews with key informants were conducted, as well as collection of seed samples. The results outline the diversity of cultivated and wild Cucurbitaceae in the region and provide a compilation of yielded information about the investigated cucurbits, including their vernacular names, synonymy, morphological descriptions, agronomy, uses and prevalence. This list of assayed cucurbits can serve as a "catalogue" of cucurbitaceous plants known to the Lozi people native to the region. Based on local knowledge, sub-divisons of the assayed crops were identified and they represent potential standalone crop species, varieties, cultivars or landraces. Additional related information was obtained, such as the fact that in specific parts of the Western Province, farmers lack access to seeds of certain crops, which limits their cultivation.

Key words: Agrobiodiversity, Barotse Floodplain, Cucurbits, Ethnobotany, Four Cell Analysis, Underutilized Crops

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List of the abbreviations used in the thesis

FGD	Focus group discussion
FCA	Four cell analysis
A. D.	*Anno Domini*
N. R.	not recorded

1. Literature Review

1.1. Taxonomy and Distribution of Cucurbitaceae

Cucurbitales is an order of dicotyledonous flowering plants containing approximately 110 genera (Zhang et al. 2006; Kubitzki 2011; Schaefer & Renner 2011). Cucurbitales contains 8 botanical families, which are heterogeneous in species diversity: Begoniaceae and Cucurbitaceae have approximately 1400 and 800 species respectively, while the other families each have less than 40 species (Zhang et al. 2006; 2016).

Apodanthaceae is the cladistically outward-most family of the order, as it is least-closely related to all the other clades and families (APG 2016). Conversely, Begoniaceae, Cucurbitaceae, Datiscaceae and Tetramelaceae are closely related to each other and form a clade within the order, which as of yet has no official name (Dahlgren 1983; Zhang et al. 2006). The members of this clade have a common ancestor, which was dioecious, had inferior ovaries, parietal placentation, exstipulate leaves, moderately-sized cotyledons and many-seeded, capsular fruits (Zhang et al. 2006). In contrast, the common ancestor of the Cucurbitaceae family had larger cotyledons and fruits of the pepo type (Zhang et al. 2006). Despite dioecy being an ancestral trait in Cucurbitaceae, monoecy and androdioecy are also found within Cucurbitaceae, as dioecy has not always been prevalent but rather was lost and re-established at least once throughout the evolution of the family (Zhang et al. 2006).

Cucurbitaceae is a family of flowering dicotyledonous plants comprising 95 genera and approximatelly 800 species (Kubitzki 2011; Schaefer & Renner 2011). It has historically been divided into two subfamilies Zanonioideae (also referred to by some as Nhandiroboideae or Fevilleoideae) and Cucurbitoideae. This classification system predates the contribution of genetic methods to our understanding of Cucurbitaceae phylogeny, therefore it is outdated and is not used by researchers anymore (Zhang et al. 2006; Kocyan et al. 2007; Schaefer & Renner 2011; Chomicki et al. 2020). Instead, a more modern subclassification system has been developed by Schaefer & Renner (2011) based on phylogenetic analyses of DNA segments of Cucurbitales plants, which placed the genera of Cucurbitaceae into 15 monophyletic tribes. This currently used system was

further refined by Guo et al. (2020) as they specified the phylogenetical placement of the tribes, as well as grouping the tribes into 8 clades, as can be seen in Figure 1.

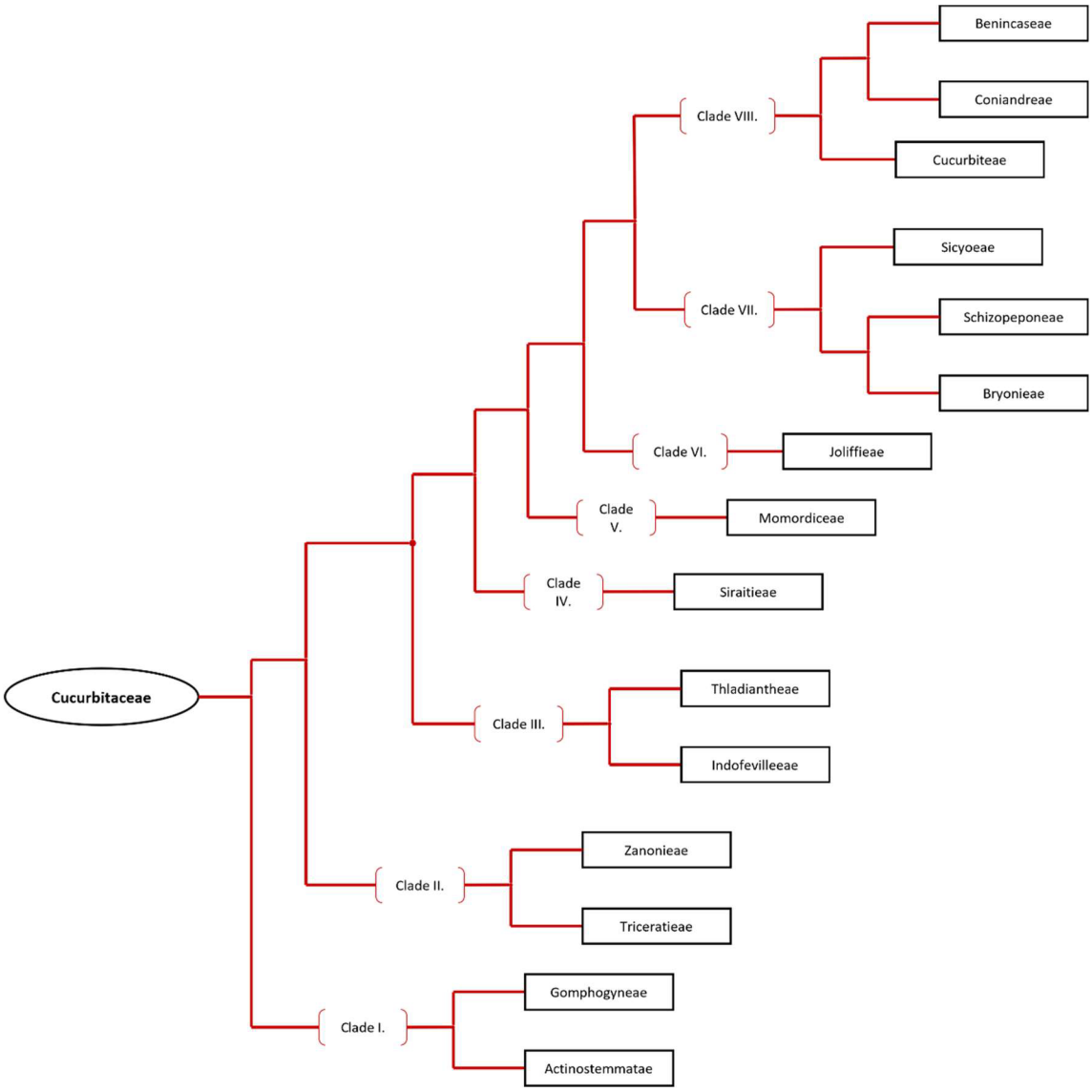

Figure 1: Phylogeny tree adapted from Guo et al. (2020), showing the most up-to-date subdivision of the Cucurbitaceae family into 8 clades and 15 tribes (author, 2023).

Species of Cucurbitaceae are most richly distributed in the tropics and subtropics and have centers of particularly high diversity in west Africa, Madagascar, Mexico and south-east Asia. They typically take the form of annual vines or woody perennial lianas, while some are shrubs, and only the genus *Dendrosicyos* has a tree habit (Kubitzki 2011). Approximately 15 species of Cucurbitaceae are currently endangered or critically

endangered, according to The International Union for Conservation of Nature ("The IUCN Red List of Threatened Species" 2022).

1.2. Importance of Cucurbitaceae crops

The Cucurbitaceae family is one of the most important botanical families worldwide from the point of view of human nutrition and feeding the world. The amount of cucurbitaceous agricultural products sold every year worldwide also makes it a plant family important for its economic significance, despite most products from these crops typically having a relatively low monetary value per unit of volume (Kubitzki 2011; Chomicki et al. 2020). Crops such as cucumbers, pumpkins and various melons are only some of the cucurbitaceous products cultivated in large volumes, while some Cucurbitaceae crop species are only of local importance or can be characterised as neglected or underutilized crops (Ngwepe et al. 2019; van Zonneveld et al. 2021). In addition, many Cucurbitaceae crops exist in the form of various varieties, cultivars and landraces, further adding to the diverse composition of diets across the globe. Cucurbits are cultivated on all five continents, and can be found under cultivation in a many regions of the world (Paris et al. 2017).

Most edible cucurbits are consumed fresh, cooked or otherwise heat-treated. Typically, the fruit is the primary edible part, but it is often not the only plant part that is eaten. Seeds of some cucurbits are consumed either along with the fruit (e.g. in cucumbers) or separately (e.g. in pumpkins). In some cultivated species, and specifically in some cultures or regions, the leaves of various cucurbits are used as a vegetable and are eaten either fresh or cooked (Kubitzki 2011; Schaefer 2020).

Moreover, cucurbits can be used in the production and extraction of valuable secondary metabolites. Namely, L-citrulline is an amino acid, produced only by few plant genera overall, which is found in many Cucurbitaceae plants and the most abundant source of it is *Citrullus lanatus* (Hdider et al. 2020). It is present in watermelon pulp, but interestingly also in its rind, meaning that the waste byproduct of watermelon rind could potentially be utilized in an economically interesting way (Tarazona-Díaz et al. 2011). As a physiologically effective precursor of L-arginine, application of medicine containing citrulline can contribute to maintaining optimal levels of nitric oxide in the human body

(Hdider et al. 2020). According to research reviewed by Aguayo et al. (2021) citrulline intake helps to prevent cardiovascular diseases, reduce erectile dysfunction, reduce effects of diabetes and improve exercise performance. Lycopene represents another example of a secondary metabolite found in cucurbits with medicinal properties. It can be extracted from watermelon and is responsible for the red colour of red-pulped watermelon cultivars. The antioxidative properties of lycopene have several beneficial effects on human physiology, such as reduced chance of developing various types of cancer, lower risk of degenerative disease and prevention of coronary and cardiovascular diseases (Tang 2013; Dasgupta & Klein 2014).

Additionally, some cucurbitaceous plants bear fruits which are crops with utility uses other than uses as food or medicine, providing a renewable source of biodegradable products. For example, fruits of *Lagenaria siceraria* are used to produce firm, durable bowls, containers, musical instruments and various other vessels in various parts of the world (Yetişir et al. 2008; Kubitzki 2011). In the same vein, fibrous fruits of *Luffa cylindrica* are used to make products, which are used as bath sponges, in addition to having fruits that are edible while immature (Kubitzki 2011; Shen et al. 2012; Maamoun et al. 2021).

1.3. Zambia and Mongu District

1.3.1. Zambia

Republic of Zambia is a sovereign state in sub-Saharan Africa, located in the southern part of the African continent. It is situated between the latitudes of 8° and 18° degrees, which is well between the equator and the tropic of Capricorn. According to the Köppen-Geiger classification of climate, the majority of Zambian land falls under the "Cwa" (acronym representing "Temperate – dry winter – hot summer") climate zone, which can be reffered to as "humid subtropical climate" (Beck et al. 2018).

Zambia's population has reached over 19,000,000 people in the year 2021, which is comprised of more than 70 ethnic groups (The World Factbook 2022). The population maintains a rapidly growing trend in the long term, with the population growth reaching 2.9 % in 2020 (The World Bank 2023). Linguistically, the Zambian population speaks more than 70 languages or dialects, which are usually connected to the specific ethnicities,

and English serves as an official, unifying language studied in schools (The World Factbook 2022).

1.3.2. The Western Province and Mongu District

Mongu District is one of the 116 administrative districts of Zambia and it is located in the Western Province, which lies in the region that has historically housed the Kingdom of Barotseland, which remained semi-autonomous from the rest of Northern Rhodesia (today's Zambia) during the colonial era (Hulec & Olša 2008). Historically, the region was and still is primarily populated by the Lozi people (comprised of various Lozi tribes), who migrated into the region approximately around the year 1700 A. D. from areas of today's Democratic Republic of the Congo (Hulec & Olša 2008). To a lesser extent, the Tonga people also reside in parts of the Western Province, as well as do the Nkoya people who are predominantly centered in the eastern part of the province around the town of Kaoma. Additionally, any other ethnic groups from other parts of Zambia (and potentially also from neighbouring coutries) may be found in the region, as people can freely migrate between different zambian provinces and it is common for some people to temporarily or permanently move to other parts of the country for study or work. According to The Zambia Statistics Agency (2023), the population of Western Province has reached 1,024,505 people in 2017 and thus has the population density of 8.1 people/km^2. Mongu District is headquartered in the town of Mongu, which also serves as the administrative center of the Western Province. Both Mongu District and the Western Province as a whole are relatively scarcely populated (especially in certain areas, some of which are completely uninhabited) with a sparse infrastructure of permanent roads. Mongu is connected to the capital city Lusaka to the west by the M9 road (610 km long, going through the towns of Mumbwa and Kaoma) and to Sesheke, the Caprivi strip, Botswana and Livingstone by the M10 road to the south. Additionally, a road with a bridge across the Zambezi river connects Mongu to Kalabo, a town less than 80 km away from Mongu, and another road to the north connects Mongu to Limulunga (which is only 17 km north of Mongu) and does not continue further towards the Northwestern Province. These four roads are practically the only paved roads in the Western Province and are themselves mostly in poor condition as judged by European standard (especially the M10 road, which in some places has potholes the size of a car). Other local roads, leading to villages and other settlements, connect to these main roads, however they are not paved and are mostly

dirt, muddy or sandy roads, in many places seasonally or permanently traversable only using a 4x4 drive vehicle or a bike. Floodplains cover a large area west of Limulunga, Mongu and the M10 road. Those areas are seasonally flooded from January to July, making all local roads unaccessible (with the exception of the elevated Mongu-Kalabo main road). Despite this logistical complication, the floodplains are inhabited year-round with people who live in villages situated in places elevated above the water level even during the flooded period.

The Western Province has sandy soils (the Kalahari-sand soils) of moderate fertility and a cropping season of 90-150 days (Shitumbanuma et al. 2021). Overall, the area receives from 800 to 1100 mm of rain per year, most of which comes in the rainy season (also known as the wet season) starting from October or November and ending in March or April (ZEMA, GRID-Arendal, UNEP, 2012). The rest of the year is divided between a cold, dry season (from April to August) and a hot and dry season (August to October or November) (Baidu-Forson et al. 2014; Shitumbanuma et al. 2021). By volume of weight, the main crops cultivated in the Western Province are maize, cassava, sorghum, beans, groundnuts, soya, wheat and rice (Baidu-Forson et al. 2014; Shitumbanuma et al. 2021).

1.3.3. The Lozi language

The language known as "Lozi", or more commonly by the endonym "siLozi", is a Bantu family language used by the Lozi people and, as the predominant language used in Mongu and many other parts of the Western Province, it can also be spoken by other ethnic groups visiting or living in the area, due to being the *lingua franca* of the Western Province (alongside English). Notably, the current form of the Lozi language was formed during a historical event when the Luyana people (today known as the Lozi people) were conquered by and subjugated to the rule of the Kololo people, who emigrated into Barotseland from a region today located in the Orange Free state of South Africa around the year 1840, after being displaced themselves by the Zulu people. The Kololo imposed their language Kololo (also known as Southern Sotho or Sesotho) on the subjugated Luyana populus. Eventually, they were defeated by the Lozi people in 1865 and were then assimilated into the Lozi population (Hulec & Olša 2008). This lead to the fusion of the languages of Luyana and Kololo (Hulec & Olša 2008). Therefore, expressions used in today's ozi can etymologically stem from either of these original languages, and for

each word, synonyms coming from the other one of the two mother languages may also be known or may used in different dialects of Lozi.

1.4. Agrobiodiversity in Zambia

Maintaining high levels of agrobiodiversity of crops is paramount to the future of mankind, as it contributes to sufficiantly diverse and nutritious diets and without agrobiodiversity, agricultural production becomes overly reliant on only few crops or cultivars, which could be for example affected on a large scale by pests and diseases and thus taken largely out of order. By conserving cultivars, varieties, landraces and wild relative species, even if those varieties or species are of much lower economic importance, we can secure resources needed for future improvement of crops (for example by breeding programmes). Additionally, sufficient agrobiodiversity provides the posibility to adapt to new or changing agricultural enviroments such as by employing different crops or varieties (Fowler & Hodgkin 2004; Love & Spaner 2007; Hajjar et al. 2008).

Though crucial for securing a sustainable future of Zambia and its people, historically, its government has not given agrobiodiversity sufficient notice and Zambian agro-ecological systems were largely left vulnerable or actively deteriorating (Convention on Biological Diversity 2023). In recent years, the Zambian government has started to consider the issue of agrobiodiversity with a greater degree of importance and has commited itself to increasing biodiversity preservation. However, agrobiodiversity specifically is not represented in the government's "National Biodiversity Strategy and Action" plan nearly as much as conservation practices related to forestry, fisheries and wildlife, and therefore, agrobiodiversity conservation in Zambia remains largely neglected (Kokwe et al. 2015).

1.5. Cucurbitaceae Used in the Western Province of Zambia

A report published by the Southern African Botanical Diversity Network (Phiri 2005) and the supposedly up-to-date online database "Flora of Zambia" (Bingham et al. 2023a) both provide a list of Cucurbitaceae species distributed in Zambia, along with specifying which taxa can be found specifically in the Western Province. However, both of these literature sources are far more focused on the naturally occurring species than on cultivated ones,

only rarely do they provide any vernacular names and they do not distinguish between subordinate taxa such as varieties, cultivars or landraces.

After scouring both scientific literature and grey literature (available online in the English language) in the period January to March of 2022, it is the author's belief that no (even non-exhaustive) list or major source of information about the species and subordinate taxa, which occur in the Western Province is available in either type of literature. This is true with minor exceptions, in the case of which the information provided was confined only to a few local names with very general and unconfirmed English translations. These exceptions include a report and seasonal calendars produced and published by nongovernmental organizations CGIAR and Bioversity International (Pasqualino 2014; Pasqualino et al. 2015). The information provided therein includes the names "malaka" translated as "white/yellow squash", namundalangwe translates as "pumpkin", mupusi translated as "orange squash" and "mangambwa" translated as "pumpkin leaves", and information about their seasonal availability in specific communities of the Western Province.

Additionally, another publication also published by CGIAR (Baidu-Forson et al. 2014) included a glossary of Lozi names for crops of the Barotseland region, which, as far as Cucurbitaceae are concerned, contains solely the name "mundalangwe" defined as "pumpkin" and "*Cucurbita pepo* or *Cucurbita moschata*".

2. Aims of the Thesis

In this thesis, the author's main objective was to elucidate the state of diversity of Cucurbitaceae plants occurring in the areas surrounding the town of Mongu in the Western Province of Zambia, as this information is by and large absent from scientific and grey literature alike. More specifically, to investigate local knowledge and to compile information about cucurbitaceous crops and wild species which can be found in the targeted area attained from investigating local knowledge, as to provide a basis upon which future research into the uses or cultivation of these plants, going into further detail, can be built upon. Ethnobotanical methods conducted in the area in person were selected as a way to fulfill these goals.

3. Methodology

3.1. Selection of Study Area

The area of interest was meant to be centered around the town of Mongu. Based on observations made by other members of the Faculty of Tropical AgriSciences (Czech University of Life Sciences, Prague), it was presumed that the region has a high diversity of cultivated cucurbitaceous crops and it has been speculated (although unconfirmed) that the word "Mongu" potentially has an etymological connection to such crops, further suggesting a higher-than-normal agrobiodiversity of cucurbits.

The Western Province was not included as the target area in its entirety for practical feasibility reasons, due to inaccessibility of remote areas (which in this case are all settlements not situated on or nearby paved roads), low population density in remote areas and overall size of the province (126,386 km^2). The Mongu District provided a smaller administrative division to be used as the target area, however as can be seen in Figure 2, the uneven shape of the district (the border of which is arbitrary in a way, as neighbouring districts are not significantly different in terms of ethnicity nor climate or agro-ecological conditions) would not be well suited for this study either.

Instead, the research was conducted in Mongu District as well as in nearby parts of neighbouring districts – largely disregarding the arbitrary division into districts and considering the entire area as one coherent region based on its history and ethnic structure.

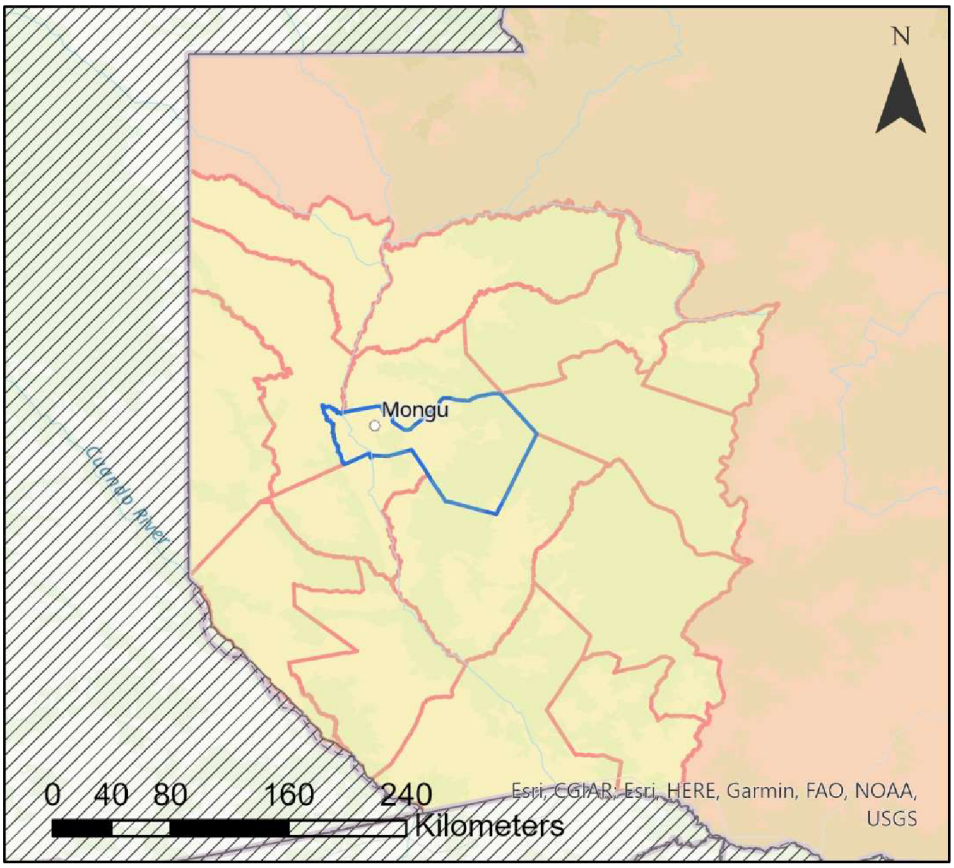

Figure 2: Map showing the shape of Mongu District (with a blue outline), surrounded by other districts of the Western Province. The area filled with a blue hashed pattern represents other countries besides Zambia. Exported from ArcGIS Pro 3.0.2 (author, 2023).

3.2. Data Collection

3.2.1. Market Survey

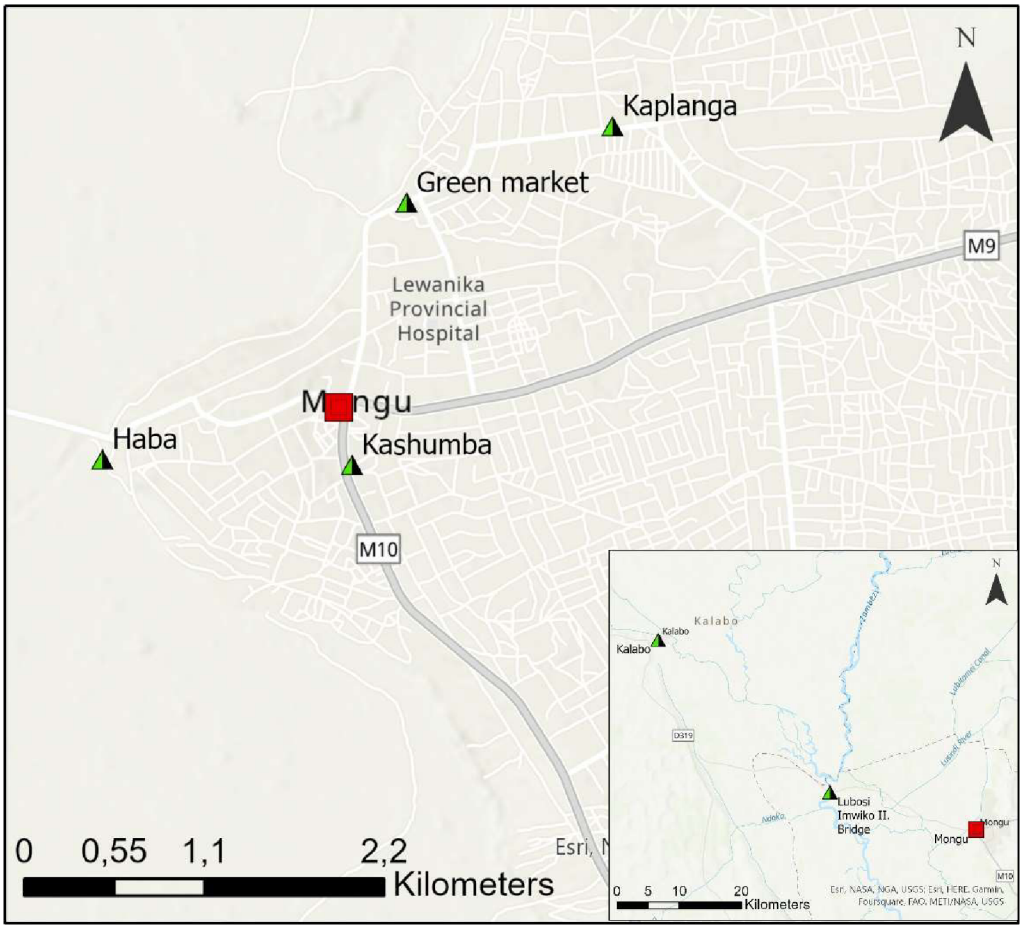

Figure 3: Map showing markets (marked with a green triangle) visited within the first part of the market survey. Two of the visited markets are located outside of Mongu town and can be seen in the map on the bottom right. The Mongu Shoprite is marked on both maps as a red square, meant as a reference point for easier orientation in the map. Exported from ArcGIS Pro 3.0.2 (author, 2023).

As a preliminary way to assess availability of cucurbitaceous crops in the region at the time of the research and to become acquainted with the specific crops and their local names prior to conducting the Focus Group Discussions, a market survey was carried out. The markets included in the first part of the market survey, which was conducted on

14. 4. 2022 in 6 markets located in the town of Mongu and surrounding areas, can be seen in Figure 3.

A second part of the market survey was conducted on 28. 4. 2022 to investigate if the quantity and composition of cucurbits available in the markets would differ two weeks later. The locations of 6 Mongu markets visited within this part of the market survey can be seen in Figure 4.

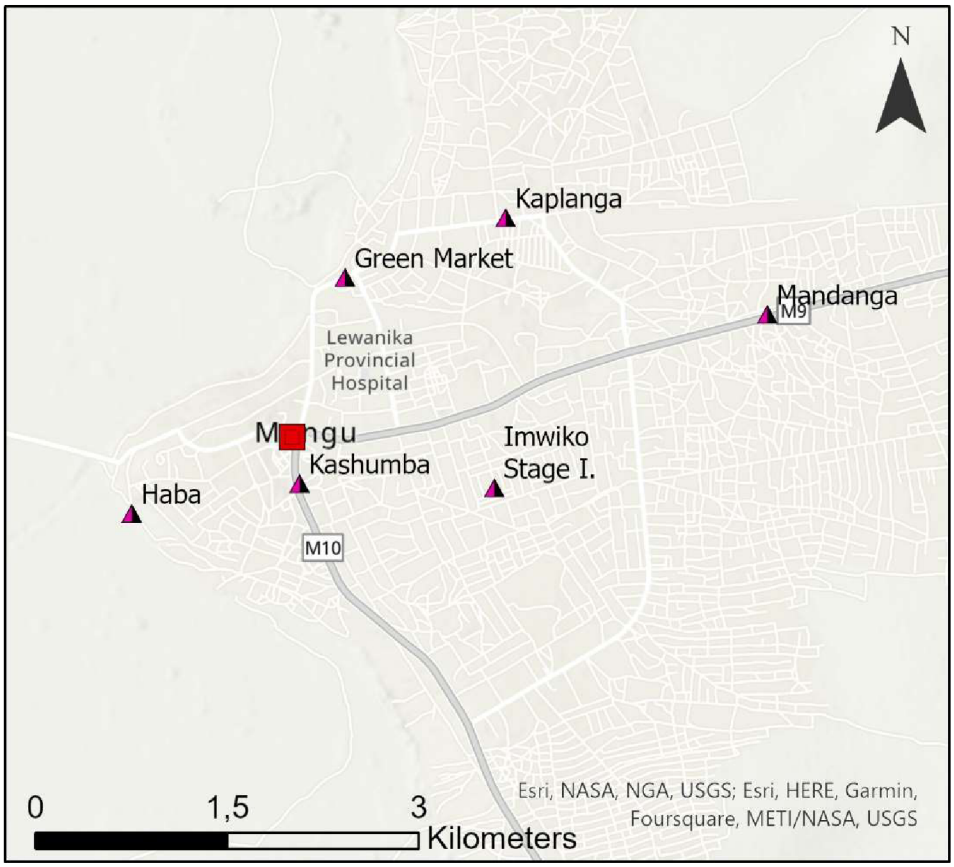

Figure 4: A map of Mongu town showing the location of markets visited within the second part of the market survey (marked by purple triangles) along with their names. The location of the Shoprite supermarket is included (represented by a red square) as a reference point for easier orientation in the map. Exported from ArcGIS Pro 3.0.2 (author, 2023).

Methodology mentioned in Alexiades & Sheldon (1996) was adapted and thus information about the identified cucurbitaceous items, including local name, place of origin and price, was recorder where possible. Where a photograph of the item or entire market stall was taken (for example in Figure 5), the seller was first asked for permission. For each separate market, its name and the approximate time of visit was noted. The surveys were conducted in collaboration with an interpreter familiar with local languages,

customs and markets. The markets were selected based on the interpreter's knowledge of local markets, which led to a difference in selected markets between the two market surveys, as a different interpreter, with knowledge of more markets, was used for the second survey. Additionally, the market in Kalabo was not visited as part of the second market survey, due to a lack of an available vehicle needed to travel there, which was available at the time of the first survey.

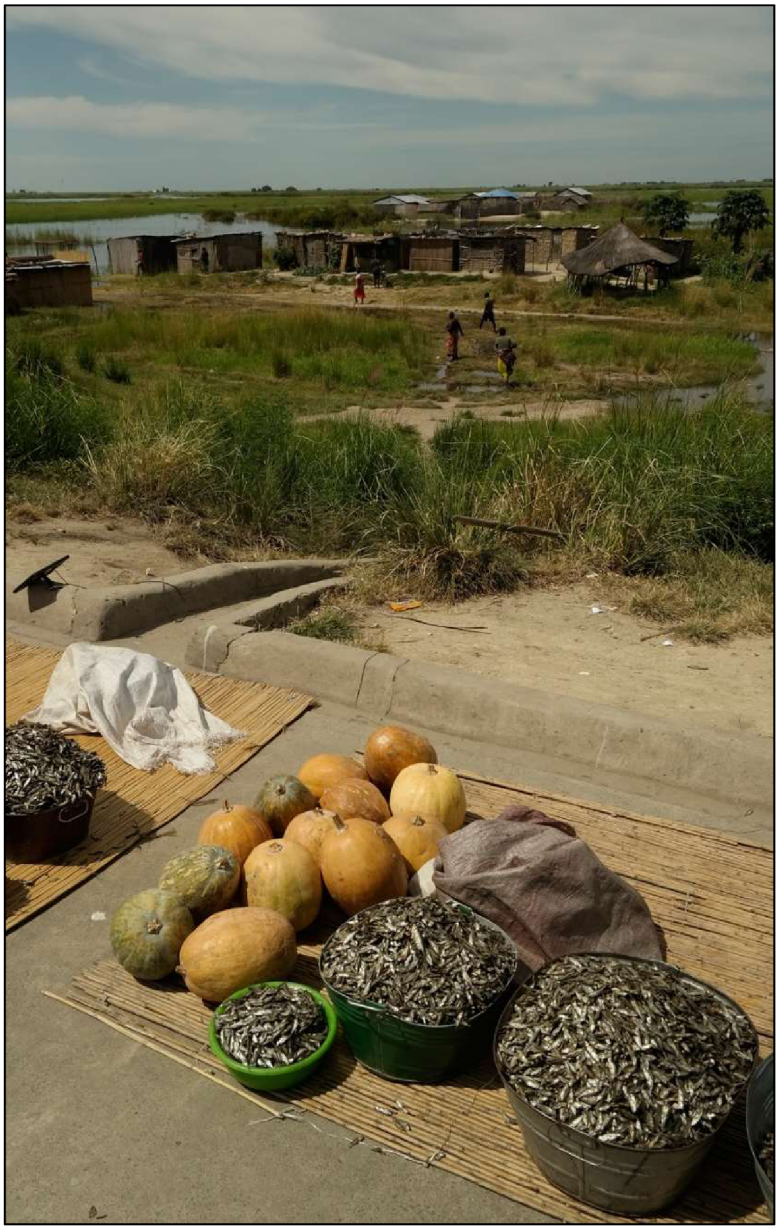

Figure 5: Namundalangwe for sale at the Lubosi Imwiko II. bridge along with fish (author, 2022).

3.2.2. Focus Group Discussions

The design of the Focus Group Discussions (abbreviated as "FGDs") was based primarily on the publication "Assessing Agrobiodiversity: A Compendium of Methods" (Mijatović et al. 2018). Questions and activities were sequenced in a given order based on a script (memorised, not physically carried around at the FGD). Prior to the official beginning of the FGD, one or two large "flipchart" papers were (with the help of the respondents) fixed upon a suitable, flat (or partially flat) surface using removable adhesive gum, so that they can be written on during the FGD using markers of different colours.

During the FGDs, information was recorded using flipchart papers and markers and mainly by writing notes down into a notebook. Additionally, the entire FGD was recorded on a dictation machine, after asking the respondents if they have any objection to being recorded and letting them know that if any of them shall object to it, the recording would not be made. This way the recordings supported the written notes and *vice versa*, in order to prevent loss of attained information, as it can happen that what is being said would not be written down by mistake or could later be found to be illegible, and certain parts of a recording could be hard to understand upon playback, especially due to wind blowing into the microphone. The local partner Titus Imenda served as an interpreter for all the FGDs, to ensure that information would not be lost or biased due to a language barrier.

Firstly, once all the respondents were present and ready and the FGD was thus started, the interviewer and the interpreter (and all other potential collaborators) were introduced and then invited the respondents to introduce themselves as well. Then the respondents were given prompt cards (see chapter 3.4) to show them, that the discussion is to be focused on cucurbits, which was simultaneously explained by the interviewer as clearly as possible. After appropriate time has been given to the respondents to familiarize themselves with the prompt cards, the respondents were asked to give local names of the plants they may have recognized in the prompt card pictures, as well as names of any similar plants. The provided names were listed on the flipchart paper as a list, with appropriate spelling being spontaneously corrected by the respondents or in some cases asked about directly. This stage of the FGD can be seen in Figure 6. Once a list of species

or crops has been created this way, the respondents were asked if they know any other names of similar crops, names of types of the already listed crops or other names for the already listed crops, and those were written down as well.

Figure 6: Conducting the FGD at the site of FGD 6 (taken by Beauty Muke, 2022).

Afterwards, a Four Cell Analysis (abbreviated as FCA) adapted from Mijatović et al. (2018) was conducted for each of the vernacular names listed. In other words, two lines were drawn on one of the flipchart papers in order to divide the space into 4 cells. Each cell represented a different category for the plant names to be divided into based on how commonly the given species is cultivated and typically on which scale: "Many people on large fields", "Many people on small fields", "Few people on large fields" and "Few people on small fields". What each of the cells represented was explained verbally, as well as made more intuitive by drawing a simple, illustrative picture into each cell (such as several houses and large circles for the "Many people on large fields" category). Then, for each plant listed before, the respondents were asked to decide (as a group) into which category it shall be placed. Generally, the respondents would make it known if a listed name refers to a plant which is not cultivated, and would not place it in any of the categories. Similarly, when the respondents considered a given name a mere synonym of another, they would make it known and either not place it in any category, or say that it is the same as the other synonym. During the first 4 FGDs, the Four Cell Analysis was

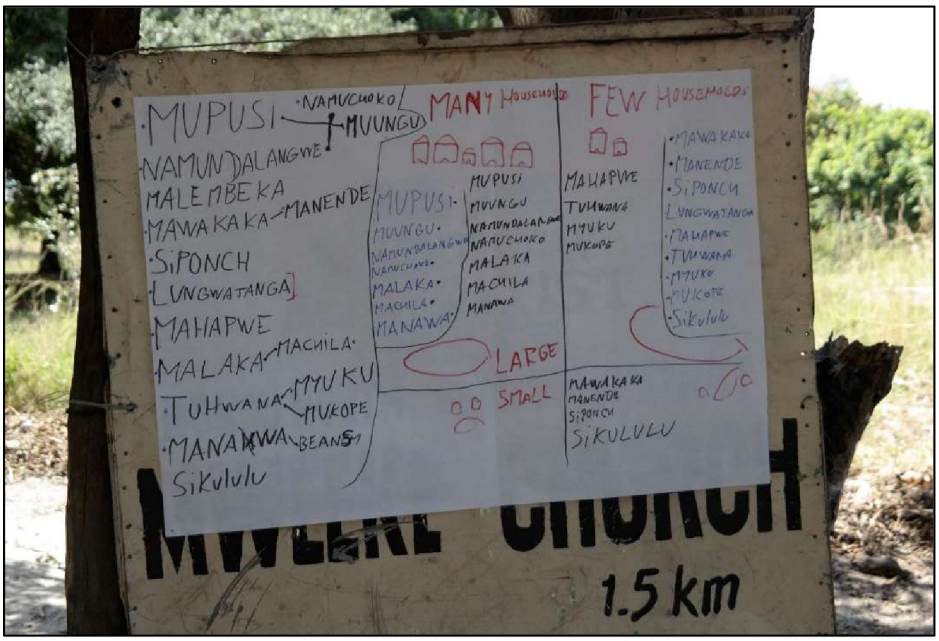

Figure 7: Flipchart paper from FGD 6 fixed upon the surface of a sign on-site, showing a list of investigated local names and the results of a four cell analysis combined on a single paper (author, 2022).

drawn and written onto a separate flipchart paper. This was changed starting from FGD 5 onwards, as finding a suitable space to fix the flipchart papers upon oftentimes provided a challenge and delayed the start of the FGD, and it was realized that both the list of local names and the four cell analysis can be fit onto one flipchart paper as can be seen in Figure 7.

After the four cell analysis, the interviewer sat down and asked questions about the mentioned plants. Firstly, going through the list one by one, the respondents were asked about the morphological appearance of the plant and about how they can tell it apart from similar crops or wild species. Where appropriate, if the respondents did not mention it on their own, it was asked specifically about colours, shapes and sizes of specific plant parts, such as the fruit (both skin a inside part), flowers, leaves and seeds. Next, the interviewer went through the list once more, asking additional questions about each plant. Specifically, the respondents were asked whether they grow the given plant and about its uses. If the respondents were not to mention it spontaneously, they were asked directly if the plant is eaten (and which plant parts are eaten), sold, fed to animals or used for anything else. Additionally, the respondents were asked to list advantages and disadvantages connected to the cultivation of each given crop. However, with hindsight, these questions were largely ineffective, as for advantages some of the respondent groups

merely repeated the crop's uses and very rarely did any of the respondent groups share any negative traits or disadvantages of a given crop with the interviewer.

In the last section, respondents were asked two additional questions. Firstly, if there are any crops that their ancestors used to grow, but are not grown any more, and secondly, which crops in their opinion should be grown more in the future and which ones should be grown less.

The sampling of settlements visited in order to conduct the FGDs could partially be characterised as convenience sampling, as for organisational feasibility reasons, selecting the locations and arranging the FGDs was done by a local partner Mr. Titus Imenda, who was familiar with the agricultural areas around Mongu and who had personal contacts with people in the visited communities or knew other people who could arrange a FGD in areas he was not directly familiar with. The sampling was also partially alike targeted sampling or purposive sampling, as it was discussed with Mr. Imenda, that shall it be

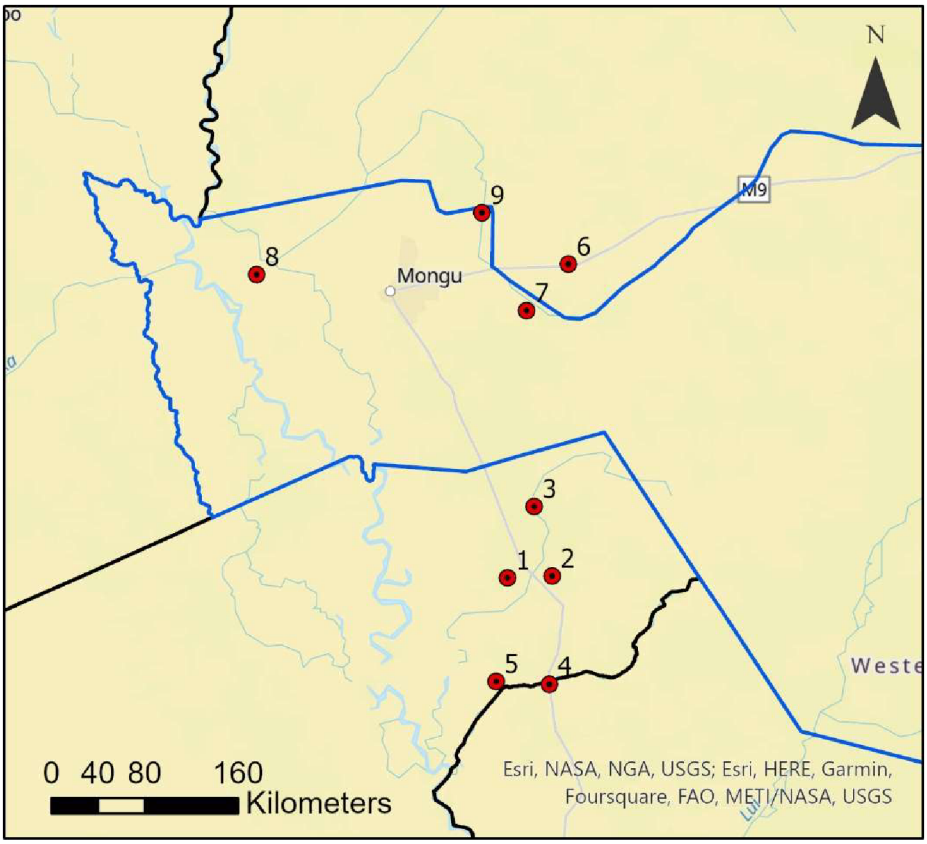

Figure 8: Locations of the conducted FGDs (marked by red circles and numbered) shown in relation to the outline of Mongu District (in blue) and other districts (black outlines). Exported from ArcGIS Pro 3.0.2 (author, 2023).

possible, he is to arrange the FGDs in areas varied as much as possible in location and agro-ecological conditions (given that there would be a realistic way to reach the given community in a vehicle from Mongu). It was due to this that the locations of the conducted FGDs were not confined exclusively to the Nalolo area south of Mongu (with which Mr. Imenda is most familiar), but were instead situated in all cardinal directions from Mongu (along all 4 paved roads going from Mongu). The locations of the conducted FGDs can be seen in Figure 8.

In all cases, the FGD was composed of 6-20 respondents native to the visited settlement (or to neighbouring villages), who were mostly (but not exclusively) farmers.

FGD 1 – Muoyo Township, Nalolo Area

The first focus group discussion was conducted on 17. 4. 2022 in the Muoyo settlement (township or village), Nalolo area. The FGD took place at 15.571 S, 23.257 E.

FGD 2 – Seianda Village, Nalolo Area

The second focus group discussion was conducted on 17. 4. 2022 in a house in the Seianda village, Nalolo area. The FGD took place at 15.569 S, 23.304 E. The respondents from FGD 2 can be seen in Figure 9.

Figure 9: A photograph showing the respondents of FGD 2 along with the interviewer (right-most), after the FGD (taken by Titus Imenda, 2022).

FGD 3 – Kataba Village, Nalolo Area

The third focus group discussion was conducted on 18. 4. 2022 in the Kataba village, Nalolo area. The FGD took place at 15.496 S, 23.285 E. The area is only accesible by sandy roads and a motorbike had to be used to reach it.

FGD 4 – Litoya Village, Nalolo Area

The fourth focus group discussion was conducted on 18. 4. 2022 in the Litoya settlement (village or township), next to the M10 road, Nalolo area. The FGD took place at 15.683 S, 23.301 E.

FGD 5 – Likuma Village, Nalolo Area

The fifth focus group discussion was conducted on 18. 4. 2022 in the Likuma village, Nalolo area. The FGD took place at 15.680 S, 23.245 E.

FGD 6 – Mueke Village, Near the M9 Road

The sixth focus group discussion was conducted on 23. 4. 2022 in the Mueke village, near the Lusaka-Mongu road, about 20 km east of Mongu. The FGD took place at 15.241 S, 23.321 E.

FGD 7 – Siwa Area

The seventh focus group discussion was conducted on 23. 4. 2022 in a village in the Siwa area, near the Lusaka-Mongu road, about 15 km south-east of Mongu (4 km south of the M9 road). The FGD took place at 15.290 S, 23.277 E. FGD 7 respondents can be seen in Figure 10.

Figure 10: FGD 7 respondents, the author-interviewer (standing) and the interpreter Titus Imenda (right-most) on-site of the discussion (taken by Beauty Muke, 2022).

FGD 8 – Likwanga Village, Lealui Area

The eighth focus group discussion was conducted on 30. 4. 2022 in the Likwanga village in the floodplains of Lealui area, 15 km west of Mongu. The FGD took place at 15.252 S, 22.993 E. At the time of the FGD, the area was fully flooded and the respondents were so kind as to take us to their village (which is situated on a small hill just above the water level) and back by canoe.

FGD 9 – North-east of Mongu (Name not Recorded)

The ninth focus group discussion was conducted on 30. 4. 2022 in a village, the name of which was not recorded (by mistake), situated about 14 km north-east of Mongu. The FGD took place at 15.187 S, 23.230 E.

3.2.3. Key Informant Interviews

To supplement the focus group discussions with additional, potentially more in-depth information, 3 key informants were identified, contacted and interviewed. For organisational reasons, the selection of interviewees was mostly left to local partner

Mukelabai Ndiyoi, with the instructions that the interviewees should be as knowledgeable as possible about cucurbits and their cultivation in Barotseland. Even though, each of the interviewees spoke a level of English proficient enough to conduct the interview, the mentioned local partner was also present during the interviews and served as an interpreter (as well as the interview co-facilitator, but not as the lead interviewer).

The interview was based on a script (order of questions), based on which the interviewee was first shown the prompt cards (see chapter 3.4.) in order to direct the discussion specifically towards Cucurbitaceae, and then asked a set of questions in a given order about each crop or species. These questions included a discussion of the local name, its etymology, synonymy and whether it's a name for the whole plant or a specific plant part; whether it is cultivated or occurs naturally (if the species only occurs wild, then a different set of questions was pivoted to); whether there are different types of the given; a detailed morphological description of the crop and (where appropriate) of each of the crop's types; the uses of the crop (if not spontaneously mentioned then asked directly whether it is eaten, sold, fed to livestock or used as a medicine); if the crop is traditional or modern (introduced); positive and negative traits of the crop; time of sowing, time of harvest and agronomy in general; and storability of the product. Additionally, information about the interviewee was recorded. Also towards the end of the interview, the interviewees were asked about specific vernacular names of crops, which were mentioned by FGD respondents, in order to attain additional information about those local names and the crops or synonyms they represent.

Sikuniso Mupo

Mr. Sikuniso Mupo (who can be seen in Figure 11**Chyba! Nenalezen zdroj odkazů.**) was intervieweed on 25. 4. 2022 in his (and his family's) garden in Mongu. Now retired, he is a former agronomist, originally from the Senanga District (which neighbours Mongu District to the south). Furthermore, he worked as a researcher in a goverment agriculture project in Kaoma (east of Western Province) and later in a similar goverment-lead agriculture project in Mongu.

Figure 11: Key informant Sikuniso Mupo (center), interpreter and facilitator Mukelabai Ndiyoi (left) and the interviewer (right). Taken in Mr. Mupo's garden, on site of the conducted interview.

Sipatonyana Kaboku

Mr. Sipatonyana Kaboku (who's likeness was not captured in a photograph by mistake) was intervieweed on 28. 4. 2022 in his home village located near the Mongu-Limulunga road northwards of Mongu (at 15.17 S, 23.15 E). As a farmer, he has experience with cultivating and selling various vegetable crops, including pumpkins, melons and butternut squashes.

Mwangala Maopu

Mr. Mwangala Maopu (depicted in Figure 12) was interviewed in the garden of his house situated in Mongu. He is a life-long resident of Mongu district. His knowledge of cucurbits stems from his past professions, which include agronomist, private sector entrepreneur (agriculture-related), farmer growing crops including both local and "exotic" vegetables such as butternut squash, educator and agriculture head of the district.

Figure 12: Key informant Mwangala Maopu (on the right) with the author, photographed on site of the interview.

3.3. Seed Sample Collection

Samples of seeds of cucurbitaceous crops were collected at the FGDs or at the key informant interviews. Either the respondents or interviewees offered to give the interviewer (author) seeds of the discussed crops on their own, or they were politely asked if they have any such seeds that they would be willing to donate. In total, 35 seed samples were collected along with their associated information, including GPS location of the FGD or interview and local crop name. The seed samples were used as an additional

source of information about the seed morphology of the given crops, they were photographed on 15. 4. 2023 and can be seen in Appendix 2.

3.4. General Notes on Utilized Ethnobotanical Practices and Procedures

Following recommendations from Thomas et al. (2013), a set of A4 paper sized "prompt cards" was prepared, printed out (with one-sided print) and coated with plastic using a lamination machine. An example of these cards can be seen in Appendix 1. Each paper contained colour-printed pictures of various morphological parts of a selected plant species (including fruit, flower and overall habit), as well as common English name, latin name and a list of names in african languages spoken in Zambia (not in the Western Province specifically), though only limited to the few examples of such names available from literature and online sources, such as from Baidu-Forson et al. (2014) and Pasqualino et al. (2015). However, after the first two focus group discussions were conducted, the author realised that names in any language should not have been included at all, in order to not interfere with the ability of the respondents to identify presented plants or to be reminded of similar plants. The printed local names were not certain to be accurate in the first place and this fact could introduce a bias into the research. For these reasons, all text from the cards was subsequently hidden using several layers of adhesive label papers (as can be seen in Appendix 1). The plant species used to prepare these prompt cards were selected only from Cucurbitaceae plants reported to be found in Zambia (with special notice given to species specifically reported to occur in the Western Province), based on a checklist by Phiri (2005) and on specific plant profiles of cucurbits in Flora of Zambia (Bingham et al. 2023a). More specifically, only species with (potentially) edible fruits were selected. Photographs used in the prompt cards were primarily sourced from the "African Plants – A Photo Guide" online database (Elke et al. 2022) and from "Flora of Zambia" (Bingham et al. 2023a), as these resources provide photographs of the given plants taken specifically in Africa and in Zambia or neighbouring countries, respectively. Additional photos were taken from the database Plants of the World Online (POWO 2022).

Special attention and effort was devoted to not using any leading questions and to keeping the discussion as neutral and and standardised as possible, to not influence the

respondents in any way that would introduce a bias into their answers, such as letting them know what the other focus groups had to say.

The word “type“ was used as a deliberately neutral, non-specific, easy to understand alternative to terms such as subspecies, variety, cultivar and landrace, as respondents were largely not expected to be familiar with plant crop phylogenetical classification and cladistics including the crop varieties level. It is not meant in the same meaning as the term “taxonomic type“. Since investigating whether or not a given crop name is a name for a specific variety or not was part of the conducted ethnobotanical research, bias would have potentially been introduced if the word “variety“ was used directly.

Both the interpreter that cooperated with the author on conducting the FGDs and the interpreter and facilitator of the key informant interviews were notably knowledgeable about agriculture and the researched area themselves and could have been chosen as key informant interviewees in their own right, which made them especially suitable for the position.

All local partners, whom have facilitated the organisation or conduct of the field work activities were financially compensated by a sum that both parties agreed on.

4. Results

4.1. Market Survey

A complete overview of the markets visited within the first part of the market survey, identified cucubitaceous plant products with associated information and time of visit can be seen in Table 1 and an overview of the markets visited within the second part of the market survey, including the same associated information can be seen in Table 2. The markets (from amongst the ones listed in Figure 3 and Figure 4) which are not mentioned in any row of the aformentioned tables did not have any cucurbitaceous items on sale at the time of visit, and thus did not yield any information apart from this fact.

Table 1: Cucubitaceous items investigated in the first part of the market survey conducted on 14. 4. 2022. "N.R." stands for "not recorded". Note that Kaoma is approximately 185 km away from Mongu and Mumbwa is approximately 440 km away from Mongu.

Number of item	Identified Cucurbitaceous Item (By Local Name)	Name of Market	GPS Location of Market	Approximate Time of Visit of Market	Place of Origin of Item	Price of Item (per piece)
1	**mahapu**	Kashumba / Station market	15.2731 S, 23.1366 E	10:00 - 11:00	Mumbwa, Central Province	N. R.
2	**mupusi**	Kashumba / Station market	15.2731 S, 23.1366 E	10:00 - 11:00	Mumbwa, Central Province	N. R.
3	**namundalangwe**	Kashumba / Station market	15.2731 S, 23.1366 E	10:00 - 11:00	N. R.	N. R.
4	**mawakaka**	Kashumba / Station market	15.2731 S, 23.1366 E	10:00 - 11:00	N. R.	less than 5 ZMW
5	**malaka**	Kashumba / Station market	15.2731 S, 23.1366 E	10:00 - 11:00	Kaoma, Western Province	N. R.
6	**namundalangwe**	Lubosi Imwiko II. bridge (roadside market)	15.2150 S, 22.9219 E	11:10 – 11:20	floodplains of Western Province	10 ZMW
7	**mupusi**	Lubosi Imwiko II. bridge (roadside market)	15.2150 S, 22.9219 E	11:10 – 11:20	floodplains of Western Province	20 ZMW
8	**namundalangwe**	Mongu Harbour / "Haba" market	15.2728 S, 23.1199 E	14:00 – 14:30	floodplains of Western Province	5 - 10 ZMW (depending on size)

Table 2: Cucubitaceous items investigated within the second part of the market survey conducted on 28. 4. 2022. "N.R." stands for "not recorded". Note that Kaoma is approximately 185 km away from Mongu and Mumbwa is approximately 440 km away from Mongu.

Number of item	Identified Cucurbitaceous Item (By Local Name)	Name of Market	GPS Location of Market	Approximate Time of Visit of Market	Place of Origin of Item	Price of Item (per piece)
1	**malaka**	Kashumba / Station market	15.2731 S, 23.1366 E	8:00 - 8:40	Kaoma, Western Province	10 ZMW
2	**cucumber**	Kashumba / Station market	15.2731 S, 23.1366 E	8:00 - 8:40	Mumbwa, Central Province	3 ZMW
3	**malaka**	Kashumba / Station market	15.2731 S, 23.1366 E	8:00 - 8:40	Kaoma, Western Province	5 ZMW
4	**malaka**	Kashumba / Station market	15.2731 S, 23.1366 E	8:00 - 8:40	Kaoma, Western Province	5 ZMW
5	**malaka**	Kashumba / Station market	15.2731 S, 23.1366 E	8:00 - 8:40	Kaoma, Western Province	10 ZMW
6	**malaka**	Kashumba / Station market	15.2731 S, 23.1366 E	8:00 - 8:40	Kaoma, Western Province	15 ZMW
7	**mahapu**	Kashumba / Station market	15.2731 S, 23.1366 E	8:00 - 8:40	Mumbwa, Central Province	15 ZMW
8	**mahapu**	Kashumba / Station market	15.2731 S, 23.1366 E	8:00 - 8:40	Mumbwa, Central Province	15 ZMW
9	**namundalangwe**	Mongu Harbour / "Haba" market	15.2728 S, 23.1199 E	8:55 - 9:16	Kwabulosi	10 ZMW
10	**namundalangwe**	Mongu Harbour / "Haba" market	15.2728 S, 23.1199 E	8:55 - 9:16	Kwabulosi	10 - 15 ZMW

4.2. Ethnobotanical Inventory of Assayed Cucurbitaceae Plants by Local Name (Alphabetically)

4.2.1. Bitende

Synonym of mawakaka (see chapter 4.2.21).

4.2.2. Butternut squash (*Cucurbita moschata*)

None of the respondents mentioned butternut squash on their own. When directly asked about whether they are familiar with it (which was done from FGD 6 onward), respondents from FGDs 8 and 9 replied that they know this crop, but people do not grow it in their area and that there is a good market (demand) for it. They were not familiar with any local name besides "butternut".

This type of squash was available in the Mongu town Shoprite supermarket (personal observation), which is the only supermarket in Western Province of Zambia, at a price higher than any vegetables found in local markets, and it is possible the respondents could have come into contact with it there.

Interviewee Mr. Maopu was familiar with butternut as he has tried to grow it himself in the past, but was not very successful at that and so has stopped to do so. According to him, it is not common in Barotseland and is not a traditional crop. Similarly, Mr. Kaboku described the crop in detail, as he has cultivated it himself in the past, for example in the year 2019. Based on his testimony, butternut is not a traditional crop in the area and has no name in the Lozi language. Only few people grow them, however, they do have good marketability due to good palatability of the fruit. The fruit has the same yellow-orange colour inside the fruit as it has outside on its surface and the ones produced by Mr. Kaboku weighed approximately 500 grams. Seeds are flat, white and "exactly like namundalangwe", and are not eaten, as they are needed for sowing. Flowers bear a yellow colour. The cultivation period last 62 or 63 days, it can be grown between July and March and the fruit can be stored for about 3 months. Butternut squash has good marketability in the region.

4.2.3. Cucumber (*Cucumis sativus*)

Focus Group Discussions

None of the respondents mentioned cucumber on their own, however when directly asked if they know and grow cucumber (which was done in FGDs 6 and onward), all respondent groups were familiar with it (FGDs 6, 7, 8, 9). FGD 6 and 7 respondents replied that they do not grow cucumbers and FGD 7 respondents specified that they lack access to cucumber seeds. Contrarily, FGD 8 and 9 respondents do grow the crop and they mostly sell it as there is good demand for it. It is not a traditionally grown crop in the area, but rather a "modern" cash crop. They do also consume the raw fruit in small quantities and feed the remaining plant parts to livestock (FGD 8, 9). When asked about which crops should be grown more in the future, cucumber was among the species listed by focus group 9, citing the good demand for it as the reason.

Key Informant Interviews

According to the interviewees, cucumber has no locally used or alternative name and people who are familiar with it, know it by the English common name. Mr. Mupo believed that very few people grow it, while Mr. Kaboku said that more and more people grow it, in part also due to it having a positive medicinal effect against diabetes. Mr. Maopu concurred that it is grown by relatively many people despite not being a traditionally grown crop by saying: "It has become traditional now."

There is good demand for cucumbers in the region (Kaboku, Maopu). Based on the opinion of Mr. Kaboku, yields reach about 100 kg/200 m^2 (5000 kg/ha) per harvest, a singular fruit is typically 15-20 cm long and there can be up to 5 or 6 harvests per year. Further, cucumber takes 2 months to go from planting to maturity, can be planted at any time from July to April and can be stored at room temperature for 5 to 7 days (Kaboku). When left growing on the field for too long, seeds harden and lose water (Maopu). None of the interviewees were familiar with multiple types or varieties of the crop.

4.2.4. Chipungu

Synonym of mupusi (see chapter 4.2.23).

4.2.5. Kababe

Described by key informant interviewee Kaboku as a type of namundalangwe (see chapter 4.2.28).

4.2.6. Kakoloti, kankoloti, kankomolola, kamwinkolola

Synonyms of kankolola (see chapter 4.2.7).

4.2.7. Kankolola

“Kankolola“ is a commonly mentioned name (FGDs 1, 2, 3, 4, 5, 7, 8, 9 and interviewees Mupo, Kaboku), which could either represent a separate crop or a sub-set of another crop. It was described as a type of namundalangwe by some (FGDs 1, 3, 5, 8 and interviewees Mupo, Kaboku), while it was instead described by others as a type of malaka or synonym for malaka (FGDs 4, 9, interviewee Mupo), as a separate crop similar to both mupusi and namundalangwe (FGD 2) or as a separate crop unavailable in the region due to a lack of seeds, despite both namundalangwe and mupusi being available in that same region (FGD 7). Respondents and interviewees mentioned the names “Kakoloti“ (FGD 2), “Kankoloti“, “Kankomolola“ and “Kamwinkolola“ (interviewee Mupo) as synonyms to kankolola, which possibly stem from different local dialects of siLozi.

Focus Group Discussions

Kankolola was mentioned at FGDs 1, 2, 3, 4, 5, 7, 8 and 9, however the group of respondents from FGD 8 said than nobody in their area grows it and FGD 9 respondents claimed that it is merely a synonym for malaka. Fruit skin and rind of kankolola is harder than that of similar crops (FGDs 1, 2, 3, 4, 5), cannot be cut with a knife (FGD 5), instead must be split using an axe (FGD 2) and the pulp inside is then scooped out without cutting the rind further (FGDs 2, 4). The fruit shape is usually not fully round and is instead something between ellipsoid, eggshaped and oblong (FGDs 5, 7). In terms of size, the fruit is relatively small (FGDs 1, 2) and has been defined as a “small namundalangwe“ by the group of FGD 1. The skin of the fruit is yellow (FGDs 1, 2, 4, 5), white-yellow (FGDs 2, 3) or yellow-green (FGDs 2), and can bear yellow spots (FGD 3).

According to some of the respondents, seeds are small and narrow (FGD 2), white (FGDs 2, 7) and similar to malaka (FGD 4). The edible part inside the fruit is yellow (FGDs 3,

5) or “white with some yellow“ (FGD 4) in colour and sweet in taste (FGD 5). Flowers are of a yellow colour (FGDs 3, 5).

Four cell analyses had kankolola placed in the category “many people on large fields” by FGD groups 1, 5 and 9, placed in the category “many people on small fields” by FGD groups 2 and 4, and placed in the category “few people on small fields” by FGD group 3. Group of respondents from FGD 7 did not place kankolola to any of the categories as they consider it a “lost crop“, for which they have no seeds and which should be grown again in the future if possible.

Fruit of kankolola can be stored for about 3 months (FGD 2). The main use of this crop is the consumption of fruit (FGDs 3, 4, 5), leaves (FGDs 3, 5) and seeds (FGDs 3, 4, 5), as well as selling the fruit (FGDs 5, 7). Moreover, the leaves are fed to animals (FGD 5). According to FGD 4 respondents, the leaves are not eaten, as they have a “hard“ quality to them. A lack of seeds limits the production of kankolola in some areas (FGDs 3, 7). Respondents from FGDs 3 and 4 listed kankolola as one of the crops that should be grown more in the future.

Key Informant Interviews

Interviewee Mupo said that kankolola (as well as “kankoloti“, “kankomolola“ and “kamwinkolola“) could be considered at type of malaka, but at the same time “is totally different“. Mr. Kaboku defined kankolola as at type of namundalangwe, which has a hard cover (rind) that can be split with an axe, has a thinner or smaller shape of fruit, which typically has a wider, round base and a narrower top part (base). It is green-ish with white stripes and the seeds look the same as ones of namundalangwe, according to his knowledge.

4.2.8. Kankoya

Synonym or type of malaka (see chapter 4.2.16).

4.2.9. Kanyangombe

Within focus group discussion 5, respondents mentioned a plant called “kanyangombe“, which is similar to sikululu (see chapter 4.2.31), but is smaller and has two types. One of the types is round and spherical, while the other is not round and was described at first as

"rectangular", but was then drawn in the sand as an oval (ellipsoid) shape. Kanyangombe was said to change colour to yellow when it reaches maturity, although whether it is the skin or the pulp that changes colour was not described further (at the fault of the author). It is not planted by people, but it instead grows wild and is eaten by animals.

In order to obtain futher information about kanyangombe even though it was not mentioned in any other FGDs or Key informant interviews, the key informant interviewees were directly asked if they are familiar with this local name. Mr. Kaboku and Mr. Maopu were not familiar with the term and Mr. Mupo stated that "kanyangombe" refers to sikululu and etymologicaly means "dropped (excreted) by cattle", which refers to the way the seeds are naturally propagated.

4.2.10. Kapolwe

Synonym of mamonde, which is a type of namundalangwe (see chapter 4.2.28).

4.2.11. Lungwatanga (*Acanthosicyos naudinianus*)

Focus Group Discussions

The cucurbitaceous plant known in Lozi as "lungwatanga" was mentioned by respondents from all the FGD groups. According to the description given by local respondents, it is a "cover crop", creeping on the soil surface (FGD 6). Its leaves are relatively small (FGDs 3, 7), green (FGDs 3, 9), smaller than mawakaka leaves (FGD 7) and similar to mawakaka leaves (FGD 6). The fruit is green (FGDs 4, 9), or in other words is green at first and eventually turns yellow when the fruit becomes "ripe" (FGDs 1, 3, 5, 7). On the surface of the fruit, thorns are present (FGDs 1, 4, 5, 6, 7, 8) although they were described as small and not quite as hard and sharp as thorns of mawakaka (FGD 4). According to some of the resondents, the inside part of the fruit is light green (FGD 7) or is white (FGD 3), similar to the inside mawakaka (FGD 6) and contains seeds which are yellow (FGD 5), or are white (FGD 3) and are similar to the seeds of sunn hemp (FGD 6). In general, lungwatanga fruit is relatively small, usually smaller than the typical size of mawakaka (FGDs 4, 6). The flowers of lungwatanga are yellow (FGDs 3, 4, 5, 6, 7, 9) and according to information gained from FGD 3 there is a second type of lungwatanga with white flowers, though this was only mentioned by respondents in this specific FGD group.

None of the respondent groups grow lungwatanga, it is available to them merely from unplanted, naturally occuring plants. Neither did any respondents report eating its fruit or leaves, some saying that the fruit is bitter (FGD 3). The fruit and the remaining above ground parts of this plant are eaten by animals (FGDs 3, 5). In addition, veterinary medicine can be made from lungwatanga and cattle is treated with it to treat "scabies", which was described as "small wounds on skin" (FGD 2), and to treat "plasmosis" (FGD 5). Furthermore, medicine made from lungwatanga roots is used for the prevention of rabies in dogs (FGDs 8, 9), and it is applied by "brushing the teeth" of dogs with the medicine (FGD 8).

Key Informant Interviews

The interviewees described the plant as having a fruit which is either green with a light green flesh inside or yellow with a yellow coloured flesh inside and having yellow flowers (Mupo, Maopu).

The creeping herb is not planted and is a wild, commonly occuring weed in Western Province. It is eaten by cattle and according to Mr. Mupo, the seeds are not bitter, can be eaten when ground and can be used as a spice. Notably, lungwatanga is believed to have various medicinal properties and different plant parts are traditionaly used to treat different diseases of cattle (Maopu). It is used against tick-borne diseases such as the redwater disease (Kaboku). It is utilized in treatment of respiratory infections and gall bladders (Maopu). Mr. Maopu described that typically, the fruits, leaves and stems are collected when still green (not fully mature), are then pound and put into water to make a solution, which is then sprayed on vegetables to protect them from insects.

4.2.12. Mahapu, lihapu (Watermelon)

Watermelon is known in the Lozi language as "lihapu" in the singular form and "mahapu" in the plural form. Alternatively, FGD 6 respondents have agreed on the spelling "mahapwe" (and "lihapwe"), which therefore can be inferred as an alternative way name or spelling for the crop, possibly in a regional dialect or taken from another ethnic group's language.

Focus Group Discussions

All surveyed FGD groups mentioned mahapu.

Morphological description of mahapu was largely varied, as groups to a certain degree described various different types (possibly varieties) of mahapu. In some cases the described difference was limited to different colours of seed, while some groups described varying fruit skin and mesocarp colours. In cases where the size and shape of the various types were mentioned, they were said to be the same for all the types.

FGD 1 described 2 types of mahapu – first with white flesh inside the fruit and second with red flesh (both specifically when ripe). Both of the types were said to be green and white on the outside surface of the fruit and no further description was given.

FGD 2 described two types, one with light green skin (without white patterns), white pulp inside and black seeds and a second type with green and white-striped skin, red pulp inside and red seeds. In addition, both types were said to have narrow and small, branching (lobed) leaves and small yellow flowers.

FGD 3 described 2 types of fruit – first with green and white-striped or white-spotted skin and red pulp, and second with green-only skin and white pulp – and separately described 5 types of seeds by colour without interconnecting the two divisions. They described seeds that are black, second type that is brown or "a bit brown and yellow", third type with black half of seed surface and white color on the other half (divided crosswise in the middle), fourth type with a black oval shaped in the center of the flat surface of seed surrounded with white colour around (as can be seen on seed sample S8 in Appendix 2) and fifth type with a light brown colour. On top of this, all types were said to have small and narrow leaves.

FGD 4 group's description suggests that mahapu is either green and white on the surface with red pulp and black or maroon seeds, or can instead be white inside with the same seed and skin colours, or can instead have red pulp with red seeds (whether this is a third type, different from the first type is not clear, which was due to the group not being in agreement with one another enough to give a unequivocal answer). All types have yellow flowers.

FGD 5 respondents described 2 types of mahapu. First type with green skin, red pulp and black seeds and a second type with the same skin colour, red seeds and pulp which is white at first and turns red with age and maturity. Flowers are yellow and leaves are the of the same size and shape in both types.

FGD 6 described two distinct types of "mahapwe", one with red pulp and black seeds and the other with white pulp and brown seeds. However, both types are supposed to have the same dark green skin colour with "blackish" patterns visible upon closer inspection, which makes them hard to tell apart. Flowers of both types are yellow and were described as big, but smaller than namundalangwe leaves.

FGD 7 respodents know mahapu with red pulp and ones with white pulp. Furthermore they know a type with black seeds and a type with red seeds. Whether or not these types based on pulp colour and types based on seed colour overlap is not clear. According to this group, all mahapu have green-and-white skin colour, yellow flowers and the fruit size depends on type of soil. They described the leaves as larger than leaves of both lungwatanga and mawakaka, but smaller than leaves of mupusi.

In addition to yellow flowers and branched leaves smaller than leaves of namundalangwe, FGD 8 respondents described mahapu as having 3 types differing only in seed colour – black, red or brown. All types have the same colour of skin and are red inside.

FGD group number 9 was familiar with a type of mahapu having black seeds and a type having brown seeds. They did not describe the colour of skin and said that the colour of pulp can be red or white. Further, they provided that flowers are yellow and leaves are green with white spots.

In the four cell analysis, FGDs 2 and 7 placed mahapu in the "few people on small fields" category, FGDs 4 and 6 placed it in the "many people on small fields" category, FGDs 4 and 6 placed it in the "few people on large fields" category and FGDs 1, 8 and 9 placed it in the "many people on large fields" category. The main use of mahapu for the respondents is selling it, as it is on good demand (FGDs 1, 2, 4, 5, 6, 7, 8, 9). The respondents eat the fruit (FGDs 1, 2, 3, 4, 5, 6, 7, 8, 9), some eat the fried seeds (FGD 3), but none eat the leaves (FGDs 1, 3, 4, 5, 6, 7, 8, 9). In some areas, like in the FGD 4 respondents' area, mahapu seeds are difficult to acquire and seeds are therefore not eaten in those areas. Seeds are available for purchase in shops, but are relatively expensive for farmers to purchase (FGD 4). Some people feed mahapu (leaves or entire plant) to animals (FGDs 4, 5, 6, 9), while others do not (FGD 1, 3, 7, 8).

When asked about disadvantages of mahapu and its traits that they do not like, respondents mentioned that the fruit gets damaged easily, which leads to spoilage (FGD 1), that unlike with other crops they cannot eat its leaves (FGD 5) and that they eat the

fruit when they run out of drinking water, and therefore it has a bad association (FGD 2). FGD groups 4 and 8 listed mahapu as one of the crops, that should be grown more in the future.

Key Informant Interviews

Mr. Mupo described two types of mahapu each having green skin with white stripes, one with red pulp inside and the other with white pulp, and also described that they can have red seeds or black seeds. He believes that the two different pulp colour types represent two different varieties of watermelon, which however cannot be distinguished using any apparent morphological trait besides the pulp.

Mr. Kaboku recognizes two types of mahapu which differ in colour of pulp – red or white. Unlike Mr. Mupo, however, Mr. Kaboku claimed that the seed are the same in both types and are black in colour wih a hard seed cover.

Mr. Maopu also described a type with red pulp and a type with white pulp, adding that the red pulp is noticably more sweet, is more popular and more commonly grown. The colour of the skin was said to be seemingly the same for both types, but in actuality likely not entirely the same, as farmers have a way of distinguishing the two types apart. Furthermore according to Mr. Maopu, the seeds are brown with black spots and there are no other types (colours) of seeds.

Flowers are yellow (Mupo, Kaboku, Maopu) and Mr. Maopu claimed that they are white at first and as they grow over time become the same kind of yellow colour as namundalangwe flowers. Leaves are around the size of lungwatanga leaves (Mupo).

Mahapu fruits are eaten, while leaves are not (Mupo, Kaboku, Maopu). Mr. Mupo mentioned that seeds can be eaten, but are not commonly so and Mr. Kaboku ad Mr. Maopu said that seeds are not eaten. Similarly, Mr. Mupo was the only interviewee to mention that leaves and stems can be fed to livestock. Advantages of mahapu cultivation include the fact that the fruit is popular and thus can be sold, and that it is "good for the soil". Undamaged fruit with handle (part of peduncle) can be stored at ambient temperature for 3 months (Kaboku, Maopu), or according to Mr. Mupo only for 1 to 2 months.

When grown without irrigation, it is typicaly planted at the begining of rainy season or just before its start and harvested after 5 months (Mupo). Conversely, when grown using

irrigation they are typically ready for harvest in February (Maopu). Alternatively, according to Mr. Kaboku, mahapu is planted at the end of cold season (around July) and then "must be irrigated", so they ripen before the start of the rainy season, otherwise they will take up too much water and rupture. It can be intercropped with cassava (Maopu).

4.2.13. Mahapwe, lihapwe

Synonym of mahapu (see chapter 4.2.12).

4.2.14. Machila

Synonym of malaka (see chapter 4.2.16).

4.2.15. Makowa

FGD 3 respondents mentioned a crop called (presumably in siLozi) "makowa" and said that a few of them grow it for its edible fruit and seeds. It is similar to sikululu, having the same colours of skin and pulp at first. However, when the fruit reaches full maturity, the colour of the pulp changes from white to yellow, unlike in sikululu, which can be used for differentiation of the two crops. Leaves of makowa are not eaten, because they are bitter in taste.

In order to obtain futher information about makowa even though it was not mentioned in any other FGDs or Key informant interviews, the Key informant interviewees were directly asked if they are familiar with this local name. Mr. Kaboku and Mr. Maopu were not familiar with the term and in Mr. Mupo's opinion, makowa is a Tonga language expression for mawakaka.

4.2.16. Malaka

"Malaka" is one of the names in the Lozi language for a specific type of pumpkin. According to key informant interviewee Mupo, in the Kololo language (which is a sub-set or "dialect" of the Lozi language) "malaka" has a meaning of "pumpkin that has lost its food supply" or "abandoned by mother". Similarly, according to key interviewee Kaboku, "lilaka" (which likely is a another form of the word "malaka") carries a meaning of "abandoned by water" and in the Sesotho language it means that "supply to it was cut" and so it "becomes small and dies".

Respondents from focus group 2 used the name “kankoya“ as a synonym for malaka. More specifically, they use it as a name for a specific sub-type of malaka named after a tribe of the same name, which resides in the Kaoma District part of Zambia‘s Western Province. Additionally, FGD group 6 used the name “machila“ as a synonym for malaka. Key informant interviewees Mupo and Maopu were also familiar with the name “machila“ and Mr. Maopu specified that it is a Luyana language expression imbued with the meaning “escaped from home“ and that it was the original expression used in Luyana instead of “malaka“ before the language fused with Kololo to form the Lozi language. Another synonym, used by respondents of FGD 7, is “matiba“. Based on the testimony of Mr. Maopu, “matiba“ is a plural form of the singular word “katiba“, which is used by the bunda tribe (who are a part of the Lozi people) and means “something that has gone from the center“. Furthermore, Mr. Maopu listed “muungu“ as an equivalent of malaka in the bemba language, and mentioned the term “matanda“, which refers to the crops malaka, mupusi and namundalangwe as a whole. “Myuku” is considered by some to be a type of malaka (see chapter 4.2.16).

“Kankolola“ as well as other names that are likely synonyms of this name such as “kakoloti“, “kankoloti“, “kankomolola“ and “kamwinkolola“ were described by some as a type of malaka (FGDs 4, 9), however these terms more likely refer to a separate crop or variety (see chapter 4.2.7).

Focus Group Discussions

All the FGD groups mentioned malaka and each provided a relatively large amount of information about it, thus it seems to be a commonly cultivated plant in all the regions in which the FGDs were conducted.

Apparently, the crop occurs in the area in the form of several morphologically distinct types (possibly varieties or cultivars), as all of the respondent groups described more than one type of malaka. The types differ in shape and size, colour of fruit skin and colour fruit pulp. Usually, the respondents did not describe clearly separated varieties of malaka, but instead listed the various colour or shape traits that malaka fruit can have (FGDs 3, 5, 6, 7, 9), with the exception of FGDs 1, 2 and 4.

FGD 1 respondents described 3 unnamed types of malaka differing in colour of fruit skin and pulp: first with either light green, green or white skin and white pulp, second type

with green skin and yellow pulp and a third type with green or white skin and light green pulp. The green-skinned types were further mentioned to sometimes have “a bit of stripes“ (a pattern).

FGD 2 respondents provided information about 3 distinct types of malaka. First mentioned type is called “kankoya“ (the only one of the types with a specific name) and the fruit has green skin, yellow coloured pulp, is larger than the second type and is more or less rounded in shape. Second type has white-coloured pulp, has the same shape as kankoya, but is smaller and has green skin with protuberances that are “like thorns, but not really thorns“. A third type of malaka has a prolonged, ellipsoid shaped similar to siponchi. The colours of the third type were not found out. Leaves of malaka were said to be of a dark green colour, regardless of type.

FGD 4 provided a description of 4 malaka types based on colour of fruit skin and pulp. First type has green skin and white pulp, and is more common than the second type, which is green on the skin and yellow inside the fruit. A third type has a white fruit skin and yellow pulp, and is more commoly distributed than the fourth type, which is white both in skin and pulp. All malaka crops regardless of type were stated to have brown seeds and white flowers.

The respondents from the other FGDs described that malaka fruit can have its fruit skin be green (FGDs 3, 5, 6, 9), light-green (FGD 7), light-grey (FGD 7), yellow (FGD 5) or cream-white (FGDs 3, 6). Some groups mentioned that the surface of malaka fruit can have a kind of morphological protuberances, which to the respondents seem as if there should be a thorn on top of them (as they liken them to the protuberances of mawakaka and lungwatanga), but are in fact thorn-less (FGDs 3, 6). These protuberances can be seen on a sample of malaka in Figure 13. When the fruit is dried, its colour changes to brown (FGDs 3, 9). The colour of the fruit pulp can vary between yellow (FGDs 3, 5, 6, 7), white (FGDs 3, 5, 6, 7), or green (FGD 6). Various possible shapes of fruit of malaka include: round or round-like (FGDs 3, 6, 7, 9), prolonged, ellipsoid similar to siponchi in shape but not necessarily in lenght (FGDs 3, 6, 7, 9), round with a narrow, “long and extended“ part on the base of the fruit (FGDs 6, 9) or various, not clearly defined shapes that are neither round nor ellipsoid, but somewhere in between (FGDs 3, 7). Flowers of malaka are white (FGDs 3, 5, 6, 7, 9). Seeds are brown (FGDs 5, 6, 9), more specifically “coffee brown“ (FGD 5) and have “rough parts“ (FGD 9). Leaves are a bit smaller than the leaves

of sihwana (FGD 3), the same size as mupusi leaves (FGD 7) and are similar to mupusi leaves (FGD 6).

Figure 13: Sample of malaka fruit received on 28. 4. 2022 from interviewee Kaboku, showing protuberances on the fruit surface. Note that the surface is partially damaged, which may have changed its appearance (author, 2022).

Malaka fruit pulp is eaten (FGDs 1, 2, 3, 4, 5, 6, 7, 8, 9). It is a popular food, especially as a breakfast food (FGD 1), has good marketability and the fruit is therefore typically sold by farmers as a cash crop (FGDs 1, 2, 3, 4, 5, 6, 7, 8, 9). It grows fast during the rainy season, when its cultivated without irrigation (FGDs 1, 6). Low manure requirements were listed as an advantage of malaka production by FGD 2 respondents. FGD 9 was the only group to mention that malaka fruit hardens when it becomes mature and must for this reason be consumed when still immature. It is therefore unclear whether this applies only to a specific type of malaka.

Some respondents claimed that malaka leaves are not edible (FGDs 1, 4, 9), and are not fed to livestock (FGDs 1, 4, 7). Contrarily, some respondents reported that leaves are eaten (FGDs 3, 5, 7) and are fed to livestock (FGDs 5, 6, 9). FGD 6 respondents have explained that some people eat the leaves and some people do not, because the leaves have a scent and taste that only some people like, and the FGD 8 group said that malaka

leaves are bitter. Additionally, one of the types of malaka has leaves, which are cooked and used alongside namundalangwe seeds to prepare a specific type of relish (FGD 2). According to some, the seeds are eaten (FGDs 5, 6, 7), although FGD 4 respondents said that the seeds are not eaten and some respondents stated that the seeds are only edible or only eaten when they are still immature (FGDs 1, 9).

Key Informant Interviews

All three interviewees were familiar with malaka and described various types of different shapes, sizes, skin colours and pulp colours.

Mr. Mupo described that some malakas are rounded, some oblong and some have a "neck" (long, narrowed part at the fruit base) similar to fruits of sihwana. Some are smooth, while others have a rough skin and they can be white or green. The fruits of malaka are smaller on average than fruits of namundalangwe and mupusi. Pulp colour can be white or yellow. Mr. Mupo described flowers as yellow, however said that he is not certain of this fact. He stated that seeds are brown, but are "bumpy" and of a darker hue than namundalangwe and mupusi seeds. Moreover, it was said that malaka seeds look like sihwana seeds, but are smaller in comparison. When asked directly, Mr. Mupo reported that the shape and colour of the fruit remains the same when a seed is taken from a specific fruit, planted and grown into a new plant – that the fruit on the daughter plant retains the same morpological traits. In other words, this suggests that the morphological traits are hereditary and would corroborate that the different types of malaka are distinct varieties rather then one (or more) type, variety or crop with multiple, randomly expressed morphological traits (as in various possible phenotypes from one genotype).

Mr. Kaboku differentiates types of malaka by shape and size and he went on to describe about 6 various shapes of malaka fruits – some rounded, oblong, oblong-curved, with a "neck" and some oblong but with thinner part in the middle than the rest of the fruit. Like interviewee Mupo, Mr. Kaboku also stated that seeds retain the morphological traits of their mother plant and that farmers typically keep various malaka seeds of different fruit shapes. However, Mr. Kaboku claimed that each type of malaka shape and size can be found in any combination of colours. The most common variety was designated to be the type of malaka which is rounded, with green coloured skin and having "spikes" (protuberances) on the surface similar to those of mawakaka. Overall, according to his testimony, the fruit skin colour can be green, yellow or white and the fruit pulp is either

white or yellow in colour. Furthermore, flowers are white and seeds are always brown. Leaves of malaka can be used for differentiation from namundalangwe and mupusi, as it never has any "spines or spikes" on the surface of its leaves, while both namundalangwe and mupusi do have some of these structures on the abaxial side of their leaves.

Mr. Maopu reported that there are various types of malaka, described some of them and stated that different varieties are well suited to different areas or soils and they also differ in taste of fruit. According to his descriptions, some malakas are green, light-green or greyish (possibly almost seeming light-blue) on their surface. Malaka types have white or yellow flesh inside and various shapes. Seeds are brown, darker than mupusi seeds, while flowers are white or pinkish, but most commonly white.

Malaka is a traditional crop (Mupo, Kaboku, Maopu) and along with namundalangwe and mupusi has been cultivated "since time immemorial", already cultivated before the Lozi people migrated from the area of today's Congo more than 300 years ago (Maopu). Its fruit is eaten (Mupo, Kaboku, Maopu), for example cooked with milk and sugar (Mupo), with fresh sour milk after being cooked (Maopu) or eaten whole with skin and seeds when the fruit is immature and thusly not yet hardened (Maopu). Outside of this specific case, the seeds are not eaten (Mupo, Kaboku, Maopu), as they become too hard. Leaves of malaka have a bad smell (Mupo), are slightly bitter (Maopu), and are usually only eaten in times of food scarcity as a famine food (Mupo, Kaboku). The fruits are commonly sold (Mupo, Kaboku, Maopu) and malaka is not fed to animals (Kaboku, Maopu). Shelf-life of immature fruit is typically 4 days long (Mupo) and mature (ripe) fruit, if the "handle" (part of peduncle) is still attached to the fruit, can be stored for about 3 months (Maopu).

This crop can be grown intercropped with maize, pearl millet or even cassava (Maopu) and, according to Mr. Maopu, this practice is commonly used (especially with maize). It needs a significant amount of water to cultivate malaka and so it is grown exclusively either during the rainy season or under irrigation. Typically, it is planted in November and grown for 3 to 4 months. However, uneven ripening (on the field) is an agronomical problem connected with malaka production and a field of malaka can therefore not be harvested all at once, but instead on a plant-by-plant basis. It is an early producing crop (which is connected with the uneven ripening) and is therefore a source of food relatively early into the rainy season.

4.2.17. Mamonde

A type of namundalangwe (see chapter 4.2.28).

4.2.18. Manende

Described by FGD 6 respondents as a synonym of mawakaka (see chapter 4.2.21), however, the same group described morphological differences between mawakaka and manende, so it likely is not merely a synonym. It could be a type of mawakaka, or possibly it could be *Cucumis anguria*.

Respondents of FGD 6 described manende as different from mawakaka by having different kind of "thorns", which are more like hairs than thorns. The fruits were said to be green when immature and yellow when mature, and typically smaller than a fist. Flowers of manende are yellow and the leaves are the same size as mawakaka leaves. A sample of manende fruits provided by FGD 6 respondents can be seen in Figure 14.

This description is in accordance with botanical descriptions of *Cucumis anguria* in the PROTA4U and Flora of Zambia databases (Wilkins-Ellert 2004; Bingham et al. 2023b).

Figure 14: Fruits identified as "manende" by FGD 6 respondents, who consider it a type of mawakaka (author, 2022).

Based on information attained from FGD 6 respondents, manende has similar uses to mawakaka, including edible fruits, which however have a different taste than those of mawakaka and cannot be eaten raw, only boiled. The fruits are eaten cooked either on

their own or put into relishes. It is not fed to animals and this was also one of the disadvantages mentioned for this crop by FGD group 6, along with the fact that the fruit cannnot be eaten raw. Whether manende is a cultivated crop or a species occurring naturally is not clear as the respondents did not spontaneously mention this and neither was it asked about directly.

FGD 3 perhaps also described manende as one of the two types of mawakaka which they had described, though never did they call the types by any name other than mawakaka. One of the mawakaka types they described has small fruits with hairs instead of thorns, and is green when young and orange when ripe.

4.2.19. Matanda

A term referring to malaka, namundalangwe and mupusi, without distinguishing between them (see chapters 4.2.16, 4.2.28 and 4.2.23 respectively).

4.2.20. Matiba, katiba

Synonym or type of malaka (see chapter 4.2.16).

4.2.21. Mawakaka (*Cucumis metuliferus*)

Mawakaka (which is identified by the author as *Cucumis metuliferus*) is a siLozi name for an edible plant, and "mawakaka" specifically is the plural form of the word, with "liwakaka" being the same name in singular form. Respondents of FGD 9 agreed on the slightly different spelling "mahwakaka". "Manende" (FGD 6) and "bitende" (FGD 7) were identified as synonyms for mawakaka, however is more likely to not be just a synonym, but rather a type of mawakaka or possibly *Cucumis anguria* (see chapter 4.2.18).

Focus Group Discussions

This plant was mentioned on all the focus group discussions. Fruits of mawakaka are green at first and change into a yellow (FGDs 1, 4, 5, 7, 9), orange (FGDs 1, 2, 3, 4, 6, 9), brown (FGD 3) or red (FGDs 8, 9) colour and have greenish lines, spots or stripes (FGD 7). When the fruit is cut open its insides are described as green (FGDs 1, 4, 7) or yellow (FGD 5) and they contain seeds of colour described as white (FGDs 4,5,8), red

(FGD 4), green (FGDs 6,7) or black (FGD 9). The fruit surface is dotted with thorns (FGDs 2, 3, 4, 5, 6, 7, 8) and, according to respondents of FGD 4, the thorns harden as the fruit matures and have to then be cut down with a knife. Alternatively, respondents of FGD 3 described two types of mawakaka: first type with big, thorny fruit, which is green when young and brown when ripe, and a second type with small fruit with hairs instead of thorns, which is green when young and orange when ripe. Flowers are yellow in colour (FGDs 3, 4, 5, 6, 7, 8, 9). Leaves of lungwatanga were said to be branched (lobed) (FGD 4), similar to siponchi leaves (FGD 1), similar to mahapu leaves (FGD 4), small like lungwatanga leaves (FGD 5, 6) and of medium size and smaller than mupusi leaves (FGD 7).

Flora of Zambia describes *Cucumis metuliferus* as having "broadly ovate, more or less shallowly (3-)5-lobed" leaves, yellow or pale orange flowers, fruits covered with stout, fleshy spines, often mottled, grey-green, orange-yellow in colour, eventually turning bright orange-red when ripe (Bingham et al. 2023c). PROTA4U describes the same species as of leaves that are "blade ovate or pentagonal in outline" and "shallowly palmately 3–5-lobed", having yellow flowers and producing fruits that are covered with "stout, broad-based, spiny protuberances" and are mottled, green, eventually turning yellow to bright orange (Wilkins-Ellert 2004b). These descriptions are largely in accordance with the descriptions provided by FGD respondents, with the exceptions of FGD 3 respondents saying that the fruit can turn brown (which is possibly true when the fruit spoils or rots, though whether that is what the respondents meant is uncertain) and also claiming that there are two distinct types of mawakaka, possibly considering another similar species such as *Cucumis anguria* as one of the sub-types.

Four cell analysis showed that most commonly mawakaka is grown by few people on small fields (FGDs 2, 3, 5, 6, 7, 9), in some areas by few people on large fields (FGDs 4, 8) and in the case of FGD 1 not grown by any respondents. Despite this, none of the respondents of FGDs 3, 4, 5, 7 and 8 have been growing mawakaka at the time of the interview (or during the prior rainy season), either due to a lack of available seeds (FGDs 3, 4, 7) or for an unspecified reason. Mawakaka fruits are edible and their consumption is the main way the interviewed communities use this plant. They can be eaten raw, put into a relish (FGDs 2, 6, 9), used in preparation of soup (FGD 2) or fed to animals,

especially goats (FGD 6). Furthermore, the groups of FGD 2 and FGD 6 mentioned that mawakaka leaves are also edible, but they themselves do not consume them.

When asked about advantages of growing mawakaka, the respondents of FGD 2 said that leaves of mawakaka which fall off the plant "contribute to manure". As disadvantages, respondents of FGD 6 mentioned that mawakaka is "worthless" and that there is "no demand" for it. As a response to a question about which crops should be grown more in the future, respondent group of FGD 2 said that mawakaka should be grown more "because it is food" and because it can grow on sandy soils.

Key Informant Interviews

Mr. Kaboku did not provide information about mawakaka as he said that he does not know much about this crop and because it does not commonly grow in the area north of Mongu town. In contrast, both Mr. Mupo and Mr. Maopu were more familiar with mawakaka and described it as a creeper covering the soil and as having yellow flowers and having a green, thorny fruit which over time turns yellow or orange and has many seeds inside.

According to Mr. Mupo, it is eaten either as a whole fruit (including skin and underdeveloped thorns) when immature and still green, or only the inside of the fruit when it matures. And the leaves are not eaten. Furthermore, Mr. Mupo stated that there are no distinct types of mawakaka.

According to Mr. Maopu, the flesh inside the fruit is eaten fresh or it is dried and used as an ingredient in relishes. It is commonly sold and can be fed to animals when unripe. Moreover, it is "usually" intercropped with cassava, pearl millet or maize, it "acts as a mulch" and prevents water evaporation, protects against soil erosion and fixes air nitrogen. The fruits are harvested when they first start to turn yellow. It is planted around November and harvested around March, as farmers take advantage of the rainy season, because mawakaka needs warm nights, warm days and the moisture this season provides. If the fruit is harvested along with the "handle" (peduncle) it has a shelf-life of more than 1 month, if it is harvested without the peduncle it lasts for less than a month.

4.2.22. Mukope

"Mukope" is a vernacular name mentioned by respondents from FGDs 2, 3 and 6, as well as by key informant interviewees Mupo and Maopu. FGD 4 respondents were also familiar with the term, though did not mention it on their own without being asked about it directly, presumably because it is not grown in their area anymore. The name "mukope" was reported to mean "shaped like a cup" (FGD 2).

This name refers to a cup-shaped product made from sihwana fruits (see chapter 4.2.29) of a certain shape and size (FGD 2) or possibly also refers to a specific type of the sihwana crop, bearing fruit of the specific characteristics (Mupo). Alternatively, FGD respondents said it refers to a smaller myuku (see chapter 4.2.25), and FGD 4 respondents and interviewee Mupo said that it is a type of malaka (see chapter 4.2.16). Seeds are brown (FGD 6) and cannot be told apart from malaka seeds, as they have the same apperance (FGD 3). Flowers are white (FGDs 3, 6). Mukope leaves are of "medium size" and generally the same as sihwana leaves (FGD 3).

The shape of the fruit has a rounded part around the apex and a "neck" going from the base, which is long and narrow, and can be straight or curved. According to FGD 2 respondents, farmers modify the fruit shape while it grows on the plant, which was also mentioned by interviewee Mupo. After harvest, the fruit is hollowed out the same way as is used to hollow out sihwana containers (see chapter 4.2.29) so that it can then hold liquids and is used as a cup for drinking (FGDs 2, 4, interviewees Mupo, Maopu) or as a ladle for drawing beer (Mupo). FGD 3 respondents reported that mukope is no longer grown in their area.

4.2.23. Mupusi

One of the 3 most common pumpkin crops cultivated in Western Province bears the name "mupusi". Alternatively, "muungu" was used as a synonym by respondents of FGDs 6 and 8 as well as by key informant interviewee Mupo, who specified that this term comes from the Luyana language. Muungu has also been used by FGD 3 respondents as a common name for both mupusi and namundalangwe. Moreover, the name "chipungu" was used as a synonym by the respondents from FGD 7. According to key informant interviewee Kaboku, mupusi does not have any separate forms for the singular and the plural and the same word is used in both contexts.

“Sichocholo“ was defined by one of the FGD 9 group of respondents as a name for immature mupusi, that is eaten uncooked. It, however, could have other meanings instead (see chapter 4.2.28).

Focus Group Discussions

Mupusi was mentioned by all focus groups. The respondents provided a description of mupusi with a variety of fruit skin colours, fruit pulp colours, fruit shapes, fruit sizes and seed colours. The skin is green when the fruit is immature (FGDs 3, 6, 7, 9) and change colour to grey or light grey (FGDs 1, 4, 5, 7, 9), white or cream white (FGDs 1, 2, 3, 4), green (FGDs 2, 3, 7), light green (FGD 1), white-yellow (FGD 6) or yellow (FGD 9). Moreover, some of these colours can be covered with a white or light grey pattern of stripes, dots or similar shapes (FGDs 1, 3, 7). The fruit pulp is yellow (FGDs 3, 5, 6, 9) or orange (FGD 7). Fruits are said to be smaller on average than namundalangwe fruits (FGD 1) or are of the same size (FGD 2) and overall can be found in various sizes and in various shapes, such as rounded, round but flattened, cylindrically oblong and possibly other shapes in between (FGDs 2, 4, 6, 7). Mupusi flowers are yellow (FGDs 3, 4, 5, 6, 8, 9) or orange (FGDs 7, 9), or possibly something in between, as for example within FGD 9, some respondents said the flower colour is yellow, while other disagreed and said it is orange. Seeds are white (FGDs 4, 5, 6, 7, 8, 9), brown (FGDs 6, 9) or beige (FGD 7). Mupusi leaves grow into various sizes depending on the soil fertility (FGDs 3, 6) and, unlike namundalangwe leaves, do not have any white spots or other white coloration (FGDs 5, 8), which could be used for differentiation of the two crops.

Mupusi is a significantly prevalent crop in the surveyed areas, as is supported by the four cell analyses, in which the majority of FGD groups placed mupusi in the “many people on large fields” category (FGDs 1, 3, 4, 5, 6, 8, 9), and groups from FGDs 2 and 7 placed it in the “many people on small fields” category. Fruits of mupusi are eaten (FGDs 1, 2, 3, 4, 5, 6, 7, 8, 9), as well as leaves (FGDs 3, 4, 5, 6, 7, 8, 9) and seeds (FGDs 3, 4, 5, 6, 7, 8, 9), which can be pound and put into a relish (FGDs 3, 6, 7, 9) or roasted (FGD 6). Respondents from the FGD 4 group used the word “mangambwa“ as a name for mupusi leaves, however the term possibly refers to all edible pumpkin leaves or to a specific dish. Some respondents reported that mupusi is fed to animals such as cattle and goats (FGDs 4, 5, 6, 9), while others claimed it is not fed to animals (FGDs 7, 8). It is commonly sold

as a cash crop (FGDs 2, 3, 4, 5, 6, 7, 8, 9). According to one of the respondents, the fruit can be stored for about 6 months (FGD 7).

The fact that mupusi attracts animals was listed as a disadvantage for its cultivation by FGD 1 respondents. Respondents from focus groups 7 and 8 mentioned mupusi as one of the crops that should be grown more in the future.

Key Informant Interviews

The three interviewees each were familiar with mupusi and described it with a certain degree of morphological and colour-based diversity. Skin colour of fruit is green (Mupo, Kaboku), whitish green or light green (Kaboku, Maopu) or light brown (Kaboku), and the fruit pulp is yellow (Mupo, Maopu). Fruit shape is most commonly spherical (Mupo, Kaboku, Maopu), but can also be flattened round, cylindrically oblong or variously ellipsoid (Kaboku, Maopu). Further, according to Mr. Kaboku's testimony, one of the round-shaped types of mupusi has a grooved, uneven surface, which was likened to that of cantaloupe. Based on the believes of Mr. Kaboku, a particular variety retains its shape and colours after planting its seeds, and combinations of shape and colour are greatly varied – a particularly shaped fruit can be found in any colour combination. Furthermore, no one particular type (combination of fruit shape and colour) of mupusi is more in demand and marketable than the others (Kaboku). Flowers are yellow (Mupo, Kaboku, Maopu) and seeds are brown (Mupo, Maopu) or beige (Mupo). According to Mr. Maopu, inside the fruit, the seeds are surrounded by a "hairy" (fibrous) structure, are removed from it along with these fibers and are therefore not consumed directly together with the fruit. Mupusi's leaves do not carry any white spots unlike namundalangwe (Mupo, Maopu).

Fruit pulp is consumed after being cooked in a similar way as malaka (Mupo, Kaboku, Maopu) and some people like to eat it along with the rind (Kaboku). Only some people eat the leaves (Mupo, Kaboku) because they have a "bad smell", but more people would eat them in times of food scarcity (Mupo). Seeds of mupusi are eaten entire, roasted or are pounded and used in a relish (Mupo, Kaboku, Maopu). Leaves and potentially also fruits are fed to livestock (Mupo).

It is a traditional crop, cultivated along with malaka and namundalangwe since before the migration of the Lozi people from more northern parts of Africa, which took place about

320 years ago (Maopu). Storability of the fruit reaches approximately 3 months (Kaboku, Maopu). It can be intercropped with maize, sorghum or cassava (Maopu). Mupusi is grown during warmer parts of the year and is typically planted in November and cultivated rainfed during the rainy season (Maopu).

4.2.24. Muungu

Synonym of malaka or mupusi (see 4.2.16 and 4.2.23 respectively). Possibly a term encompassing both mupusi and namundalangwe without distinguishing between them.

4.2.25. Myuku

"Myuku" was described by the respondents of the FGD 6 group as well as by key informant interviewees Mupo, Kaboku and Maopu as a music instrument (or part of a music instrument) made from the fruit of cultivated crop – whether or not this name can also be used to refer to that crop or a specific type of that crop is unclear. According to the FGD 6 respondents and to Mr. Maopu, the crop is a type of sihwana (see chapter 4.2.29), according to Mr. Mupo it is either sihwana or malaka and according to interviewee Kaboku, it is a type of malaka. The crop (or type of that crop) is green as it grows and eventually turns brown when it is dried (FGD 6). Based on the description from FGD 6 respondents, its seeds are brown, flowers are white and fruit shape are various, similar to (or possibly the same as) shapes of sihwana fruits. It is not edible (Kaboku). The fruits are instead hollowed out (like containers made form sihwana), placed under a "plank" in the traditional xylophone music instrument and used to change the tone that the plank makes while struck (Mupo, Kaboku, Maopu). A traditional xylophone can be seen in Figure 15.

Figure 15: Traditional xylophones made by the Lozi people. Photographed outside of a gift shop located in the northern part of Mongu town (author, 2022).

4.2.26. Namuchoko, muchoko

Synonyms or types of namundalangwe (see chapter 4.2.28).

4.2.27. Namuchokwe

Synonym or type of namundalangwe, possibly another form of the word “namuchoko“ (see chapter 4.2.28).

4.2.28. Namundalangwe

The name “Namundalangwe“ refers to a local pumpkin crop, that in itself contains a notable variety in terms of morphological forms, colouration, taste of fruit and uses, which could be indicative of the existance of localy used varieties, cultivars or landraces within this crop. Moreover, various vernacular names were recorded, each of them representing either a synonym to namundalangwe or potentially a name specific for a sub-type (possibly variety) of the crop. “Mundalangwe“ was used as a name for

namundalangwe by respondents from FGDs 5 and 8, it is inferred as a synonym and likely is another form of the word "namundalangwe" in the same local language (similarly to for example how both "siLozi" and "Lozi" can be used to refer to the Lozi language and how both "maKololo" and "Kololo" can be used to refer to the Kololo ethnic group of people).

"Sichocholo" was put down as a synonym, specifically meaning "small namundalangwe" (FGD 1). According to key informant interviewee Kaboku, it corresponds to soft, immature namundalangwe fruit. Contrarily, according to FGD 9 respondents, this term refers to immature mupusi, which is eaten cooked.

"Kankolola", as well as its synonyms "kakoloti", "kankoloti", "kankomolola" and "kamwinkolola", could possibly represent a synonym or sub-type of namundalangwe, though are likely instead names for a separate crop or variety (see chapter 4.2.28). Additionally, key informant interviewee Kaboku described a type of namundalangwe, which is called "kababe".

"Mamonde", along with its synonym "kapolwe", is a type of namundalangwe – based on the testimony of FGD 1 respondents. Specifically, it has green fruits when they are immature, that later turn into an orange colour (not yellow) on the surface. The fruits should be larger than those of kankolola, but smaller than those of namundalangwe proper.

"Namuchoko" was mentioned by respondent groups of FGDs 1, 2, 4, 6 and 7, and by key informant interviewee Maopu. FGD 1 respondents defined the term as a harder type of namundalangwe, while, contrarily, all the other FGD respondents said that it was simply a synonym of namundalangwe, with FGD 2 respondents adding that it is an original, traditional name for namundalangwe. Interviewee Maopu described it as a type of namundalangwe, which bears green fruits, that are of a white colour inside the fruit and have a shape and size similar to mahapu. Furthermore, he stated that namuchoko is not commonly eaten or grown nowadays and only occurs in the wild. It used to be grown, but people stopped to do so, because its fruit has a mediocre, non-sweet taste (as compared to namundalangwe, malaka and mupusi) and it therefore is more of a famine food. According to key interviewee Maopu, the word "namundalangwe" may be introduced into siLozi, and the Luyana language expression "namuchoko" is the traditional name for this crop. However, still according to Mr. Maopu, "namuchoko" is also another, separate

name for a type of "namundalangwe", which is not cultivated, grows wild, cattle feeds on it and is eaten by humans in times of food scarcity. Additionally, he mentioned that the term "muchoko" refers to all mupusi, malaka and namundalangwe combined.

"Namuchokwe" (which possibly is an alternative spelling of "namuchoko", however, this was not mentioned by any respondents or interviewees) was mentioned by the FGD 4 respondent group and specified to be a name for namundalagwe, more specifically for "tasteless namundalangwe". They reported that it can be eaten (fruits, seeds and leaves) as well as fed to animals, and in their opinion it should not be cultivated.

"Siteti" was used by the focus group 1 respondents as a version of "namuchoko" in a specific dialect, and specified that when a field with namuchoko is flooded with water, which changes the appearance of namuchoko fruits, then the fruits are called siteti.

Focus Group Discussions

Namundalangwe was known to all the respondent groups and was mentioned at all the FGDs.

When mature, its fruit can have a striped or otherwised shaped pattern on a green colour (FGDs 1, 2, 5), a green surface presumably without a pattern (FGDs 1, 4, 5, 7), a light-yellow with a white-ish pattern (FGD 3), a yellow-to-orange colour with a spotted pattern (FGD 4), a yellow colour (FGDs 1, 4, 5, 8, 9), a grey colour (FGDs 5, 8) or an orange colour (FGDs 6, 7). The colour of the edible fruit pulp was described as yellow (FGDs 2, 4, 5, 8, 9), orange or light-orange inside (FGDs 1, 7) or red (FGD 9).

The respondents from focus group discussion 2 were able to separate namundalangwe into 3 named types differing in shape: a type called, "simbwichi-bwichi" (as heard and phonetically transcribed) or "seimbwichi-ichi" (as dictated and spelled by the interpreter) with relatively large, round fruits, a smaller round type simply referred to as "small namundalangwe" (this is likely a translation) and a third type called "wandombe" with long, sometimes green fruits, that are "shaped like a cuttlefish". Other groups described the fruit shape as similar to mupusi (FGDs 3, 4), larger than mupusi (FGDs 3, 5) or having many various shapes such as rounded, more or less flattened, egg-shaped, oblong, curved (FGDs 5, 7, 8, 9), et cetera. Focus group 6 stated that the fruit has "plenty of hair inside, more than mupusi", therefore the fruit possibly is fibrous. Namundalangwe flowers are yellow according to most (FGDs 3, 4, 5, 6, 8) or orange according to some (FGDs 7, 8),

possibly somewhere in between the two colours. Seeds were described as white (FGDs 6, 7, 9), white with a light brown rim (FGD 3), yellow-white, or in other words grey (FGD 4) or as yellow (FGD 5). Unlike mupusi and malaka, leaves of namundlangwe are not simply green, but also have white spots (FGDs 2, 3, 5), which can be used for their differentiation. A sample of namundalangwe leaf can be seen in Figure 16. Namundalangwe is consumed by people in the form of fruit (FGDs 1, 2, 3, 4, 5, 7, 8, 9), leaves (FGDs 1, 2, 3, 4, 5, 7, 8, 9), flowers (FGD 1) and seeds (FGDs 1, 3, 4, 5, 7, 8, 9), which are sun dried, pounded, roasted, cooked or pressed for oil (FGDs 1, 8) and can be added to a relish (FGDs 1, 2, 8). Futhermore, people sell fruits (FGDs 2, 3, 4, 5, 7, 8, 9) and leaves (FGDs 2, 4, 9), and feed namundalangwe to animals (FGDs 1, 4, 5, 8, 9). Fruit can stored for 3 to 4 months and is high in demand (FGD 1). Pest resistance was mentioned as an advantage of the namundalangwe crop (FGD 1). FGD 7 respondents mentioned namundalangwe as one of the crops that should be grown more in the future.

Figure 16: Leaf (and seeds) of namundalangwe received and identified from FGD 6 respondents. Notably, the adaxial leaf blade surface contains "white" (lighter-green) patches (author, 2022).

Key Informant Interviews

Based on information obtained through interviews with key informants, namundalangwe is a traditional crop, which has variable fruit shapes, such as round, flattened round, having a different width at the base and at the apex, and oblong (Mupo, Kaboku). The

fruit surface has a green colour when immature and eventually turns into a yellow colour (Mupo, Kaboku, Maopu). Pulp is yellow in colour (Mupo, Kaboku, Maopu) and contains "hairy stuff" (Maopu), possibly fibers. Flowers are yellow (Kaboku, Maopu) and seeds are white (Mupo, Kaboku, Maopu). Leaves were defined as bigger than malaka and mupusi leaves (Mupo, Kaboku) or as of the same size (Maopu). In addition to namundalangwe proper and kankolola, Mr. Kaboku also mentioned a type of namundalangwe called "kababe", but did not provide a description of it.

Namundalangwe fruit pulp is eaten (by some together with the rind), as well as are its leaves and seeds (Mupo, Kaboku, Maopu), and both the fruits and leaves are commonly sold (Mupo, Kaboku, Maopu). It can be fed to animals, but is not currently fed so, as it is typically consumed by people instead (Kaboku, Maopu). The fruit pulp can be prepared for consumption in various ways, for example by being peeled, then boiled and mixed with mealie meal (course maize flour) and fresh or sour milk. Namundalangwe leaves are used in the preparation of a traditional dish called "mangambwa" (Kaboku).

Namundalangwe has been traditionally cultivated for many years, since before the Lozi people migrated to the region from more northern parts of Africa more than 300 years ago. The fruit can be stored for 3 to 4 months, as long as the "handle" (part of peduncle) is left one fruit (Mupo, Kaboku, Maopu), and then the fruit can be cut into pieces, allowing for even longer storage (Kaboku). It is typically sown in November and then cultivated rainfed during the rainy season until the harvest, which is done in February, March and April (Mupo, Kaboku, Maopu). Alternatively, it can be planted in August and grown under irrigation (Mupo). It can be intercropped with maize, sorghum or cassava (Maopu). According to Mr. Maopu, cultivating namundalangwe leads to fixation of nitrogen into the soil, "mulching" of the soil and prevention of soil run-off.

4.2.29. Sihwana, tuhwana (*Lagenaria siceraria*)

"Sihwana" is a cultivated crop primarily used to make containers. "Tuhwana" was used by FGD 6 respondents as the name for this crop and based on key informant interviewee Mupo "tuhwana" means "many small sihwanas" in the Lozi language. Moreover, Mr. Mupo mentioned the word "sitele" as a Luyana language synonym of sihwana.

"Mukope" and "Myuku" both are names either for a type of sihwana or a product made from sihwana fruit (see 4.2.22 and 4.2.25 respectively).

Focus Group Discussions

Sihwana (or tuhwana) was mentioned by respondents from focus groups 1, 2, 3, 5 and 6. In addition, FGD 4 respondents reported that sihwana was grown in their area in the past and is not cultivated there anymore. When asked about this name directly, respondents from FGDs 8 and 9 also knew the name sihwana, however both groups said that they do not grow this crop anymore. While most groups seemingly considered sihwana its own crop, FGD 1 respondents defined it as a type of malaka.

Sihwana has a fruit of variable shape with a hard rind (FGD 1). The shapes can roughly be described as round with a long "neck" (thinner part of fruit) at the base; oblong shape with the same width near the base and near the apex, but notably thinner in between them; and various shapes between spherical, rectangular and ellipsoid with or without a "neck" (FGDs 1, 3, 5, 6), although the "neck" can be cut down for practicality of handling (FGD 3), so the respondents may have been describing the shapes without the "neck" in mind even if it originally was present). The presence of the "neck" differentiates sihwana from other crops, especially from malaka, to which it is similar when immature (FGDs 1, 3). Fruit skin is green at first as the fruit grows and later dries and becomes yellow to brown (FGDs 3, 5, 6), while the colour inside the fruit is white (FGDs 5, 6). The fruit can grow relatively large, some were said to have a capacity of 20 liters (FGDs 2, 5). The traditional way to hollow out sihwana fruit is to cut a small hole in it and soak it in water for 2 or 3 days, which leads to the inside pulp becoming soft and easier to remove (FGD 2). Seeds of sihwana were described in two types by FGD group 3, oblong seeds with a roughened surface on its size (widthwise) and the other with an oblong shape, notably widened on two opposite sides (situated lenghtwise). Other accounts of sihwana seed morphology include brown colour (FGD 6) and same as or similiar to malaka seeds (FGDs 3, 5). Focus group 2 reported that there is a connection between seed shape and size and the shape and size (possibly type) of the fruit. According to them, big, broad seeds give rise to plants endowed with large fruits, while small, narrow seeds sow plants bearing smaller fruits. Flowers have a white colour (FGDs 3, 5, 6). Leaves are of the same size as malaka leaves (FGD 5) and are similar to both mupusi leaves and malaka leaves (FGD 6).

No plant parts of sihwana are eaten (FGDs 1, 3, 5, 9) and the fruit is used as a storage container for water (FGDs 2, 3, 5), milk (FGDs 1, 2, 3, 5), seeds (FGDs 1, 2, 3, 5), honey

(FGD 5), local beer (FGDs 3, 5), and chibwantu (FGD 3), which is a local type of fermented beverage made from maize and roots of specific species of bushes. It can be grown with the intention of selling the fruit (FGDs 1, 5), however, the demand for sihwana is low, becuase in the present times, alternatives in the form of containers made from synthetic materials are commonly available in the markets (FGDs 6, 9). According to FGD group 2, only those farmers that keep larger herds of cattle want to grow the crop to obtain containers for the storage of milk. FGD 3 and 5 respondents expressed a lack of available seeds as a limiting factor in sihwana cultivation, and respondents from FGD 3 listed sihwana as one of the crops that should be grown more in the future.

Key Informant Interviews

Based on descriptions provided by interviewees Mupo and Maopu, one type of sihwana fruit typically has "a head, a neck, and a body" (Mupo), another type has a long "neck" and no "head", and a third type is rounded. The fruit is green as it grows and become brown when dried (Mupo, Maopu).

Flowers are yellow (Mupo), seeds are bigger than seeds of other similar crops, are brown and have rough edges (Mupo). Namundalangwe leaves were said to be different in shape to those of mupusi and muungu, as well as larger than malaka leaves and of the same size as namundalangwe leaves (Mupo).

The inside part of the fruit is not eaten, as it is bitter (Mupo) and the fruit is used for storage and transport of grain, water, beer, porridge and milk (Mupo, Maopu). Sihwana is utilized less and less for this purpose as alternative non-plant containers are available in the market (Maopu). Containers made from sihwana were said to last for 30 years and to generally not deteriorate in quality over time, apart from being damaged by human error (Mupo). The surface of these containers (originally fruit skin and rind) are so hard that insects cannot bore into them (Mupo). Smaller types of sihwana fruit are dried and used to make a part of a traditional music instrument (see chapters mukope 4.2.22 and myuku 4.2.25). Sihwana is typically sown in November and harvested in March or April (Mupo, Maopu).

4.2.30. Sichocholo

Small, immature fruit of either mupusi or namundalangwe (see chapter 4.2.28).

4.2.31. Sikululu, likululu (*Citrullus lanatus* var. *citroides*)

The plant known in siLozi as "sikululu" is both a naturally spreading weed and a crop. FGD respondents agreed on the spelling "likululu", which is hence inferred as an alternative way to spell the name. According to interviewee Mupo, "likululu" could possibly mean either "wide path" or it could be a plural form of sikululu meaning "many sikululu" (vaguely similar to "lihapu" and "mahapu" or "liwakaka" and "mawakaka"), though this remains uncertain.

"Makowa" and "Kanyangombe" are either a synonym or a sub-type of sikululu (see chapters 4.2.15 and 4.2.9 respectively).

Focus Group Discussions

Sikululu (or likululu) was meantioned by respondents in focus groups 1, 2, 3, 4, 5 and 6, and additionally, respondents from FGD 8 were familiar with the crop even though they did not mention it on their own.

Sikululu is overall morphologically similar to mahapu (FGDs 1, 2, 3, 4, 6) and is said to be easily mistakeable for it (FGDs 3, 4). Specifically, it has the same size of fruit (FGD 5, 6) and leaves of the same size (FGD 4). Interestingly, reports of the colour of sikululu flowers were varied between groups, with FGD groups 4 and 6 stating that the flowers are yellow and FGD groups 3 and 5 claiming that the flowers are white, despite the fact that FGD group 3 respondents also specifically said that the visual traits making sikululu and mahapu hard to distinguish from one another include the flowers. Fruit skin is light-green or green without stripes (FGDs 1, 2, 3, 4, 5, 6) or of a light, green-yellow colour without stripes (FGD 2). The colour of the pulp inside the fruit is white (FGDs 3, 4, 6) or yellow (FGD 2). However, perhaps respondents of FGD 2 described a type of sikululu called kanyangombe and are not familiar with this fact or name (see Kanyangombe chapter 4.2.9). Respondents of various groups described seeds of various colours: black seeds (FGDs 2, 5), black and brown seeds (FGD 6), white seeds (FGDs 3, 5) and red seeds (FGD 4).

It is a creeping, fast-growing weed, which covers the soil (FGDs 1, 2) and creates a problem for farmers as it spreads on arable land and then competes with and "overtakes" other crops, such as malaka and namundalangwe (FGD 1). Typically, nobody plants sikululu and only comes in contact with it when it spreads to them naturally as a weed

(FGDs 1, 2, 3, 5, 6, 8). In these cases, sikululu is typically browsed by or fed to animals and not eaten by people (FGDs 1, 2, 3, 5, 6, 8). However, the fruit is edible for humans (FGDs 2, 4) and is sometimes planted by people for the production of fruit. The FGD 4 group of respondents were the only respondents who said that they sometimes grow sikululu for this purpose. They eat only the fruit, as leaves and seeds are not eaten (FGD 4). When asked about disadvantages of the sikululu crop and its cultivation, respondents of the FGD 4 group said that they do not like that the leaves are not edible and respondents from the FGD 1 group said that sikululu deteriorates soil quality and they do not want to grow it for this reason.

Key Informant Interviews

Mr. Kaboku was not very familiar with sikululu and had said that he had only heard of it, never had he seen it himself. Unlike all of the FGD respondents, Mr. Maopu described sikululu as being similar to namuchoko, which is either a synonym of or type of namundalangwe (see chapters 4.2.26 and 4.2.28). He described that sikululu fruit is of the same shape, of the same colour and contains the same seeds as namuchoko, and that sikululu fruits are smaller. Furthermore, based on Mr. Maopu, sikululu is not grown nor eaten by humans, occurs naturally in the wild, is eaten by animals and it "flourishes" from November to April.

Mr. Mupo described sikululu as a species that is something "between weed and crop" similar to watermelon, having white pulp inside the fruit. Mr. Mupo however specified that despite being very similar to the white-pulp type of mahapu (see chapter 4.2.12), it is not the same crop and to his knowledge is only distinguishable from it by a taste test. The flowers were said to be similar to mahapu flowers.

According to his testimony, mature sikululu fruit is typically not eaten raw, but is instead cut open, the pulp is then removed and boiled or cooked and combined with mealie meal (course maize flour). However, despite the fact that it can be consumed, the fruit along with leaves is mostly used as feed for cattle. It is consumed by humans especially in times of food scarcity as a famine food.

4.2.32. Siponchi (Sponge gourd)

Respondents most commonly referred to this plant as "siponchi", which can be explained as the locally used way to pronounce the English word "spongy" or "sponge", most likely meaning sponge gourd – *Luffa cylindrica*. In FGDs 1, 2, 3, 4, 5, 7, 8 and 9, the respondents agreed on the spelling "siponchi", however in FGD 5, the word was written on the flipchart paper as "sponchi" at first and the respondents corrected the name to "Siponchi". Thus it can be inferred that "sponchi" is not one of the ways that this word is spelled or pronounced. Furthermore, in FGD 6, the word was agreed by the respondents to be written down by as "siponch", which is therefore inferred to be one of the used ways to spell the local name. The interviewees in the key informant interviews all knew the "siponchi" plant, however both Mr. Mupo and Mr. Maopu used the spelling "siponji", unlike the FGD respondents. This name (in its various forms) is in the Lozi language and no other names were known to the interviewees.

Focus Group Discussions

Siponchi was mentioned by the respondents of all the conducted FGDs. The respondents of FGDs 1, 2, 3, 4, 5, 7, 8 and 9 described it as bearing a fruit which is green when immature and turns brown or brownish as it becomes "mature", "ripe" or "dry", while respondents of FGD 6 mentioned only that the fruit is green. Moreover, whitish stripes or spots, were described to sometimes be present on the green fruit (before it browns) during both FGDs 3 and 5. The inside of the fruit was said to be white (FGDs 2, 4, 6, 7) with the morphological structure being described as a "mesh" or "net" (FGDs 2 and 6) or "some kind of strings" (FGDs 7 and 8). The color of seed was agreed by respondents of FGDs 4, 5, 6, 7 and 9 to be white, while the respondents of FGD 4 added that the inside of the seed when open (when cotyledons are parted) is white and respondents of FGD 6 claimed that its seeds are overall similar to seeds of namundalangwe. All respondent groups agreed with each other that siponchi leaves are green (although not all explicitly mentioned this fact, as it likely seemed obvious to some of them), however they gave varied information about the shape and size of the leaves. At FGD 4 it was simply mentioned that leaves are "broad and branched", yet at FGDs 3 and 5 it was claimed that the leaves are similar to the leaves of lungwatanga (*Acanthosicyos naudinianus*), at FGD 7 that they are of medium size and smaller than leaves of mawakaka and at FGD 9 that they are smaller than leaves of namundalangwe. Interestingly, the group of respondents

from FGD 8 claimed that flowers of siponchi are white, despite that groups from FGDs 2, 3, 5, 6, 7 and 9 all said that the flowers are yellow.

Flora of Zambia reports *Luffa cylindrica* to be present in Zambia (though not specifically in the Western Province) as a cultivated plant. *Luffa cylindrica* has yellow flowers, 3 to 5 lobed leaves and brown fruit, which is dry when mature and containing a persistent spongiform vascular network inside (Achigan-Dako et al. 2023; Bingham et al. 2023d). This description is in accordance to the description of "siponchi" provided by FGD respondents.

Siponchi is used for cleaning (as a bath sponge), none of the FGD respondents reported that they or others consume any part of the sponge gourd plant nor that they feed it to animals (FGDs 1, 2, 3, 5, 6). Within the four cell analysis question, siponchi was placed into the "few people on small fields" category by the respondents in all the conducted FGDs. Respondents of FGDs 2 and 6 clearly stated that they grow siponchi and respondents of FGD 8 said that "a few" of them grow it. Respondents at FGDs 4, 5 and 9 do not grow siponchi at all, and neither do respondents of FGD 7, which specified that the reason limiting them from doing so is a lack of available seeds. The people of FGD 3 said that they used to grow it, but do not anymore, as there is no demand for the crop, and that once there shall be "market" (demand) for siponchi again, they will return to growing it. When asked about which crops they want to grow more of or less of in the future, the respondents in the first FGD replied that they do not wish to grow siponchi, because they do not need more of it, as there is no demand for them to sell it, due to richer people usually buying alternative products from stores instead. FGD 3 respondents listed siponchi as one of the crops for which seeds are not available to them.

Key Informant Interviews

Interviewees described siponchi (or "siponji") as having a long, oblong fruit, which is green when young, yellow when mature and brown or greyish when dry and having a white mesh on the inside with white seeds. Yellow are flowers, leaves are "not very big" and are bigger than lungwatanga (Mupo, Maopu). While all interviewees stated that siponchi is used for cleaning, Mr. Mupo said also said that the fruit "is edible when it is tender and small before it develops fibers inside" and Mr. Kaboku claimed that people of indian descent living in Livingstone eat the fruits when small.

The dried fruit or the fibrous mesh from inside the fruit has long storability (Maopu). It grows naturally and can be planted by people but is not commonly planted so, or is planted only on a small scale (Mupo, Kaboku, Maopu).

4.2.33. Sitele

Synonym of sihwana (see chapter 4.2.29).

4.2.34. Siteti

A synonym of namuchoko, which is a type or synonym of namundalangwe (see chapter 4.2.28).

4.2.35. Wandombe

A name possibly used for a type of namundalangwe, which has a fruit of a specific, long shape (see chapter 4.2.28).

4.3. Investigated Crops Identified as Not Cucurbitaceous

In some cases, respondents interviewed in the focus group discussions would discuss crops that are not from the Cucurbitaceae family and are thusly not intended as a part of this research. Farmers in the area are mostly not familiar with concepts used in botanical taxonomy and do not necessarily consider the (relatively) morphologically heterogeneous crops such as watermelons, pumpkins, horned cucumbers and sponge gourds to be related or similar in some way and therefore, when asked about which "other, similar crops" they can think of, not all of the answers provided were cucurbits.

In total, 5 vernacular crop names, discussed within the FGDs, were identified as non-cucurbitaceous, using a combination of the information provided about the plant including morphological description, English name provided by respondents themselves, the interpreter's knowledge of local crops and information provided by key informant interviewees when asked about the name directly. Specifically, the non-cucurbit names include "ngulu" which is a local name for sweet potato (FGD 2), "malembeka" which refers to eggplant (FGDs 5, 6), "manawa" meaning "beans" (FGD 6) and "lisetoyansali" along with "lisetoyamuna" which represent the plant species from the genus *Harpagophytum*, which are known in English as "devil's claw" (FGD 2).

4.4. Comparison of Locally Cultivated Types of Pumpkins (Malaka, Mupusi, Namundalangwe and Kankolola)

Table 3 compiles information in a simplified form, showing the differences in morphology and use of the four locally cultivated pumpkin crops, which (based on the information provided in chapters 4.2.16, 4.2.23, 4.2.28 and 4.2.7) are likely to be distinct types of pumpkin (possibly cultivars, varieties or landraces) rather than synonyms. Information provided in Table 3 can be used for the differentiation of these crops.

Table 3: Simplified comparison of locally cultivated types of pumpkins. Numbers in brackets represent number of accounts, that is in total how many FGD groups and inteviewees mentioned the given information. “N.R.” stands for “not recorded”.

Crop Name	Fruit Skin Colour	Fruit Pulp Colour	Flower Colour	Seeds	Leaves	Size of fruit	Edible Plant Parts	Other Notes
Malaka	green (7) white or cream-white (3), light-green (2), yellow (1) or light-grey (1); sometimes with protuberances (3)	white (8)	white (8)	brown (7); with rough or bumpy parts (2); darker than namundalangwe and mupusi (2)	dark green; hair-less; having a "bad smell" and bitter	smaller than namundalangwe	pulp (12), leaves eaten by some (3), seeds eaten according to some (3)	harder rind than namundalangwe
Mupusi	grey (5), white (4), green (4), light green (2), white-yellow (1), yellow (1) or light brown (1); may have a white pattern (3).	yellow (6) or orange (1)	yellow (9) or orange (2)	white (6), brown (4) or beige (2)	without white spots, hairs on abaxial side, with a "bad smell" and bitter	smaller than namundalangwe	Fruits (9), leaves (7) and seeds (7)	N.R.
Namunda-langwe	yellow (8), green without a pattern (4), green with a pattern (3), grey (2), orange (2)	yellow (8), orange (2) or red (1); contains fibers (1)	yellow (7) or orange (2)	white (6), white with a light brown rim (1), grey (1) or yellow (1)	green with white spots; hairs on abaxial side; bigger than malaka and mupusi	largest	fruit (8), leaves (8), flowers (1) and seeds (1)	N.R.
Kankolola	yellow (4), white-yellow (2) or yellow-green (1); bearing yellow spots (1).	yellow (2), white with yellow parts (1)	yellow (2)	small and narrow (1); white (2); similar to malaka (1)	N.R.	smallest	fruit (3), leaves (2) and seeds (3)	very hard rind

5. Discussion

Though this research did not conclusively discover the taxonomical level that the crops (as taken by vernacular name) locally cultivated in the Western Province represent (whether for example mupusi and malaka are different species, subspecies, varieties, cultivars or landraces), the results show that the diversity of cucurbitaceous crops cultivated in the region is relatively high. Locally cultivated *Cucurbita* spp. are not limited to only "pumpkin", but instead, according to the attained information, are represented at least by "namundalangwe", "mupusi", "malaka" and "kankolola", with additional potential types identified in the results. All the respondents without exception were familiar with cultivated cucurbits, which shows the prevalence of their cultivation and use in the region, despite not being the major crops produced in the area.

By and large, a practically convenient way to estimate the taxonomical identity of the investigated crops and plants was used, which was a combination of the authors knowledge, the knowledge of the respective interpreters, inspection of the few samples of plant parts available and comparison with morphological descriptions of Cucurbitaceae species in literature, especially in Flora of Zambia (Bingham et al. 2023a). Admittedly, other methods exist that would have provided more insight and scientific rigidity to the results. For instance a botanist already knowledgeable in local plant species could have identified the assayed plants were he to inspect them growing *in situ*. Or the plants could have been inspected in detail by the author while growing *in situ* with the use of taxonomical keys and a list of spot characters could have been prepared for the different local types (including minuscule plant parts like tendrils, that respondents are not likely to be able to discuss in sufficient detail). Alternatively, a DNA sample could have been taken from (all of) the assayed crops (while still growing *in situ*) and analysed using genetic methods. The main reason that these methods were not employed as part of this research stem from the time of the author's visit of the targeted area, which took place after the rainy season and thusly after the vegetative period and harvest of cucurbitaceous crops. The mentioned methods should be utilized in future research, as to further ascertain the taxonomical standing and genetic distinctiveness of the crops and their sub-types.

It was apparent from the conducted market surveys, that the presence of cucurbitaceous items was relatively scarce in the markets due to the specific time of year and they were

therefore not of great contribution to this research, apart from showing the state of Cucurbitaceae availability in the market at that time and preparing the interviewer for the FGDs and other interviews. The surveys did however yield some notable information – for example the fact that it is economically viable for retailers of crops such as mahapu and malaka to transport it to Mongu from as far as Mumbwa and Kaoma in order to sell it. This is one of the pieces of information that clearly shows mahapu (watermelon) as an important cash crop in the region, along with the results form the four cell analyses of mahapu, which by and large placed it in the "many people on large fields category" and the fact that all FGD respondents had a lot to say about mahapu, and that 8 out of 9 of the respondent groups specifically mentioned that mahapu is commonly grown to be sold and that it has good marketability. Contrarily, based on the information provided by the respondents, it can be seen that mawakaka (*Cucumis metuliferus*) cultivation is limited not only by its poor marketability and selling price in the region, but also by the unavailability of seeds for sowing in some specific areas.

Lack of available seeds has been mentioned by FGD respondents in several different areas in the case of several different crops and it can thus be inferred that their cultivation and use could potentially be increased if this situation was to be ameliorated, for example as part of some government-lead project that would establish seed banks or some similar system. This seems to be the case of (parts of) the Nalolo area located south of Mongu and the site of FGD 7 (east of Mongu), as in these localities the respondents reported a limitation in the availability of konkolola, mahapu (watermelon), cucumber, sihwana (*Lagenaria siceraria*) and siponchi (*Luffa cylindrica*) seeds.

Some of the assayed plants were discussed to be of lesser popularity and prevalence, and many of such crops or types represent sources of famine foods needed in any potential times of food scarcity. In this way, the importance of wild or cultivated foods such as fruits of sikululu, namuchoko and leaves of mupusi and malaka, is not always obvious, but still would be significant, were a scarcity of food to occur. Though apparently not eaten at all in the region, *Luffa cylindrica* (siponchi) fruits are edible while immature and could serve as a famine food source as well. Perhaps, lungwatanga (*Acanthosicyos naudinianus*) fruit could also be eaten as a famine food despite its bitter taste, as literature does report the fruit as edible (Bosch 2004; Olarewaju et al. 2021). Focus group respondents described uses of *Acanthosicyos naudinianus* (lungwatanga) as a source of

natural veterinary medicine. FGD 2 respondents reported that they treat the skin of cattle against "scabies" is similar to reports from Katima Mulilo, Namibia (which is located in the Caprivi strip and closely neighbours the southern part of Western Province), where local farmers use it in combination with other (non-cucurbitaceous) plants to treat the skin of livestock against skin rashes (Chinsembu et al. 2014). Similarly, *A. naudinianus* has been reported to be used in the Kavango East region of Namibia in the treatment of humans against the symptoms of gonorrhoea, body sores and fungal skin infections (Chinsembu et al. 2015), as well as against mental illnesses in the Oshikoto region of Namibia (Cheikhyoussef et al. 2011).

Given the ostensible similarity of the words "Mongu" and "muungu" (the second of which is a term likely referencing pumpkins, more specifically the namundalangwe and mupusi crops or types taken altogether) and the fact that the name of Mongu town is at least rumored to have (if not clearly having) an etymological meaning of something like "pumpkin" or "pumpkins" (based on personal communication with local partners) – possibly coming from the Luyana language or from another specific dialect or subset of the Lozi language, which could make this meaning less obvious and only known to some – it is possible that these terms are etymologically related. This remains uncertain and perhaps should be investigated further in the future.

Some described types of watermelon (mahapu) have white coloured pulp, much like some types of sikululu. Besides interviewee Mupo's claim that the two are not the same crop, not much evidence for their disparateness was attained. Thus, sikululu could still be a type of mahapu, rather than a distinctly separate crop (which would be in alingment with the position of *Citrullus lanatus* var. *citroides* under *Citrullus lanatus* proper in taxonomy). This is not clearly in congruence with respondent groups overall not agreeing with one another on the colour of sikululu flowers (some saying that they are white, while an equal amount of other groups saying that they are yellow), as online databases such as PROTA4U and Flora of Zambia report only yellow as the colour of *Citrullus lanatus* flowers (van der Vossen et al. 2004; Bingham et al. 2023e).

Due to the nature of conversation-based methods employed to assess local or traditional knowledge, the results presented in this thesis should not be taken as fact, but rather as an estimate of the truth. This is because the knowledge of the respondents or interviewees may always be imperfect and because potential sources of bias can never be fully

removed. Therefore, for example, if one singular group of respondents or an interviewee provide a piece of information (if we assume that they are not lying), this information may be likely to be true, but there is a chance that it is not, as the respondent could be wrong, not sufficiently knowledgeable, remembering incorrectly or the information can be erroneously translated by the interpreter. However, the more respondents or respondent groups mention the same piece of information (the higher the number of accounts), the more likely it is to be true and the more weight should be given to it. Sometimes, the respondents would discuss crops or wild species that they have never seen first hand, that they have no direct experience with and only heard about from other people, which the interviewer is oftentimes not made aware of, and which can lead to inaccuracies in the provided information. Moreover, some types of information are harder to verbally describe than others, such as shapes, sizes and colours. It is entirely possible that two respondents would provide two different descriptions, for example, for a shape of fruit, despite both having seen the same shape and them trying to describe it as accurately as possible. Therefore, potential differences in the ability to describe the given information and personal style of creating a description should be taken into consideration as potential sources of bias. The Results chapter provided information about discussed crops which were recognized as non-cucurbits. It is theoretically possible, that some of the crops or species presented in chapter 4.2 also are non-cucurbitaceous and were not recognized as such. In the case of this research, this is highly unlikely, among other reasons due to the fact that almost all of the discussed local names were given by the respondents in relation to specific prompt cards or in relation to well known crops such as pumpkin, watermelon, sponge gourd and so on. Futhermore, it is possible that the high amount of synonyms locally used for some Cucurbitaceae crops cultivated in the area introduced a source of bias to the attained information. More specifically, when respondents considered a specific local name as a synonym, they would in some cases be entirely dismissive of it, saying that information about the crop or species is the same as the information provided by them about the already discussed other synonymous name. This of course makes sense, were we to simply assume that those terms are in fact purely synonyms. However, this likely was not always the case. For example, in the case of the crop called “kankolola“ (see chapter 4.2.7), FGD 9 respondents believed that it is merely a synonymous name for malaka, and they would then not provide any information about kankolola, as they have already discussed malaka with the interviewer. Based on the

overall results however, it is more likely that kankolola is a separate type (possibly a variety) of pumpkin. It is reported to be morphologically different to malaka and other similar crops (as can be seen in Table 3). In another example, FGD 8 respondents claimed that the flowers of siponchi (see chapter 4.2.32) are white, while all the other focus groups and interviewees attested that the flowers are yellow. The amount of accounts supporting the yellow colour is so high, that we can assume that the FGD 8 group was mistaken. With hindsight, perhaps it should have been explicitely made clear to FGD respondents while conducting the four cell analyses, whether they are being asked how many people grow the given crop specifically in their area or generally in the whole province. Some groups understanding it one way and other groups taking it the other way may have possibly occurred and to an extent biased the four cell analysis results. *Luffa cylindrica* (siponchi), which was not listed in the literature as to be occuring in the Western Province, was in fact found by personal observation or reported by respondents and interviewees to occurr in the province. This would suggest that other species of Cucurbitaceae, which are not listed in the literature can potentially be found in the Western Province and based on this assumption, perhaps more of such species should have been included in the prompt cards. Description of leaves of the investigated plants by the respondents was mostly confined to comparisons of size and shape in between them. For example, in the case of mawakaka, its leaves were said to be similar to leaves of siponchi, similar to lungwatanga leaves (in terms of size), similar to mahapu leaves and smaller than mupusi leaves. This can be attributed to how leaves of Cucurbitaceae species are mostly relatively similar and were a study be conducted investigating the sizes and shapes of the species, crops and types, which were explored in this thesis in detail, this information could be used for their differentiation (among other morphological characteristics).

It is likely that what was described as a type or synonym of mawakaka by some respondent groups (FGDs 3 and 6) is in fact *Cucumis anguria* instead. This is because, despite being vaguely similar in appearance, there are major differences in the described (and shown) fruit morphology between the two (their size, and thorns versus hairs). The description of "manende" by FGD 3 is also completely in accordance with botanical descriptions of *C. anguria*.

Respondents from the first focus group discussion were the only ones to mention edibility of namundalangwe flowers. In general, this is entirely realistic, as pumpkin flowers are

edible (Bieżanowska-Kopeć et al. 2022). It is notable, that only this one respondent group mentioned this fact, which shows that flowers are likely not commonly consumed in the region at all.

Being replaced by synthetic alternative products more an more, both *Lagenaria siceraria* and *Luffa cylindrica* are clearly on the decline in terms of production and demand in the region. Should this declining trend continue, these sources of traditional and natural, non-synthetic products could potentially disappear altogether in the future. For this reason, in order to prevent their potential complete disappearance, Zambian government (or some nongovernmental organization) should put in place a system for the conservation of the seeds of these crops.

The list of vernacular names presented in chapter 4.2 compiles information about cucurbitaceous crops and wild species occurring in the Western Province of Zambia. To the best of the author's knowledge, this information could not be found anywhere in scientific (as well as non-scientific) literature including online sources prior to the publication of this work. Therefore, this thesis can serve as a novel "checklist" or "catalogue", providing the meaning of locally used vernacular names and serving as a source of compiled information about these crops and wild species. Further research should be done to ensure that the provided list is exhaustive and to complement this study with additional information. Moreover, future research should be conducted to elucidate whether the various types of crops described in the Results chapter of this thesis truly represent various cultivars (or varieties and landraces) of the given crops, as could otherwise be assumed. More specifically, the taxonomical standing and inter-relationships of malaka, mupusi, namundalangwe and kankolola should be elucidated in future research. Similarly, the different types of mahapu described by local farmers and consumers should be collected and genetically analysed along with samples of sikululu, in order to determine which taxa they represent and once and for all determine their relatedness and genetical distinctiveness, answering question such as whether the white-pulped mahapu type and sikululu are one and the same or in fact different crops or varieties. Additionally, makowa could represent a distinct variety of sikululu and manende could either represent a type of mawakaka or *Cucumus anguria*, which should be ascertained in future research as well. Furthermore, interviewees Mupo and Kaboku claimed that types of malaka retain their morphological traits in a hereditary fashion, and

Mr. Kaboku also claimed the same about types of mupusi. If true, these claims would strongly support the assumption that the various types of malaka and mupusi, which differ in morphological features such as colour and surface evenness of fruit skin, are distinct varieties of those crops. For this reason, a field experiment should be conducted, investigating whether the traits truly are hereditary, or alternatively, the types should be investigated using genetic methods to answer the same question.

6. Conclusion

This body of work provides a compilation of previously unavailable information pertaining to cucurbitaceous plants which can be found in the Mongu District and in surrounding districts of Zambia, along with information about their vernacular names and synonymy. The ethnobotanically obtained and compiled data can serve as an "encyclopedia" of Barotseland's cucurbits, their descriptions, agronomy and uses. The diversity of the Cucurbitaceae species was outlined by the examination of local knowledge of the possible sub-divisions of cultivated cucurbit crops as well as by the amount of items contained in the mentioned, near-exhaustive list of local crops and wild species. The validity and exact taxonomical position of the crops and their investigated sub-types should be ascertained in a future research, which could potentially lead to discoveries of novel varieties or cultivars originating from Zambia or near-by african countries. Morevoer, the genetical distinctiveness and relationships of specific crops, especially the ones known as malaka, mupusi, namundalangwe, kankolola, kankoya and makowa, should be confirmed in a future study, as the mentioned plants represent crops of high potential in terms of contribution to diets of local people and of potential for future intensification of agronomical production. Due to the potential sources of bias described in the thesis, future studies should not only expand upon the scope of the presented research, but also confirm the validity of its results. Future investigations should also assay the local knowledge of and vernacular names specifically used by ethnic groups other then the Lozi people residing in the Western Province, and local knowledge of people in other regions of Zambia as well.

A lack of available crop seeds was discovered in certain areas, and it would therefore be appropriate for a government-lead or nongovernmental organization-lead system to preserve and distribute seeds in the Western Province. The same tentative seed preservation project should conserve the seeds of different local types of *Lagenaria siceraria* and seeds of *Luffa cylindrica*, as their prevalence in the region was shown to be on a declining trajectory and their local germplasm could be lost altogether in the future.

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8. Appendices

List of Appendices

8.1. Appendix 1 – Example of "Prompt Cards" used in Focus Group Discussions and Key Informant Interviews

siLozi: ?

West Indian gherkin or maroon cucumber

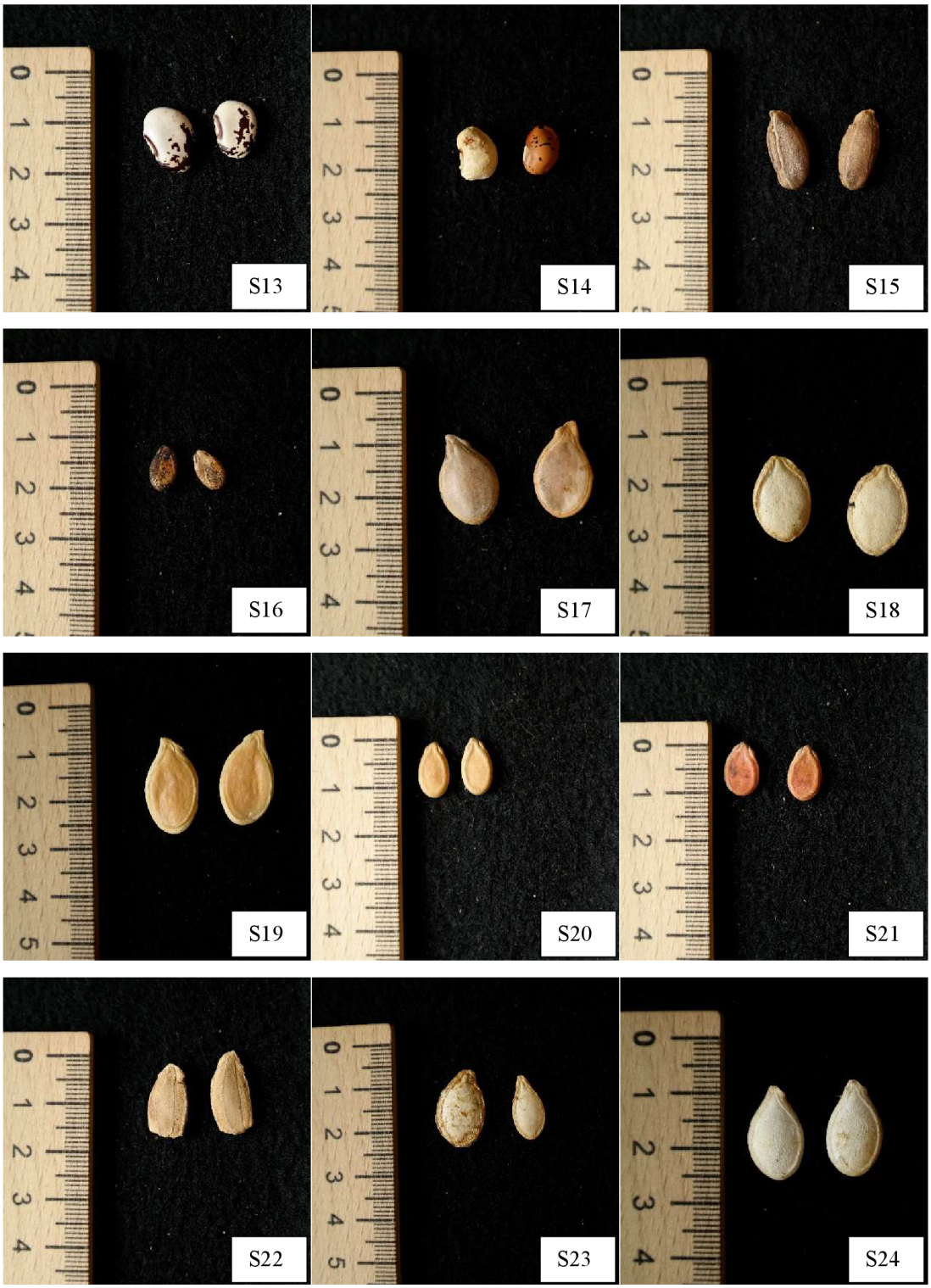
Cucumis anguria

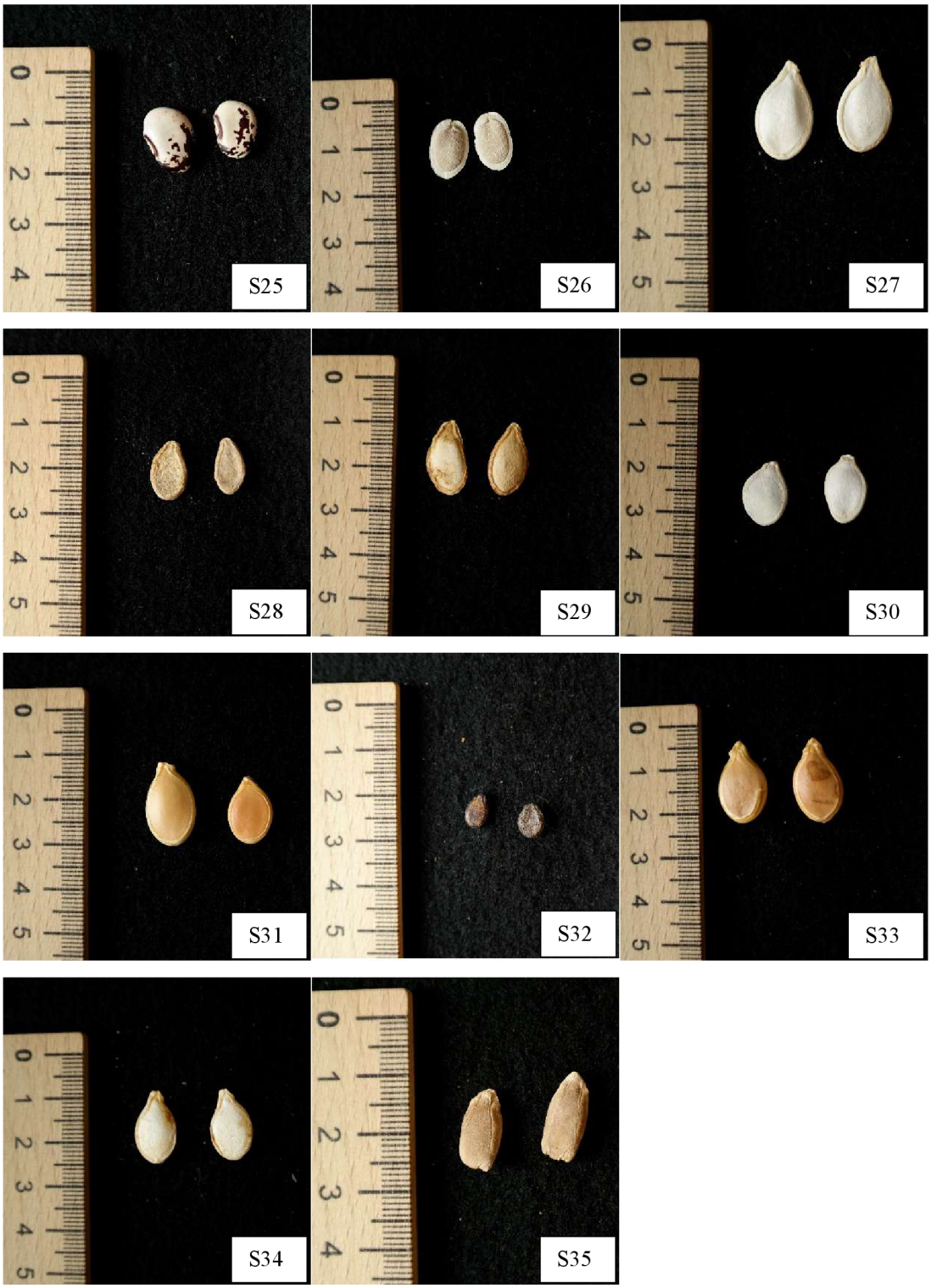
Bemba names: amankolobwe, citende, caka

Prompt card made for the species *Cucumis anguria*, shown in the way it looked before the research was started to be conducted (author, 2022).

Prompt card made for the species *Cucumis anguria*, modified in the field to not show any printed text (author, 2022).

8.2. Appendix 2 – Photographic Record of Seed Samples Collected in the Western Province, Zambia (Photographed on 15. 4. 2023)


S13
S14
S15
S16
S17
S18
S19
S20
S21
S22
S23
S24


S25
S26
S27
S28
S29
S30
S31
S32
S33
S34
S35

Seed Sample	Local Name of Crop	Attained from	Date of Collection
S1	Mahapu	Kashumba market (purchased)	22.4.2022
S2	Mupusi	FGD 3	18.4.2022
S3	Namundalangwe	FGD 3	18.4.2022
S4	Sihwana	FGD 3	18.4.2022
S5	Sihwana	FGD 3	18.4.2022
S6	Mahapu	FGD 3	18.4.2022
S7	Mahapu	FGD 3	18.4.2022
S8	Mahapu	FGD 3	18.4.2022
S9	Mahapu	FGD 4	18.4.2022
S10	Malaka	FGD 4	18.4.2022
S11	Mupusi	FGD 4	18.4.2022
S12	Mahapu	FGD 4	18.4.2022
S13	Manawa (non-cucurbit)	FGD 6	23.4.2022
S14	Manawa (non-cucurbit)	FGD 6	23.4.2022
S15	Malaka	FGD 6	23.4.2022

Seed Sample	Local Name of Crop	Attained from	Date of Collection
S16	Mahapu	FGD 6	23.4.2022
S17	Mupusi	FGD 6	23.4.2022
S18	Namundalangwe	FGD 6	23.4.2022
S19	Mupusi	FGD 7	23.4.2022
S20	Mahapu	FGD 8	30.4.2022
S21	Mahapu	FGD 8	30.4.2022
S22	Mahapu	FGD 8	30.4.2022
S23	Namundalangwe	FGD 8	30.4.2022
S24	Mupusi	FGD 8	30.4.2022
S25	Mupusi	Interviewee Mupo	25.4.2022
S26	Siponchi	Interviewee Mupo	25.4.2022
S27	Namundalangwe	Interviewee Mupo	25.4.2022
S28	Kankolola (unviable)	Interviewee Kaboku	28.4.2022
S29	Namundalangwe	Interviewee Kaboku	28.4.2022
S30	Mupusi	Interviewee Kaboku	28.4.2022

Seed Sample	Local Name of Crop	Attained from	Date of Collection
S31	Mupusi	Interviewee Kaboku	28.4.2022
S32	Mahapu	Interviewee Maopu	29.4.2022
S33	Mupusi	Interviewee Maopu	29.4.2022
S34	Namundalangwe	Interviewee Maopu	29.4.2022
S35	Malaka	Interviewee Maopu	29.4.2022